



Hepatitis B Vaccination Uptake Rate and Predictors in Healthcare Professionals of Ethiopia

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Introduction: Healthcare professionals continue to be at risk of acquiring occupation-related hepatitis B virus infection because of noncompliance for the 3-dose primary series of hepatitis B vaccine recommended. The objective of the study was to determine the rate of and to identify the predictors of hepatitis B vaccination uptake in healthcare professionals in Ethiopia.

Methods: A multicenter cross-sectional survey was conducted between May 19 2018 and June 15 2018. A stratified with systematic random sampling technique was used to select 260 healthcare professionals. A structured questionnaire was used to collect all the necessary primary data from samples. This survey analyzed hepatitis B vaccination uptake as the binary outcome variable (“noncomplete” vs “complete”) with regard to the 30 potential predictor variables. Both descriptive and inferential statistical analysis techniques have been used to address the study objective.

Results: The rate of complete vs noncomplete hepatitis B vaccination uptake was 37.7% vs 62.3%. The significantly independent predictors of hepatitis B vaccination uptake were professional qualification ($P=0.004$), professional experience ($P=0.013$), household income ($P=0.006$), workload status ($P=0.015$), routine infant immunization program existence at the workplace ($P=0.014$), perceived susceptibility to infection ($P=0.005$), perceived safety of vaccine ($P=0.001$), prior occupational exposure to blood ($P=0.006$), training on universal precautions ($P=0.015$), and colleagues’ suggestion ($P=0.002$).

Conclusion: The rate of hepatitis B vaccination uptake found was currently low. The significantly independent predictors of hepatitis B vaccination uptake included perceived safety, colleagues’ suggestion, professional qualification, perceived susceptibility, household income, prior occupational exposure to blood, professional experience, existence of routine infant immunization program at the workplace facility, workload status, and universal precautions training.

Keywords: hepatitis B, virus, occupational risk, vaccine, healthcare professionals

Introduction

Hepatitis B (HB) is a dynamic multimodal highly contagious and pathogenic infection caused by HB virus that mainly affects the human liver. It remains a disease of major global public health burden causing substantial morbidity and mortality, with the highest prevalence in Asia and Africa.¹ One of the most important risk factors in acquiring HB infection is being a healthcare professional (HCP). The HCPs are recognized as significantly 2 to 10 times more likely to acquire HB virus infection than the general adult population.² This risk appears to be related to repetitive percutaneous and permucosal occupational exposures (OEs) to the patients’ blood in the occupation. The costs of occupational injuries and

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diseases are serious and real,³ often much greater than immediately understood.⁴ The HB virus is also one of the most serious blood-borne pathogens which are the major risks that HCPs encounter in the occupation both at the hospital and nonhospital setting worldwide.⁵

Fortunately, a vaccine is available as the best prevention strategy against HB virus transmission and the subsequent multifaceted negative repercussions. The HB vaccine has been proven to provide long-lasting effective protection after the completion of all 3-dose primary series amongst persons vaccinated with the recommended schedule.⁶ The HB immunization program is initially publicized for infants and later for children and adolescents. Nowadays, vaccination of all high-risk adults against HB virus infection is also found to be very crucial. It is expected that vaccinating healthcare providers as adults against HB virus is not only important to maintain their occupational safety and health, but also a key component of chronic HB virus infection prevention and eventual eradication. However, it is not widely implemented and not sufficiently utilized even among HCPs. The HB vaccination coverage rate with the ≥ 3 doses completion among HCPs differs roughly from 12.0%⁷ to 72.0%⁸ in Africa, from 38.8%⁹ to 85.2%¹⁰ in Asia, and from 40.0%¹¹ to 95.0%¹² in the leftover continents. The HCPs continue to be at serious risk of acquiring occupational HB infection due to vaccination noncompliance;¹³ only those with ≥ 3 doses of HB vaccine uptake are considered protected.

There are several studies indicating that the HB vaccination uptake rate and its factors associated vary between different HCP populations and settings. The rate of HB vaccination uptake could be influenced by many factors/predictors within demographic, psychosocial, behavioral, and other domains. There are very limited data from Ethiopia on this aspect.¹⁴ Therefore, the aim of the present study was to assess the HB vaccination uptake rate and predictors in HCPs in Ethiopia.

Methods

Design and Period

A questionnaire-based quantitative cross-sectional survey was conducted to assess the HB vaccination uptake rate and predictors in HCPs of Ethiopia, from May 19 2018 to June 15 2018.

Settings and Participants

This study specifically took place in Gondar, Ethiopia. Gondar, or Gonder, former capital of Ethiopia, is now the capital city of the Central Gondar Zone of the Amhara National Regional State of Ethiopia. The survey was addressing multiple health institutions from the described study area. There are 44 (eight public primary health centers, three private primary clinics, nine private medium clinics, 23 private specialist clinics, and one private primary hospital) healthcare facilities functional in Gondar city serving the general community under the zone's health administration. All these 44 health facilities with their employees were therefore used as the study setting.

This study targeted multiple groups of HCPs in professions including physicians, dentists, nurses, midwives, laboratory technicians/technologists, physiotherapists, anesthetists, pharmacists/pharmacy technicians, and health officer clinicians. It intended to indicate those HCPs who had routine patient-care activities. Aside this, the HB vaccination program for HCPs in Ethiopia was initiated around 2004 upon the FMOH-Ethiopia infection prevention guidelines endorsement like the WHO or the CDC recommendation: all HCPs should be fully vaccinated before engaging occupational risk as well. Since there is no mandatory HB vaccination policy or mass campaign headed to HCPs documented in Ethiopia, the way of receiving HB vaccine by them appears to be through self-paid voluntary vaccination policy.

The required total sample size was determined as follows. Step I. Conveying the estimator values ($z=1.96$, $p=0.5$, $e=0.05$, $N=597$ HCPs). Step II. Computing with the standard formula ($n=[z^2 \times p \times (1-p)/e^2]/[1+(z^2 \times p \times (1-p)/e^2 \times N)]$). Step III. Adjusting for possible nonresponse extent (about 10%), it finally becomes certain ($n=260$ HCPs).

Here, n is the sample size, z is the z-score related with a 95% level of confidence, p is the hypothesized proportion of HB vaccine uptake, e is the margin of error, and N is the population size.

The total sample size calculated above was also proportionally redistributed into the five strata ($n_j=[N_j/N] \times n$) and then a systematic random sampling technique ($k=N/n$) was applied to select each sample of each stratum (the strata is "type of health facility as a current workplace for the HCP"):

- HCPs employed in the public primary health centers ($N_j=331$, $k\approx 2$, $n_j=144$)
- HCPs employed in the private primary clinics ($N_j=33$, $k\approx 2$, $n_j=14$)
- HCPs employed in the private medium clinics ($N_j=96$, $k\approx 2$, $n_j=42$)
- HCPs employed in the private specialist clinics ($N_j=117$, $k\approx 2$, $n_j=51$)
- HCPs employed in a private primary hospital ($N_j=20$, $k\approx 2$, $n_j=9$)

Here, n_j is the sample size in the stratum, N_j is the population size in the stratum, and k is the sampling interval.

We accomplished regular contacts throughout the study period in order to invite all sampled HCPs for participation after written informed consent, and to avoid re-participation.

Variables

We interviewed the participants in order to comply with the structured survey questionnaire. The questionnaire covered all the necessary data regarding the study variables.

HB vaccination uptake was used as the dependent (outcome) variable. Demographic characteristics including sex, age, marital status, number of persons in the household, income of the respondent, income of the household, professional qualification, professional role type, professional experience, sector of workplace, department of workplace, workload status, and routine infant immunization program (RIIP) presence in the workplace were used as potential independent (predictor) variables. Psychosocial characteristics including perceived susceptibility to infection, perceived severity of infection, perceived efficacy of the vaccine, perceived safety of the vaccine, perceived affordability of the vaccine, perceived accessibility of the vaccine, perceived efficacy of personal protective equipment (PPE), and perceived efficacy of post-exposure prophylaxis (PEP) were also used as potential predictor variables. Behavioral characteristics including ever tested for human immunodeficiency virus (HIV), alcohol use, tobacco use, prior OE to blood, and adherence in practicing universal precautions (UP) were also used as potential predictor variables. Miscellaneous characteristics including history of jaundice, taken training on UP, know HB infected persons, and ever gets colleagues' suggestion were additionally used as potential predictor variables. For

the definition of these variables, see [Supplementary Table S1](#).

Statistical Analysis

The data were processed and analyzed via IBM SPSS version 25.0.0. Frequency analysis (percentage and a 95% confidence interval [CI] for percentage) was used to determine the rate of HB vaccination uptake as the outcome variable. Bivariate (crude) analysis was done using the Pearson chi-square test to explore every single potential predictor variable by the outcome variable. The potential predictors that have shown $P\leq 0.25$ in this bivariate crosstab analysis were accordingly chosen for further analysis, although only those with $P<0.05$ were considered significant. Multivariate (adjusted) analysis was done using the binary logistic regression model to identify the independent predictors of the outcome. All those selected potential predictors from the bivariate crosstab analysis were entered into the multivariable binary logistic regression model simultaneously. After series of logistic regression models through backward stepwise elimination approach, predictors that have shown $P<0.05$ were declared as independently significantly associated with the outcome. For this purpose, we computed adjusted odds ratios (AORs) and their CIs as a measure of the strength of association. The Hosmer–Lemeshow goodness of fit test was used to comment on model fitness.

Results

A total of 260 eligible participants were sampled, invited, interviewed, and ultimately analyzed in the study with 100% responses.

The frequency analysis determined that the overall complete vs noncomplete HB vaccination uptake rate was 37.7% vs 62.3% among 260 participants ([Table 1](#)).

[Tables 2–5](#) show the demographic, psychosocial, behavioral, and miscellaneous characteristics of participants according to HB vaccination uptake. The rate of HB vaccination uptake was significantly different for the following demographic factors at $P<0.05$ in the bivariate analysis: number of persons in the household, income of the respondent, and income of the household ([Table 2](#)). The rate of HB vaccination uptake was significantly different for the following psychosocial factors at $P<0.05$ in the bivariate analysis: perceived susceptibility to infection, perceived severity of infection, perceived efficacy of the vaccine, perceived safety of the vaccine, perceived

Table 1 Hepatitis B Vaccination Uptake Rate Among Participants (n=260)

Variables		%	CI
HB vaccination uptake	Complete	37.7	31.9–43.3
	• Received 4 doses	1.2	...
	• Received 3 doses	36.5	...
	Noncomplete	62.3	56.7–68.1
	• Received only 2 doses	10.4	...
	• Received only 1 dose	31.1	...
	• Received 0 dose	20.8	...

Abbreviations: CI, 95% confidence interval; HB, hepatitis B.

Table 2 Participants' Demographic Characteristics and Hepatitis B Vaccination Uptake

Variables		n	HB Vaccination Uptake		χ^2	P
			Complete	Noncomplete		
			%	%		
Sex	Male	127	39.4	60.6	0.298	0.585
	Female	133	36.1	63.9		
Age	Younger	156	35.3	64.7	0.985	0.321
	Older	104	41.3	58.7		
Ever married	Yes	129	36.4	63.6	0.173	0.678
	No	131	38.9	61.1		
Persons in the household*	Low	111	45.0	55.0	4.459	0.035
	High	149	32.2	67.8		
Income of the respondent	Lower	181	31.5	68.5	9.752	0.002
	Higher	79	51.9	48.1		
Income of the household	Lower	167	30.5	69.5	10.173	0.001
	Higher	93	50.5	49.5		
Professional qualification	<BS	134	32.1	67.9	3.696	0.055
	≥BS	126	43.7	56.3		
Professional role type	Nurse	178	39.9	60.1	1.158	0.282
	Other	82	32.9	67.1		
Professional experience	Junior	185	34.1	65.9	3.615	0.057
	Senior	75	46.7	53.3		
Sector of workplace	Public	144	39.6	60.4	0.491	0.483
	Private	116	35.3	64.7		
Department of workplace	Emergency	36	30.6	69.4	0.906	0.341
	Other	224	38.8	61.2		
Workload status	High	173	35.3	64.7	1.302	0.254
	Low	87	42.5	57.5		
RIIP presence in workplace	Yes	131	42.7	57.3	2.874	0.090
	No	129	32.6	67.4		

Note: *Number of persons in the household.

Abbreviations: HB, hepatitis B; RIIP, routine infant immunization program; χ^2 , chi square; P, significance.

Table 3 Participants' Psychosocial Characteristics and Hepatitis B Vaccination Uptake

Variables		n	HB Vaccination Uptake		χ^2	P
			Complete	Noncomplete		
			%	%		
Perceived susceptibility to infection	High	107	45.8	54.2	5.082	0.024
	Low	153	32.0	68.0		
Perceived severity of infection	Harsh	145	43.4	56.6	4.625	0.032
	Lenient	115	30.4	69.6		
Perceived efficacy of vaccine	Effective	132	46.2	53.8	8.287	0.004
	Ineffective	128	28.9	71.1		
Perceived safety of vaccine	Safe	142	44.4	55.6	5.934	0.015
	Unsafe	118	29.7	70.3		
Perceived affordability of vaccine	Cheap	111	47.7	52.3	8.339	0.004
	Expensive	149	30.2	69.8		
Perceived accessibility of vaccine	Easy	129	45.0	55.0	5.760	0.016
	Difficult	131	30.5	69.5		
Perceived efficacy of PPE	Effective	121	30.6	69.4	4.877	0.027
	Ineffective	139	43.9	56.1		
Perceived efficacy of PEP	Effective	97	33.0	67.0	1.457	0.227
	Ineffective	163	40.5	59.5		

Abbreviations: HB, hepatitis B; PEP, post-exposure prophylaxis; PPE, personal protective equipment; χ^2 , chi square; P, significance.

affordability of the vaccine, perceived accessibility of the vaccine, and perceived efficacy of PPE (Table 3). The rate of HB vaccination uptake was not significantly different for any behavioral factors at $P < 0.05$ in the bivariate analysis (Table 4). The rate of HB vaccination uptake was significantly different for the following two miscellaneous factors at $P < 0.05$ in the bivariate analysis: taken training on UP and ever gets colleagues' suggestion (Table 5).

Regardless of the statistical significance criterion stated, all those 20 of the 30 potential predictors that have shown $P \leq 0.25$ from the bivariate crosstab analysis were entered into the multivariable binary logistic regression analysis simultaneously. After series of logistic regression models through backward stepwise elimination approach, 10 different predictors were finally identified as independently associated with HB vaccination uptake at $P < 0.05$ statistically significant criterion (Table 6): perceived safety, colleagues' suggestion, professional qualification, perceived susceptibility, household income, prior OE, professional experience, RIIP existence, workload status, and UP training. The Hosmer–Lemeshow test suggests the overall predictive model is a good fit to the data (Table 6).

Discussion

The first specific objective of this survey was to determine the rate of HB vaccination uptake in HCPs of Ethiopia during 2018. The finding shows that the complete HB vaccination uptake rate was 37.7% (CI 31.9–43.3). The majority of the HCPs remained whether “partially vaccinated” (41.5%) or “unvaccinated” (20.8%), resulting in 62.3% (CI 56.7–68.1) for the noncomplete HB vaccination uptake rate.

Although direct comparison seems difficult, these compliance vs noncompliance rates are in line with the rates from Tanzania—during 2015,¹⁵ India—during 2011,⁹ Pakistan—during 2010,¹⁶ China—during 2008,¹⁷ and Sweden—during 2006.¹¹ Our study's key result on the HB vaccine compliance rate is also higher than the rates from some sub-Saharan African areas, such as Benin City, Nigeria—during 2011;¹⁸ Yaoundé, Cameroon—during 2014;⁷ and Shashemene, Ethiopia—during 2015.¹⁹ But it is lower than many others shown throughout the globe, including those in Oceania,¹² Americas,^{20,21} Europe,^{22–24} Asia,^{10,25–27} and Africa^{8,28,29} with mysterious time variation between studies. The unexplained parity or disparity,

Table 4 Participants' Behavioral Characteristics and Hepatitis B Vaccination Uptake

Variables		n	HB Vaccination Uptake		χ^2	P
			Complete	Noncomplete		
			%	%		
Ever tested for HIV	Yes	162	38.9	61.1	0.262	0.609
	No	98	35.7	64.3		
Alcohol use	Ever	76	31.6	68.4	1.709	0.191
	Never	184	40.2	59.8		
Tobacco use	Ever	27	37.0	63.0	0.006	0.941
	Never	233	37.8	62.2		
Prior OE to blood	Ever	143	32.9	67.1	3.150	0.076
	Never	117	43.6	56.4		
Adherence in practicing UP	Good	195	35.4	64.6	1.769	0.184
	Poor	65	44.6	55.4		

Abbreviations: HB, hepatitis B; HIV, human immunodeficiency virus; OE, occupational exposure; UP, universal precautions; χ^2 , chi square; P, significance.

Table 5 Participants' Miscellaneous Characteristics and Hepatitis B Vaccination Uptake

Variables		n	HB Vaccination Uptake		χ^2	P
			Complete	Noncomplete		
			%	%		
History of jaundice	Yes	27	29.6	70.4	0.834	0.361
	No	233	38.6	61.4		
Taken training on UP	Ever	134	44.0	56.0	4.729	0.030
	Never	126	31.0	69.0		
Know HB infected persons	Yes	222	38.7	61.3	0.708	0.400
	No	38	31.6	68.4		
Ever gets colleagues' suggestion	Yes	146	44.5	55.5	6.611	0.010
	No	114	28.9	71.1		

Abbreviations: HB, hepatitis B; UP, universal precautions; χ^2 , chi square; P, significance.

in broad, maybe relies on the presence or absence of comprehensive data per exact context, as well as due to such differences or similarities as concerning the study design, period, place, and/or population attribute.

The second specific objective of this survey was to identify the predictors of HB vaccination uptake in HCPs of Ethiopia during 2018. The finding shows that only two of several psychosocial factors assessed were found the best independent predictors of HB vaccination uptake among HCPs: "perceived susceptibility" and "perceived safety." The HCPs who perceived themselves as low susceptible were significantly more likely to have

vaccination noncompliance (AOR 2.369, CI 1.302–4.312, P 0.005) than those who perceived themselves as high susceptible. A study from Nigeria demonstrates a similar pattern.³⁰ The HCPs who perceived the vaccine as unsafe were significantly more likely to have noncomplete vaccination uptake (AOR 2.674, CI 1.458–4.905, P 0.001) when compared with those who perceived the vaccine as safe. This finding is congruent to literatures respectively from India,⁹ Georgia,³¹ and England.³² It also agrees with a study that described "[T]he main reason for declining vaccination was the risk of vaccine side effects."³³ The aftermath of a person's perceived susceptibility to the

Table 6 Significantly Independent Predictors of Hepatitis B Vaccination Uptake in 260 Participants

Variables		HB Vaccination Uptake: Noncomplete vs Complete		
		AOR	CI	P
Perceived safety of vaccine	Unsafe Safe	2.674 	1.458–4.905 ref	0.001 ref
Ever gets colleagues' suggestion	No Yes	2.584 	1.411–4.730 ref	0.002 ref
Professional qualification	<BS ≥BS	2.417 	1.326–4.404 ref	0.004 ref
Perceived susceptibility to infection	Low High	2.369 	1.302–4.312 ref	0.005 ref
Prior OE to blood	Ever Never	2.300 	1.266–4.178 ref	0.006 ref
Income of the household	Lower Higher	2.284 	1.269–4.108 ref	0.006 ref
Professional experience	Junior Senior	2.265 	1.187–4.320 ref	0.013 ref
RIIP presence in workplace	No Yes	2.115 	1.163–3.846 ref	0.014 ref
Workload status	High Low	2.196 	1.167–4.130 ref	0.015 ref
Taken training on UP	Never Ever	2.081 	1.154–3.752 ref	0.015 ref

Notes: Hosmer–Lemeshow test of goodness of fit statistics, chi square = 4.284; degree of freedom = 8; $P = 0.831$.

Abbreviations: AOR, adjusted odds ratio; CI, 95% confidence interval; HB, hepatitis B; OE, occupational exposure; RIIP, routine infant immunization program; UP, universal precautions; P , significance.

harsh disease threat and a person's perceived safety of taking successful action to reduce that threat may help them for willingness to pay for the cost of the vaccine being received.

Based on the Health Belief Model, the individual's demographic characteristics and knowledge levels are modifying factors. Hypothesize that diverse demographic and cognitive factors affect the individual's perception and thus indirectly influence the individual's health-related behavior. For example, educational achievement, believed to have an indirect effect on HB vaccination uptake as the recommended health action or behavior by influencing the individual's perceived threat agent (such as susceptibility to and severity of the infection) and perceived benefits–barriers of the action agent (such as safety, efficacy, and affordability of the vaccine) being taken to reduce that threat.³⁴ However, our study shows that some demographics including professional, socioeconomic, and organizational characteristics have independently shown a

statistically significant relationship with HB vaccination uptake from the best-fit predictive model.

The HCPs who had below BS degree were significantly more likely (AOR 2.417, CI 1.326–4.404, P 0.004) to have noncomplete vaccination uptake than those who had BS degree or above. This result is supported by a study carried out in Nigeria.²⁹ Similarly, junior HCPs were significantly more likely (AOR 2.265, CI 1.187–4.320, P 0.013) to have noncomplete vaccination uptake than senior HCPs. This is consistent with previous studies,^{22,29} but not with another one showing insignificant association.³⁵

The HCPs who had low-level household income were significantly more likely (AOR 2.284, CI 1.269–4.108, P 0.006) to have noncomplete HB vaccination uptake than those who had high-level household income. This designate may be modifiable through perceived cost of the vaccine, number of persons generating income for the household, number of economically dependent persons in the household, income of the respondent themselves, and readiness to pay

for the cost of the vaccine being taken. Although income of the respondent³⁶ and perceived affordability of the vaccine³⁷ are among important predictors of the individual's vaccination behavior, they become insignificant after adjustment in the present study. There is no previous statistical evidence from the literature showing the effect of household income on HB vaccination uptake among HCPs. We statistically discovered that association was best explained by income of the household rather than income of the respondent and perceived affordability of the vaccine. According to previous studies, lack of money to pay for the vaccine⁷ or high cost of the vaccine³⁷ is described as one of the most common self-declared reasons among unvaccinated and/or incompletely vaccinated HCPs, which may be best explained by household income. According to one previous study carried out in the USA, the highest compliance rates are associated with hospitals paying the cost of vaccinating high-risk healthcare workers.³⁸ We also believe that household income and other factors on the path can no longer be affecting the outcome if the vaccine is available with free cost for HCPs or if the institutions can pay for the cost of vaccinating them.

The HCPs who had high workload were significantly more likely (AOR 2.196, CI 1.167–4.130, P 0.015) to have vaccination noncompliance compared to those who had low workload. Whereas high workload could lead to lack of time to spend in getting vaccination, lack of time is also described as one of the most common self-declared reasons by unvaccinated and/or partially vaccinated HCPs.^{7,14} Other studies have shown that the department¹⁷ and sector¹⁹ of workplace facility have independent significant association with HB vaccination uptake behavior. These organizational demographics found not to be significant in our study as well as the result about the department and/or sector agrees with results from Tanzania,¹⁵ Nigeria,³⁹ and India.⁹ It suggests that slight effects might be explained in part by workload variations between workplaces through that time spent-mediated pathway. However, this possibility was not directly explored in the present study, and further investigation is required.

The HCPs who are employed in the healthcare facilities not having RIIP had been significantly more likely to have vaccination noncompliance (AOR 2.115, CI 1.163–3.846, P 0.014) than those employed in the healthcare facilities having RIIP. Here, establishing RIIP throughout healthcare facilities could also be very important to increase the vaccination uptake rate in their employees against HB virus infection, despite further exploration for the mechanism of the association appears unclear, and would require further research with a better approach to

clarify this quantitative evidence discovered for the first time. Additionally probing why that program is not available between healthcare institutions will have multidimensional benefits.

Among behavioral factors, OE history becomes an independent predictor of the outcome. The adjusted odds of being unvaccinated/partially vaccinated were significantly higher (AOR 2.300, CI 1.266–4.178, P 0.006) in the HCPs ever exposed to blood compared to those never exposed to blood. This result contradicts with another study showing statistically significantly higher rates of HB vaccination in Serbian healthcare workers who had at least one episode of OE to blood over the past year;²² OE as a positive motivating factor for favorable vaccination behavior. The main explanation for this inconsistency may be due to the national prevalence level of HB virus infection. It is clear that high prevalence of HB virus in developing countries (eg, Ethiopia) increases the risk of OE for HCPs who had contact with the patients' blood to acquire/develop acute and/or chronic HB infections. One known divergent clinical perspective in this pathogenesis-mediated pathway is PEP (post-OE prophylactic therapy with anti-HB virus immunoglobulin); its availability, effectiveness, and usage may raise another question among the exposed HCPs. Somehow, frequent OE can probably bound them from receiving vaccination by making them ignorant unless actually infected – or by making them anxious toward acceptance of a volunteer HB surface antigen test as a requirement for PEP or vaccination eligibility in Ethiopia, and therefore national struggles must be ready to improve pre-OE compliance of vaccination in HCPs when they are approaching a high-risk target group.

Of the miscellaneous factors, both colleagues' suggestion and UP training persisted independently significant. HCPs who did not get colleagues' suggestion were significantly more likely to have vaccination noncompliance against HB virus (AOR 2.584, CI 1.411–4.730, P 0.002) than those who get colleagues' suggestion. This is congruent to previous results from Italy,⁴⁰ Georgia,³¹ and Ethiopia.³⁷ Lastly, HCPs untrained on UP were significantly more likely to have HB vaccination noncompliance (AOR 2.081, CI 1.154–3.752, P 0.015) than those who trained on UP. UP training may influence their decision to choose their own best preventive action being taken to reduce that threat through a cognitive-mediated pathway. This result is supported by a previous study carried out in the Amhara regional state hospitals of Ethiopia that mentions that UP training will increase the awareness

level of infection prevention among health professionals so they will become ready to be vaccinated.³⁷

The results from this study will be very important to develop context-based comprehensive implementation and policy-making that may be effective to improve the HB vaccine uptake by HCPs as the best primary prevention strategy of HB infection; many potential influencing factors were tested, thereby the statistically significant independent factors were identified from the specific situation. This could fundamentally contribute to maintain the occupational safety and health among HCPs. Devoting in occupational safety and health reduces both direct and indirect costs, increasing societal security and health, decreases absenteeism, increases worker and coworker morale, and then improves overall performance and productivity in the country. Nationally, reduced societal security and healthcare costs means better economic performance and enhanced societal benefits.⁴ Our study might further oblige as part of the “global hepatitis eradication goal by 2030” which is planned by the WHO and is already accepted by the regime FMOH-Ethiopia.

This study has several limitations. First is that the vaccination behavior was investigated by interviewing the participants, for which reflected recall bias may have affected the results of this study. It is also measured only based on the number of doses received by the participant, regardless of time after the last dose and time lapses between doses. As the second limitation was while vaccination did not always render into serologic antibody response, we were unable to investigate anti-HBs serologic antibody titers. Integrating the survey results with medical records or laboratory assessment of anti-HBs serologic antibody titers would have helped to inform policy change mainly including whether post primary series completion booster doses are required. In addition, we were unable to use pre-enrollment serologic HB virus antigen screening. Serologic antigen laboratory investigation would be required to exclude the HB-infected HCPs from analysis and then would have helped to avoid underestimation of vaccination uptake rates. The third limitation was as the largest proportion of participants in our study are nursing HCPs, we were only able to analyze other groups of HCPs (eg, physicians, lab technologists, physiotherapists, anesthetists) merged due to tiny frequency distributions. Caution must be therefore used to generalize the results to other groups of HCPs separately (vs nursing HCPs) regarding professional role type. The fourth limitation was that we were restricted to the forms

of indicators we could use. We were unable to examine the effect of the availability of HB vaccine particularly for HCPs between their own workplace facilities, instead, we used the availability of RIIP between their own workplace facilities and their perception toward the accessibility of HB vaccine in any nearby facility as indicators. We believe that only vaccinated participants tend to have default information on whether the HB vaccine is available at their own workplace institutions for vaccinating themselves even if that information is inadequately broadcast to the overall participants. Direct investigation of the healthcare workplace facilities for the availability of HB vaccination for vaccinating HCPs is therefore required. As professional role type was reclassified quite broadly in the present study, our categories differed from those often used in previous studies. In addition, self-declared reasons for non- or partial-vaccination status against HB virus infection were not directly described in the scope of the present study because they are not applicable to conduct such statistical comparison among all analytic participants. Separate enrollment and analysis of unvaccinated/partially vaccinated participants is therefore required to clearly determine whether there is any effect from self-declared reasons. These limitations may affect the results of this study, making them less generalizable. Future research studies should take these points into account as well.

Conclusion

The rate of HB vaccination uptake in HCPs of Ethiopia found was currently low. The significantly independent predictors of HB vaccination uptake included perceived safety, colleagues' suggestion, professional qualification, perceived susceptibility, household income, prior OE to blood, professional experience, existence of RIIP at workplace facility, workload status, and UP training.

Abbreviations

AOR, adjusted odds ratio; CDC, Centers for Disease Control and Prevention; CI, 95% confidence interval; FMOH, Federal Ministry of Health; HB, hepatitis B; HCP, healthcare professional; HIV, human immunodeficiency virus; IBM, International Business Machines Corporation; OE, occupational exposure; PEP, post-exposure prophylaxis; PPE, personal protective equipment; RIIP, routine infant immunization program; SPSS, Statistical Product and Service Solutions; UP, universal precautions; WHO, World Health Organization.

Data Sharing Statement

All relevant data are available in this manuscript and its supplementary materials.

Ethics Approval and Consent to Participate

The University of Gondar the College of Medicine and Health Sciences ethics committee approved the study protocol. In addition, the study obtained an official permission letter from the Central Gondar Zone Health Administration. All participants gave their written informed consent to participate.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest for this work.

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