MINISTRY OF EDUCATION| AND TRAINING

MINISTRY OF HEALTH

NATIONAL INSTITUTE OF HYGIENE AND EPIDEMIOLOGY

----------*----------

PHAM NGOC THANH

THE CURENT SITUATION, FACTORS RELATED TO HEPATITS B VIRUS INFECTION AMONG ADULTS IN THE CENTRAL HIGHLANDS REGION AND EFFECTIVENESS OF INFECTION PREVENTION INTERVENTIONS

Track: Epidemiology

Code: 9 72 01 17

DOCTOR OF PHYSOLOPHY THESIS SUMMARY

HANOI – 2021

The thesis was completed at National Institute of Hygiene and Epidemiology

Supervisors:

1. Prof. Phan Trong Lan, PhD.
2. Assoc. Prof. Nguyen Thi Thi Tho, PhD.

Reviewer 1: Assoc. Prof. Ngo Van Toan, PhD.

Reviewer 2: Assoc. Prof. La Ngoc Quang, PhD.

Reviewer 3: Assoc. Prof. Trinh Thi Ngoc, PhD.

The thesis was defensed before Review Committee at Institute level at National Institute of Hygiene and Epidemiology at 9 am, 09/09/2021

The thesis can be found at:

1. National Library
2. National Institute of Hygiene and Epidemiology Library

INTRODUCTION

Viral hepatitis is a common infectious disease that causes serious health consequences and leads to death due to dangerous complications such as acute liver failure, cirrhosis and liver cancer. Among the five types of hepatitis viruses, hepatitis B virus (HBV) has the most impact on human health. According to estimates by the World Health Organization (WHO), there are about 257 million cases of chronic HBV infection and 1.4 million deaths each year. HBV is responsible for 57% of cirrhosis cases and 78% of primary liver cancer cases. HBV can be transmitted in many ways, including mother-to-child, blood-borne, and sexual contact. HBV infection can be prevented by vaccination as well as by improving knowledge and behaviours in the community.

Vietnam is one of the countries with a high rate of HBV infection in the region. Some studies showed that the prevalence of HBV infection in our country is quite high (from 8 to 25%). An estimated 8.6 million people are currently infected with HBV and more than 23,000 people could die in 2015 because of this disease.

The Central Highlands is the key economic, political, social, security and defense region of Vietnam with a high percentage of ethnic minorities and low educational attainment compared to other regions. In the Central Highlands, studies on the prevalence of HBV infection were conducted at small scale and there is no overall study. Therefore, it contributed to the limitation of the health care system to the problem of HBV infection, including prevention and treatment activities. To provide evidence for the development of a master plan on hepatitis B prevention, the study ***"The current situation, factors related to hepatitis B virus infection among adults in the Central Highlands region and effectiveness of infection prevention interventions"*** was implemented with the following objectives:

1. To describe the situation of hepatitis B virus infection among adults in the community in 3 provinces of Kon Tum, Gia Lai, Dak Nong, 2018.
2. To analyze some factors related to hepatitis B virus infection among adults in the community in 3 provinces of Kon Tum, Gia Lai, Dak Nong, 2018.
3. To evaluate the effectiveness of behavior, change communication interventions to prevent hepatitis B virus infection in the community, 2018-2019.

Novelty: The study provided the first comprehensive data on the current situation of HBV infection, related factors as well as effectiveness of infection prevention preventions in the Central Highlands region. The study also applied the DID (Difference in Differences) method to evaluate the effectiveness of interventions to prevent HBV infection.

Applicability: The topic of this study has practical and urgent significance to help policymakers develop effective plans for HBV prevention and control activities in the Central Highlands region.

Thesis structure:

The thesis consists of 127 pages, 4 chapters: Introduction (3 pages); Literature review (33 pages); Research Methodology (25 pages); Research results (34 pages); Discussion (28 pages); Conclusion (2 pages); Recommendations (2 pages). The thesis has 27 tables, 17 figures, 144 domestic and international references.

CHAPTER 1: LITERATURE REVIEW

1.1. Overview of Hepatitis B virus

Viral hepatitis is a common name for hepatitis caused by hepatitis viruses, mainly hepatitis viruses A, B, C, D, E, G … In which, HBV causes the most severe consequences.

HBV belongs to the family of Hepadnaviridae, genetic double-stranded DNA, has a small sphere, 40 nm in diameter, consisting of 3 outer layers with about 7 nm thick, a box-shaped capillary shell about 27 - 28 nm in diameter and a core containing the genome of virus.

The main routes of HBV transmission are blood-borne, sexual contact and mother-to-child. Viral concentrations are at high level in blood, serum, and injured areas; moderate level in sperm, saliva, and vaginal fluids; and low level or absent in other body fluids.

1.2. Current situation of Hepatitis B virus infection

1.2.1. Worldwide

In general, the situation of HBV infection varies in each geographical region and tends to increase in countries around the world. Currently, there are about 257 million people are infected with HBV, 3/4 of these are Asians, 25% of people with chronic HBV infection could change to chronic hepatitis, cirrhosis, and primary liver cancer.

1.2.2. Vietnam

Vietnam is a country with a high prevalence of HBV, with an estimated 8.6 million people infected with HBV. The prevalence of chronic HBV infection is estimated at 8.8% for female and 12.3% for male.

1.2.3. The Central Highlands region

Data are generally reported for viral hepatitis types. According to the infectious diseases reporting system in Circular No. 48/2010/TT-BYT, in the period 2012-2016, the Central Highlands region recorded 5845 cases of viral hepatitis.

1.3. Factors related to Hepatitis B virus infection

Socio-demographic characteristics: According to different authors in the world, demographic factors such as age, sex, ethnicity and some factors such as socioeconomic conditions, hunger poverty, educational attainment... have impact on the risk of HBV infection in the community.

Knowledge factor: The lack of knowledge in the community and high-risk groups, as well as among healthcare workers, is hindering efforts to prevent and control the risk of HBV infection. Several studies have shown that people who have a better understanding of HBV transmission and its consequences have lower rates of HBV infection.

Behavioral factor: In Vietnam, several studies have shown that three common risk behaviors are associated with HBV infection including: sharing needles, sharing acupuncture needles, and sharing toothbrush. Studies in Vietnam and around the world have also found the relationship of HBV infection with behavioral factors such as: medical history activities, infusion behavior, sexual behavior and mother-to-child transmission.

1.4. Hepatits B virus infection prevention intervetnions

The World Health Organization strategy

In 2012, WHO issued the Global Framework for Action on Hepatitis Infection Prevention with the vision that viral hepatitis would no longer be transmitted in the world and all patients would have access to safe and effective care and treatment. The Framework consists of four key components: 1) Raising awareness, fostering partnerships and mobilizing resources; 2) Evidence-based policy and data for action; 3) Prevention of transmission; 4) Screening, care and treatment.

Vietnam strategy

The Ministry of Health of Vietnam has issued a Master Plan to prevent viral hepatitis for the period 2015-2020, a 5-year period with the goal of reducing hepatitis virus transmission and increasing people's access to viral hepatitis prevention, diagnosis, care and treatment services. Vietnam is one of the countries in the world that actively promulgates the plan to prevent viral hepatitis with many practical and important contents such as: strengthening communication, screening for early detection, increasing the rate of hepatitis B

vaccination coverage, coordinating with health insurance agencies to reduce the cost burden for people.

Specific activities

- Surveillance of viral hepatitis in Vietnam
- HBV vaccination
- Prevention of mother-to-child transmission
- HBV testing for women before giving birth
- Safety practice in blood transfusion and blood products
- Risk reduction for high-risk people
- Management of patients/people infected with HBV on timely antiretroviral therapy.
- Communication interventions to raise awareness and change behavior for the community.

CHAPTER 2: RESEARCH METHODOLOGY

2.1. Research methodology for objective 1 and 2

2.1.1. Research subject

Male and female who are older than 18 years old and living in the research site (foe more than 1 month) in 3 provinces of The Central Highlands region, including Kon Tum, Gia Lai and Dak Nong.

2.1.2. Research duration: From September 2018 to March 2019.

2.1.3. Research sites: The study was implemented in 3 provinces, including Kon Tum, Gia Lai and Dak Nong.

2.1.4. Research methodology

Research design

Applying the cross-sectional study method to describe the current situation of HBV infection and identify some factors related to HBV infection among adults in The Central Highlands region.

Sample size

Applying the formula for calculating sample size of the cross-sectional study design to determine the HBV prevalence in the population with multi-stages (according to WHO guidelines)

$$n = Z^2_{1-\alpha/2}\frac{p(1-p)}{d^2}DE$$

In which: n: the minimum number of research subjects; With a confidence level of 95%, $Z_{1-\alpha/2} = 1.96$. According to the modeling results of the estimated burden

of disease due to hepatitis B and C virus and investment efficiency analysis the Ministry of Health and WHO (2017), the rate of hepatitis B infection is from 6-20%, then p = 14%. DE: design factor = 2; d: desired precision (d = 0.02). Applying the above formula with 5% of the opt-out estimation, the total number of subjects participating in the study was **2428**.

Sampling method

Step 1- Province selection: Select purposefully 3 provinces in the Central Highlands region including Kontum, Gia Lai, Dak Nong.

Step 2- District selection: In each selected province, 3 districts/towns/cities were randomly selected by simple random sampling method.

Step 3- Commune selection: Make a list of all communes in each selected district, 3 communes/wards were randomly selected by simple random sampling method.

Step 4- Research subjects selection: In each commune randomly, select 90 households (= 2430: 3: 3: 3) with family members aged 18 years or older by systematic random sampling method. In each household, one eligible research subject was selected by the Kish table method.

Information collection method

- Collect information on the current situation of HBV infection by testing the blood of research subjects.
- Collecting information on knowledge and behavior on HBV infection prevention of research subjects by interview with the structured questionnaire.

Testing technique for hepatitis B virus

Biological products for serological testing of HBV were produced by Abbott Architech. A blood sample is determined to be infected with HBV when total Anti-HBc is positive and HBsAg is positive according to the following diagram:

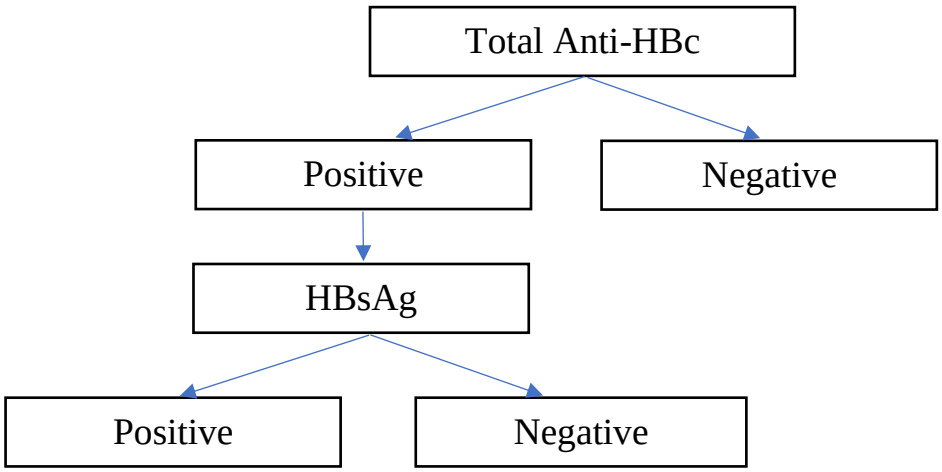

Figure 2.1. Diagram of testing for Hepatitis B virus

Evaluation Criteria

Knowledge

The knowledge of each research subject was evaluated based on 13 questions; each correct answer gets 1 point, the wrong answer or no answer gets 0 points, then the total score of 13 questions was calculated.

The knowledge evaluation scale is as follows:

Knowledge	**Threshold for "passed" score**
Knowledge on the transmission routes of HBV	3/4 correct answers
Knowledge on prevention of HBV	5/6 correct answers
Knowledge on HBV vaccination	2/3 correct answers
General knowledge	**10/13 correct answers**

Behaviors

The behaviors of each research subject were evaluated based on 10 questions; each correct answer gets 1 point, the wrong answer or no answer gets 0 points, then the total score of 10 questions was calculated.

Behaviors	**Threshold for "passed" score**
Prevention of blood-borne infection	4/4 correct answers
Prevention of sexual contact infection	1/2 correct answers
Prevention by vaccination and testing	1/2 correct answers
Prevention of infection via tobacco and alcohol use	1/2 correct answers
General behaviors	**7/10 correct answers**

2.1.5. Data management and analysis

Data was entered and double checked by the Epi data 3.1 software.

Analysis of the prevalence of HBV infection: Calculate the weight according to the base weight, the weight adjustment coefficient according to the actual sample size by sex and provinces and omit 1% of the weight value in the distributions. The Stata 15.0 software was used for analysis.

Other data were analyzed by the SPSS 26.0 software. Logistic regression model was used for multivariate analysis to remove confounding factors.

2.2. Research methodology for objective 3

2.2.1. Research subjects

The subjects of the intervention are people living permanently in the research sites.

2.2.2. Research duration: From April 2019 to May 2020.

2.2.3. Research sites: Purposely select 2 communes in Kon Tum city, Kon Tum province to conduct research. In which, Truong Chinh commune was selected as intervention group and Nguyen Trai commune was selected as control group. These two communes, with 10 km distance between them, have similar socio-economic characteristics.

2.2.4. Research methodology

Research design

Applying the community interventions with case-control research method to evaluate the effectiveness of the interventions by comparison of before and after the intervention and comparison of the intervention group and the control group.

Sample size

The interventions were applied for the entire community. The formula calculating the sample size to test the difference between the two rates for evaluating the effectiveness of the intervention was applied.

$$n_{1=}n_{2=}\frac{\left\{z_{1-\propto/2}\sqrt{2p(1-p)}+z_{1-\beta}\sqrt{p_1(1-p_1)+p_2(1-p_2)}\right\}^2}{(p_1-p_2)^2}DE$$

In which:

n_1, n_2: Minimum sample size of intervention and control groups

p_1: Absolute expected change in behaviors in the intervention group = 30%

p_2: Absolute expected change in behaviors in the control group = 10%

p = (p1 + p2)/2 = 20%

$z_{1-\propto/2}$: desired confidence, for 95% confidence then $z_{1-\propto/2}$= 1.96.

$z_{1-\beta}$: with the sample force of 95%, then $z_{1-\beta}$ =1.64

DE: design effect = 2

The sample size to evaluate the effectiveness of the intervention was **440** people for both the intervention and control groups.

Sampling method

Applying the multi-stage selection method. Stage 1: Select 4 clusters in each commune (2 residential groups and 2 villages). In each cluster, select 220/4=55 people. Stage 2: Randomly select subjects according to the household list (1

person per household) by drawing in both communes until the sample size is reached.

2.2.5. Intervention content and communication materials

Communication messages: i) Hepatitis B virus can be transmitted through 3 routes: mother-to-child, blood-borne and sexual contact; ii) Vaccination is the effective way to prevent HBV infection: iii) Use condoms during sexual intercouse to reduce the risk of HBV infection; iv) Do not share needles and medical equipment to prevent HBV infection.

Interventions media

Mass communication (radio): Indirect communication was conducted through mass media such as radio systems, loudspeakers in communes, and organizing mobile communication campaigns or incorporating into culture activities of the local people.

Direct communication: Direct communication was carried out through a collaborative network with various activities such as group discussions, thematic talks, mobile communication combined with culture activities. Direct communication activities were organized with the participation of local mass organizations such as the Women's Union, Youth Union, Farmers' Union...

Distributing leaflets, posters and banners: This activity aims to increase the transmission of media messages to the community.

Counseling:

- Counseling integrated into community activities: conducted by Commune Health Station (CHS) staff in 2 rounds (every 05 months). The content focused on the prevention of HBV infection.
- Counseling at the Commune Health Station: conducted by CHS staff when patients came to the station for health examination. The content focused on the prevention of HBV infection.
- Counseling through talking and group counseling for people infected with hepatitis B virus: conducted by CHS staff in 2 rounds. The content focused on the prevention of HBV infection and access to treatment services.

2.2.6. Data management and analysis

Objective 3 data were analyzed using the Difference in Differences (DID) method to assess the impact of the interventions. The significance of the regression coefficients was illustrated in the following figure:

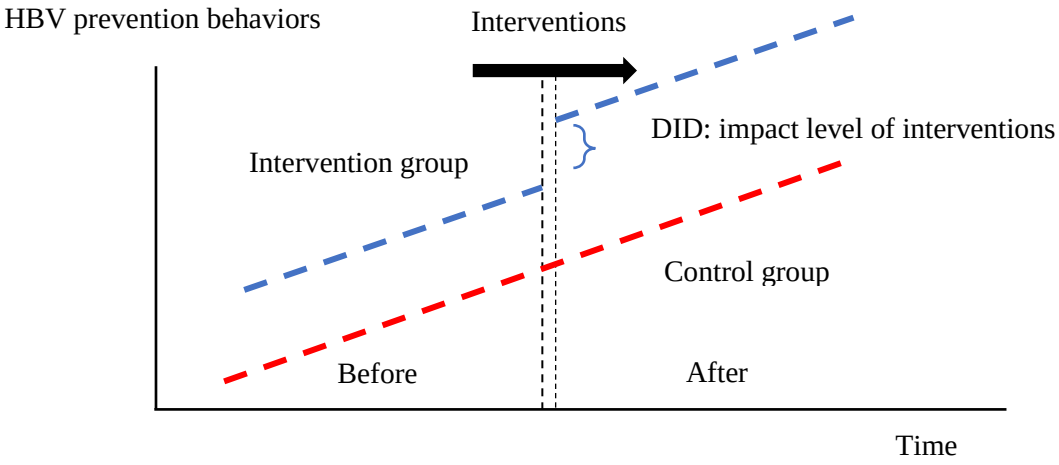

Figure 2.2. Illustration of the impact of intervention with DID method

2.3. Research ethics

The procedures, research participation agreement, subjects enrollment, and related documents were reviewed and approved by the Institutional Review Board (IRB) of Tay Nguyen Institute of Hygiene and Epidemiology according to the certificate No. IRB-VN01057-24/2017 (December 13, 2017).

CHAPTER 3: RESEARCH RESULTS

3.1. Current situtaion of Hepatis B virus infection

3.1.1. Characteristics of the research subjects

3.1.1.1. Demographic and sociological information

Table 3.1. Information on gender, ethnicity, age groups, education levels, marital status and occupation of the research subjects (n=2428)

Characteristics		Quantity	%
Gender	Male	1139	46.9
	Female	1289	53.1
Ethnicity	Kinh	1469	60.5
	Other	959	39.5
Age groups	<30 years old	411	16.9
	30-39 years old	684	28.1
	40-49 years old	655	27.0
	50-59 years old	419	17.3
	>= 60 years old	259	10.7
Education levels	Primary school	873	36.0
	Secondary school	863	35.5

Characteristics		Quantity	%
	High shcool	469	19.3
	College and higher	223	9.2
Marital status	Not married	151	6.2
	Married	2040	84.0
	Divorced	47	1.9
	Separated/widowed	190	7.8
Occupation	Farmer	1832	75.5
	Others	596	24.5

The results in table 3.1 showed that among 2428 study participants, male accounted for 46.9% while female accounted for 53.1%. About 60% of the study subjects belonged to the Kinh ethnic group, the remaining 40% belonged to other ethnic groups. The age group from 30-39 years old accounted for the highest proportion (21.18%) and the age group >=60 years old accounted for the lowest rate (10.7%). Most of the study subjects had a high school education or below (nearly 90.8%) and only 9.2% of the study group had college level and higher education. Besides, most of the study subjects were also married (84.0%), the number of unmarried people accounted for 6.2%. The main occupation of the subjects is farmer (75.5%), the total proportion of the rest are different occupations accounting for only 24.5%.

3.1.2. Current situation of Hepatis B virus infection

Table 3.2. Current situation of Hepatis B virus infection by provinces (n=2428)

HBV infection	Quantity	% (adjusted)
Dak Nong (n= 810) Positive HBV	95	11.8
Kon Tum (n= 810) Positive HBV	94	11.7
Gia Lai (n= 808) Positive HBV	84	10.1
All 3 provinces (n= 2428) Positive HBV	273	11.1

The results of table 3.2 showed that the HBV infection rate in the Central Highlands at the time of the study was 11.1%. Dak Nong is the province with the highest infection rate with 11.8%, second position belongs to Kon Tum with 11.7% and the lowest rate is Gia Lai with 10.1%.

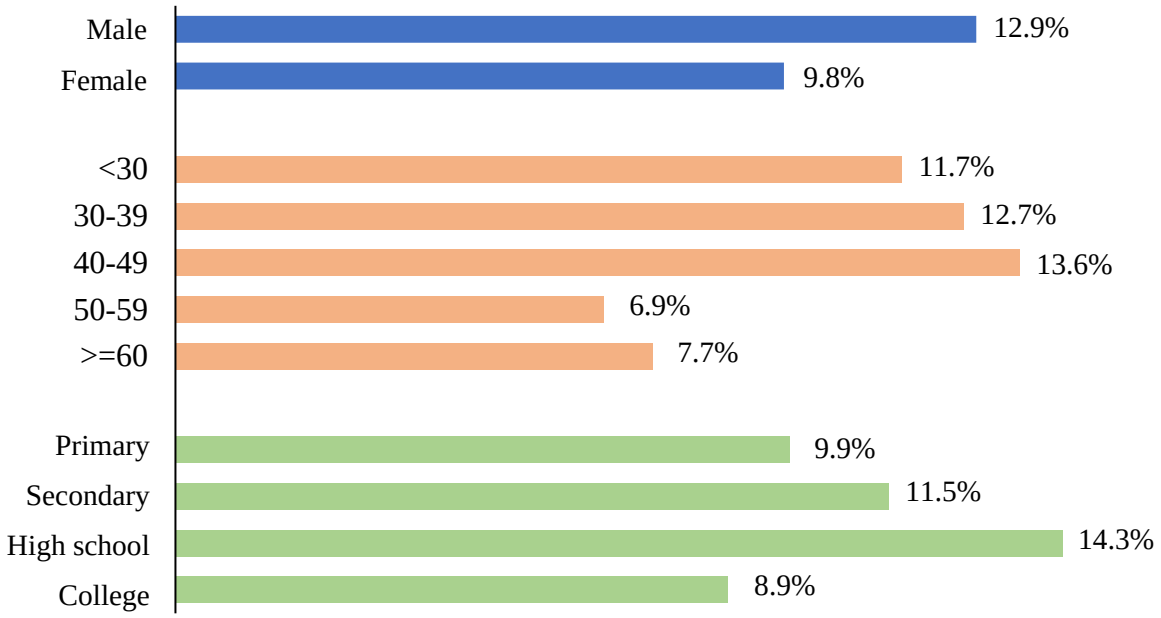

Figure 3.1. Current situation of Hepatis B virus infection by gender, age groups and education levels of the research subjects (n=2428)

Figure 3.1 showed the distribution of HBV infection rates according to demographic characteristics . Particularly, male has higher rates of HBV infection than female (12.9% versus 9.8%). The rate of HBV infection gradually increased by age groups and reached the highest rate in the age group of 40-49 years old (13.6%). The rate of HBV infection also increased gradually by education levels and reached the highest rate in the high school group with 14.3% and the lowest in the College and higher group with 8.9%.

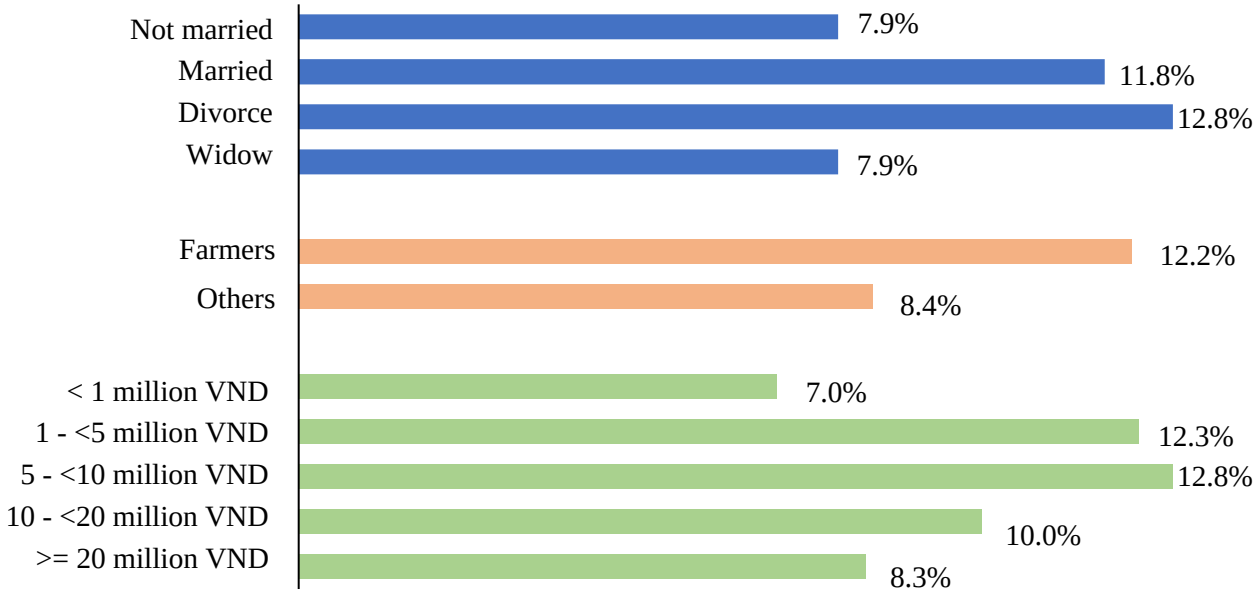

Figure 3.2. Current situation of Hepatis B virus infection by marital satus, occupation, and monthly income of the research subjects (n=2428)

Figure 3.2 showed that the positive rates in the group of married (11.8%) and divorced (12.8%) were higher than the groups of unmarried (8.0%) and separated/widowed (7.9%). The prevalence of HBV infection among farmer was 12.2% and among other occupation was 8.4%. The prevalence of HBV infection increased gradually with monthly income levels, from 7% (<1 million VND group) to the highest 12.8% (5-<10 million VND group) and back to 8.3% (> = 20 million VND group).

Besides, among 40 pregnant women participating in the study, the prevalence of HBV infection was 12.5%.

3.2. Factors related to Hepatitis B virus infection

Table 3.3. Logistic regression of factors associated with Hepatitis B virus infection

Factors	OR	95% CI	p
Gender			
Female	1	-	-
Male	1.31	1.05-1.70	0.046*
Occupation			
Others	1		
Farmer	1.46	1.03-2.06	0.032*
Relatives with liver diseases			
Yes	1	-	-
No	0.47	0.32-0.70	0.001*
Dialysis for kidney disease			
No	1	-	-
Yes	3.80	1.10-13.24	0.034*
HBV vaccination			
Vaccinated	1	-	-
Unvacinated	2.17	1.59-2.86	0.031*
Knowledge for HBV prevention			
No	1		
Yes	0.71	0.52-0.97	0.031*
Behaviors for HBV prevention			
No	1		
Yes	0.31	0.19-0.51	0.001*

**p<0,05; Binomial Logistic Regression*

In table 3.3, the multivariable logistic regression model was developed by selecting variables that have statistically significant relationship with HBV infection status from previous univariate analysis results and references from the literature review. The results show that in demographic and sociological factors, male infected with HBV higher more likely than female (OR=1.31; 95%CI=1.05-

1.70), farmers infected with HBV higher more likely than other occupational groups (OR=1.46; 95%CI=1.03-2.06). Regarding the factors of medical history, the group having relatives without liver disease decreases the risk of HBV infection compared to the group having relatives with liver disease (OR=0.47; 95%CI=0.32-0.70); dialysis for kidney disease increased the risk of HBV infection compared to the group that did not undergo this procedure (OR=3.80; 95%CI=1.10-13.24); the unvaccinated group infected with HBV higher than the vaccinated group (OR=2.17; 95%CI=1.59-2.86). In addition, the results also showed that good knowledge (OR=0.71; 95%CI=0.52-0.97) and good behavior (OR=0.31; 95%CI=0.19-0.51) reduced the risk of HBV infection.

3.3. Effectiveness of behaviors change commnication on Hepatitis B virus infection prevention in the community

3.3.1. Effectiveness of interventions for improving knowledge on Hepatitis B virus infection prevention

Table 3.4. Knowledge change on Hepatitis B virus infection prevention before and after intervention

Knowledge	Intervention group (n=220)		Control group (n=220)		p			
	Before (1)	After (2)	Before (3)	After (4)	2 vs 1	4 vs 3	1 vs 3	2 vs 4
% having good knowledge on HBV transmission routes	25.0	76.8	26.4	30.5	<0.05	>0.05	>0.05	<0.05
% having good knowledge on HBV prevention ways	19.1	75.0	20.9	24.1	<0.05	>0.05	>0.05	<0.05
% having good knowledge on HBV vaccination	40.5	83.2	42.7	48.2	<0.05	>0.05	>0.05	<0.05
% having good knowledge on general HBV prevention	10.9	63.2	14.1	15.0	<0.05	>0.05	>0.05	<0.05

(2) vs (1), (4) vs (3): McNemar test; (1) vs (3), (2) vs (4): χ^2 test

The data in table 3.4 showed that in the intervention group the percentage of people having good knowledge after the intervention increased significantly in all evaluated items in comparison before the intervention ($p<0.05$). Concurrently, after the intervention, the percentage of people having good

knowledge in the intervention group was also higher than the one before the intervention (p<0.05).

Particularly, the percentage of people having good knowledge on HBV transmission routes after the intervention was 76.8%, 3 times higher than the one before the intervention (25.0%) (p<0.05). The percentage of people having good knowledge on HBV prevention ways after the intervention was 75.0%, 3.9 times higher than the one before the intervention (19.1%) (p<0.05). The percentage of people having good knowledge on HBV vaccination after the intervention was 83.2%, 2.1 times higher than the one before the intervention (40.5%) (p<0.05). The percentage of people having good knowledge on general HBV prevention after the intervention was 63.2%, 5.8 times higher than the one before the intervention (10.9%) (p<0.05). The change in knowledge between before and after the intervention between the intervention group and the control group was at (62.2%-10.9%) - (15.0%-14.1%) = 51.4%. Meanwhile, in control group, there was no statistically significant difference in the percentage of people having good knowledge before and after the intervention with an increasing of only 1.1 - 1.2 times (p>0.05).

Table 3.5. DID analysis to evaluate the effectiveness of interventions for improving knowledge on Hepatitis B virus infection prevention

Factors	**B**	**OR**	**95% CI**		**p**
Interventions	-0.550	0.58	0.315	1.056	0.075
Time	0.078	1.08	0.626	1.868	0.780
Interventions*Time	2.832	16.99	7.858	36.713	0.000*
Ethnicity	0.421	1.52	0.829	2.801	0.175
Age	-0.291	0.75	0.507	1.101	0.141
Gender	-0.212	0.81	0.559	1.172	0.263
Education level	0.327	1.39	0.854	2.25	0.186
Marital status	-0.972	0.38	0.18	0.795	0.010*
Income level	0.979	2.66	1.719	4.12	0.000*
p-value of the model: p<0.001					

**p<0.05. Value of variables in the model including: Intervention (0: control, 1: intervention), time (0: before intervention, 1: after intervention), ethnicity (0: others, 1: Kinh), age (0: =<40 years old, 1: >40 years old), gender (0: female, 1: male), education level (0: high school;, 1: college), marital status (0: not married, 1: married), monthly income level (0: <10 million VND, 1: >=10 million VND).*

Table 3.5 indicated the results when comparing knowledge on HBV infection prevention after the intervention in Truong Chinh commune (intervention group) and Nguyen Trai commune (control group). Particularly, the

intervention increased the percentage of people have having good knowledge on HBV prevention in the intervention group was 0.58 x 16.99 = 9.85 times higher than the one in the control group after adjustment with ethnicity, age, gender, education level, marital status and income level. In addition, the model also showed that in both groups, factors of marital status and income were related to the increasing of people's knowledge on HBV prevention. The percentage of people having good knowledge in the not-married group was only 0.38 times lower than the one in the married group, and the percentage of people having good knowledge with monthly income >10 million was 2.66 times higher than the one with monthly income <10 million.

3.3.2. Effectiveness of interventions for improving behaviors on Hepatitis B virus infection prevention

Table 3.6. Behaviors change on Hepatitis B virus infection prevention before and after intervention

Behaviors	**Intervention group (n=220)**		**Control group (n=220)**		**p**			
	Before (1)	After (2)	Before (3)	After (4)	2 vs 1	4 vs 3	1 vs 3	2 vs 4
% having good behaviors on HBV prevention via blood-borne route	85.0	94.5	82.3	83.2	<0.05	>0.05	>0.05	<0.05
% having good behaviors on HBV prevention via sexual contact route	9.1	32.3	13.2	14.5	<0.05	>0.05	>0.05	<0.05
% having good behaviors on HBV prevention via vaccination and testing route	80.0	85.9	77.7	79.1	<0.05	>0.05	>0.05	<0.05
% having good behaviors on HBV prevention via non-smoking and non-alcohol use	61.8	75.9	64.1	65.9	<0.05	>0.05	>0.05	<0.05
% having good behaviors on general HBV prevention	2.7	30.5	4.5	5.0	<0.05	>0.05	>0.05	<0.05

(2) vs (1), (4) vs (3): McNemar test; (1) vs (3), (2) vs (4): χ^2 test

The data in table 3.6 showed that in the intervention group, the percentage of people having good behaviors after the intervention increased significantly in all evaluated items in comparison to before the intervention ($p<0.05$). Concurrently, after the intervention, the percentage of people having good behaviors in the intervention group was also higher than the one before the intervention ($p<0.05$).

Particularly, the percentage of people having good behaviors on HBV prevention via blood-borne route after the intervention was 94.5%, 1.2 times higher than the one before the intervention (85.0%) ($p<0.05$). The percentage of people having good behaviors on HBV prevention via sexual contact route after the intervention was 32.3%, 3.6 times higher than the one before the intervention (9.1%) ($p<0.05$). The percentage of people having good behaviors on HBV prevention via vaccination and testing route after the intervention was 85.9%, 1.1 times higher than the one before the intervention (80.0%) ($p<0.05$). The percentage of people having good behaviors on HBV prevention via non-smoking and non-alcohol use after the intervention was 75.9%, 1.2 times higher than the one before the intervention (61.8%) ($p< 0.05$). The percentage of people having good behaviors on general HBV prevention after the intervention was 30.5%, 11.2 times higher than the one before the intervention (2.7%) ($p< 0.05$). The level of change in behaviors between before and after the intervention between the intervention group and the control group was at (30.5%-2.7%) - (5.0%-4.5%) = 27.3%. Meanwhile, in control group, there was no statistically significant difference in the percentage of people having good behaviors before and after the intervention with an increasing of only 1.1 times ($p>0.05$).

Table 3.7. DID analysis to evaluate the effectiveness of interventions for improving behaviors on Hepatitis B virus infection prevention

Factors	**B**	**OR**	**KTC95%**		**p**
Interventions	-0.572	0.57	0.196	1.624	0.289
Time	0.102	1.11	0.456	2.691	0.821
Interventions*Time	2.824	16.85	4.829	58.776	0.000*
Ethnicity	0.358	1.43	0.610	3.354	0.411
Age	-0.373	0.69	0.414	1.147	0.152
Gender	-1.499	0.22	0.128	0.391	0.000*
Education level	0.398	1.49	0.780	2.843	0.227
Marital status	0.378	1.46	0.480	4.436	0.505
p-value of the model: p<0.001					

**p<0.05. Value of variables in the model including: Intervention (0: control, 1: intervention), time (0: before intervention, 1: after intervention), ethnicity (0: others, 1: Kinh), age (0: =<40*

years old, 1: >40 years old), gender (0: female, 1: male), education level (0: high school;, 1: college), marital status (0: not married, 1: married).

Table 3.7 indicated the results when comparing behaviors on HBV infection prevention after the intervention in Truong Chinh commune (intervention group) and Nguyen Trai commune (control group). Particularly, the intervention increased the percentage of people have having good behaviors on HBV prevention in the intervention group was 0.57 x 16.85 = 9.60 times higher than the one in the control group after adjustment with ethnicity, age, gender, education level and marital status. In addition, the model also showed that in both groups, factor of gender was related to the increasing of people's behaviors on HBV prevention. The percentage of female having good knowledge was only 0.22 times lower than the male.

CHAPTER 4: DISCUSSION

4.1. Current situation of Hepatitis B infection

Research results showed that the HBV infection rate in 3 provinces of the Central Highlands was high (11.1%) in comparision to the other regions in Vietnam and worldwide. In comparision to the other countries in Southeast Asia (0.3% - 7.0%), it can be seen that the HBV infection rate of the research is much higher. With this rate, 3 provinces of the Central Highlands were classified as high endemic areas (≥8%). In comparision to the overall infection rate of Vietnam in 2018 (9.4%), the Central Highlands was also included in the groups with a high infection rate compared to the rest of the country such as the South Central Coast (11.3%), North West (11.1%) and North Central (7.5%). The reason for the high prevalence of HBV infection in the Central Highlands can be attributed to socio-economic factors as well as the limited health service system compared to the delta areas. The results also indicated that there was no significant difference between the HBV infection rates among the three provinces. It also showed the similarity in the circulation of HBV in the community in the Central Highlands. However, if compared with previous studies in some provinces or regions such as Hanoi (15-25%), Lam Dong (16.7%), Binh Thuan (17.7%), the Central Coast (12.8-197%), the positive rate of 3 provinces in the Central Highlands was lower.

Besides, it could be seen that the HBV infection rate increases gradually by age groups and reaches the highest rate in the 40-49 years old group. This is also the general trend of HBV infection worldwide and in Vietnam. It partly reflects the impact of the HBV vaccination program. Younger groups tends to be better covered by vaccination programs, so the HBV prevalence is lower in this group. Meanwhile, middle-aged group has less access to vaccines. Moreover,

with the high rate of vaccination under 1 year old in many localities, the younger group is better protected than the adults group who had little chance to be exposed to vaccination in the previous period.

An important finding was found that the HBV infection rate tends to be higher in the group with monthly income <10 million VND and lower in the high-income group, especially the group with monthly income >20 million. It can be partly explained by the fact that high-income group often has better access and more chance to utilize of healthcare services, and they are also more conscious and qualified in taking care of their own health and their families. This research result is similar to previous results in the world. For example, in Turkey, the research by Tosun et al has shown that the population with high income and good living conditions has at least 10% lower prevalence of HBV infection than low-income and poor living conditions groups.

The results also showed that among 12.5% of the pregnant women in the research had positive HBsAg results. Meanwhile, the literature review had indicated that many studies measuring the prevalence of hepatitis B in pregnant women with similar results. Research results of Le Dinh Phuc Vu and colleagues at Medic Medical Center hospital showed that the rate of HBsAg (+) in women aged 20 to 35 years old was 12.6%, higher than the overall HBV prevalence among women or HBV prevalance in the community in Hanoi and Bac Giang (8%). Although Vietnam started HBV vaccination program since 1997, communication campaigns on transmission routes and HBV vaccination benefits were very widespread, but up to now, the rate of HBsAg (+) is still high in the women group in reproductive age. HBV vaccination has been included in the Expanded Program on Immunization (EPI) since 2002 for children under 6 years old. Thus, the reseach subjects has not yet benefited from HBV vaccination program or EPI. It may explain that up to now, the prevalence of HBV infection in this age group is still high. In 1992 and 1996, Pham Song and Tran Thi Loi studied the prevalence of HBV infection in pregnant women at Hanoi Obstetrics and Gynecology Hospital and Tu Du hospital. The results showed that the rate of HBV infection was low with 12.7% and 11.6% respectively.

4.2. Factors related to Hepatitis B infection

4.2.1. Socio-demographic factors

Among demographic factors, gender and occupation were the factors related to the prevalence of HBV infection in the 3 provinces of the Central Highlands. Various studies have shared the similar restuls that male have a higher positive HBV rate than female, from studies in Asia (China, Pakistan, India, Turkey) to Africa (Uganda). An immunological research showed that female have a better immune system response than male, so they are less susceptible to

infectious diseases. This finding contributes to the explanation of why male are infected with HBV more than female. In addition, male often have more risk behaviors for HBV infection (smoking, alcohol use, unsafe sex) along with the tendency to access healthcare services at late stage or infrequent utilization.

Occupation factor was also mentioned in some studies and also similar to the results in 3 Central Highlands provinces when showing a high positive rate among farmers, such as the study in Thua Thien Hue. Farmers have a higher rate of HBV infection than other occupational groups because this group often have limitations and difficulties in accessing healthcare services related to HBV prevention including repdocutive services as well as vaccination, health education and communication activities.

Besides, there was a factor of ethnicity related to HBV infection that was found from the literature reviwe but the results of this research showed that there is no difference in the status of HBV infection among ethnic groups. Initially, when designing the study, the research team also expected that with many ethnic groups living in the Central Highlands, the research results could show a relationship with the infection status, but the actual results did not show the results as expected.

4.2.2. Medical history factors

Regarding the medical history factors, having relatives with liver diseases and dialysis for kidney disease were identified to be related to HBV infection. This is remarkable finding as well as important things in HBV prevention activities in the community. Similar results have been found in previous studies and this is even more true for countries with high endemic such as Vietnam. Some other factors that have been evidenced in previous studies such as previous surgery, dental procedures, tattoos, sharing razors, sharing rushes and sexual intercourse ... were not found in this research.

Infusion practice among the research subjects was not very common with only 19.5% of them having had intravenous infusion in the 12 months prior to the survey.

In addition, the research also provided evidence that the vaccinated group had a lower rate of HBV infection than the unvaccinated group. This result is similar to the results of previous studies as well as the WHO report on the effectiveness of the EPI program, including the vaccine to prevent HBV infection. Newborns infected with HBV from their mothers have a 90% chance of becoming chronically illness and about 25% of them will die from liver cancer and cirrhosis. Research results have provided evidence to once again confirm the role and significance of vaccines in the prevention of infectious diseases in general and hepatitis B in particular.

4.2.3. Knowledge and behaviors factors

Regarding the knowledge of prevention of HBV infection, it could be seen that the knowledge of the research subjects was not high, the rate of correct answers on different contents about transmission routes, prevention methods, and HBV vaccination. The highest level is only nearly 40% and there are many contents with only about 20-30% of research subjects giving the correct answers. Among the evaluated content, knowledge on transmission had the lowest correct answer rate (28.9%) and knowledge about HBV vaccination had the highest correct answer rate (40.3 %). However, the difference between these two groups was not much. It showed that there is a need to strengthen communication activities to improve people's knowledge about the prevention of HBV infection in the community. Compared to the regions in the National Survey, the Central Highlands and the South-Central Coast are the two regions where people have the lowest rate of having correct knowledge on HBV infection prevention and control. Thus, once again, we can see the importance of improving people's knowledge in the community about prevention of HBV infection.

Among the risk behaviors for HBV infection related to sexual contact, there was an important result that the rate of people always using a condom when having sex with their partner was very low (6.8%). This rate may be related to the customs and habits of ethnic minorities in the Central Highlands when the concept of using condoms is still not accepted by many people. This is a remarkable point in the communication programs related to the prevention of sexually transmitted diseases and HBV in the three provinces of the Central Highlands.

Research results also showed that only 9.8% of pregnant women have ever been tested for HBV. Compared to the data of the whole country (14.8%) and some other regions such as the Northeast (23.5%), the Northwest (26.6%), the rate of the Central Highlands is quite low. Compared to the Southwest region (9.1%), the three provinces of the Central Highlands have the same rate. These areas have similar characteristic that the area is large, the terrain is not convenient for traffic, and the people's ability to access medical services is relatively difficult.

4.3. Effectiveness of behaviors change commnication on Hepatitis B virus infection prevention in the community

4.3.1. Results of communication interventions

Research results showed that there were similarities in demographic characteristics as well as medical history of research subjects between Truong Chinh and Nguyen Trai communes. This is an important basis to help compare

and evaluate the effectiveness of the intervention between the intervention group and the control group objectively and accurately.

Many interventions related to communication, capacity building and service access had been implemented. These activities were carried out with the aim of increasing knowledge and behaviors for both healthcare workers and the community in the prevention of HBV infection. Healthcare workers and collaborators of CHS also attended training courses for capacity building as well as assisting in the implementation of other interventions. These interventions are also consistent with the WHO's recommendations on intervention strategies for hepatitis B prevention. Consistency and concordance of the results between after and before the interventions can be seen clearly. Before the interventions, the role of the stakeholders was very limited, but after the interventions, their participation in the communication activities improved significantly with nearly 4000 people participating in communication activities. Besides, there is a huge difference between the two communes, the intervention group and the control group.

4.3.2. Factors related to effectiveness of communication interventions

Research results show that various factors are related to the change of people's knowledge and behaviors on HBV infection prevention. Regarding knowledge, the interventions had a better impact on the knowledge of the married group and the group with monthly income >10 million than on the other groups. It could be explained that the groups that are married and have higher incomes tend to be more concerned about health issues. When they have accessed to information sources, they are also more active in acquiring knowledge and disseminating it to other family members, especially with diseases related to infectious and ineffective treatment diseases such as HBV.

Meanwhile, in terms of behavior improvement, the interventions had more effective impact on male. This result suggested that the intervention needs to ensure that female have more opportunities to receive interventions and behaviors improvement to protect themselves from HBV. Studies on HBV on female subjects have also shown this issue, in which in addition to providing knowledge, creating favorable conditions and environment for female to perform protected behaviors related to HBV prevention includes vaccination, early access to healthcare services...

The results showed the role of socio-demographic factors in influencing the improvement of the knowledge and behavior of researchers in the prevention of HBV infection. It suggested for the continuous implementation of HIV prevention strategies. Specifically, it should conduct needs assessment, identify the current situation of low-income groups, fame, and unmarried groups to make

appropriate adjustments in developing communication content, messages and methods to prevent HBV infection. In addition, it is also important to consider factors related to health finance capacity, structure and capacity of the health system in providing disease prevention and treatment services. in ensuring the effectiveness of the intervention program. In addition, for areas where many ethnic groups living, it needs to consider the cultural issues, language, service accessibility and ability to pay for healthcare services. This issue should be considered in order to make appropriate adjustments to the interventions in the future.

CONCLUSION

5.1. Current situation of Hepatitis B virus infection among adults in 3 provinces of Kon Tum, Gia Lai, Dak Nong, 2018

The prevalence of HBV infection in the Central Highlands region is 11.1% and there is not much difference among provinces (Dak Nong: 11.8%; Kon Tum: 11.7%; Gia Lai: 10.1%). 12.5% of pregnant women were infected with HBV.

5.2. Factors related to Hepatitis B virus infection among adults in 3 provinces of Kon Tum, Gia Lai, Dak Nong, 2018

Logsitrc regression results showed that male have higher rates of HBV infection than female (OR=1.31, 95%CI=1.05-1.70). Farmers have higher rates of HBV infection than other occupational groups (OR=1.46; 95%CI=1.03-2.06). People having relatives without liver diseases have lower rate of HBV infection than people having relatives with liver diseases (OR=0.47, 95%CI=0.32-0.70). People undergone dialysis for kidney disease have higher rates of HBV infection than those who have not had this procedure (OR=3.80; 95%CI=1.10-13.24). The unvaccinated group has lower rates of HBV infection than the vaccinated group (OR=2.17; 95%CI=1.59-2.86). People with good knowledge and behaviors on HBV prevention have lower rates of HBV infection than the group with inadequate knowledge (OR=0.71; 95%CI=0.52-0.97) and bad behaviors (OR=0.31; 95%CI=0.19-0.5).

5.3. Effectiveness of behaviors change communication on Hepatitis B virus infection prevention in the community

The interventions in the research focused on communication to improve community's knowledge and behavior in preventing HBV infection. These interventions also complied the requirements and criteria in the communication strategy on hepatitis prevention of the Ministry of Health.

Communication interventions have improved knowledge on HBV in the intervention group from 10.9% (before the intervention) to 63.2% (after the intervention). The change in knowledge between before and after the intervention

between the intervention group and the control group (DID) was at 51.4%. Communication interventions have also improved the behaviors of HBV iprevention in the intervention group from 2.7% (before the intervention) to 30.5% (after the intervention). The level of change in behaviors between before and after the intervention between the intervention group and the control group (DID) was at 27.3%.

RECOMMENDATIONS

- Strengthening interventions to prevent HBV infection for all 3 provinces in the Central Highlands including Kon Tum, Gia Lai, and Dak Nong. In which, priority is given to target groups such as male, farmers, family member with liver diseases, and dialysis patients for kidney disease.
- Communication intervetnions should focus on:
    - Tramission routes and how to prenvent HBV infection.
    - Practical guidance on prevention of HBV infection for the community.
    - Priority for HBV testing during pregnancy for appropriate treatment
    - Complying with HBV vaccination procedure for children, especially the dose within 24 hours after birth.
- Strengthen cooperation with authorities, mass organizations and social organizations to improve the effectiveness of communication interventions.
- Follow-up studies can focus on improving the services accessibility and utilization as well as calculating the cost-effectiveness of interventions.

LIST OF PUBSLISHED PAPERS RELATED TO THE THEIS

1. Pham Ngoc Thanh, Nguyen Thi Thi Tho, Tran Dac Phu, Tran Dai Quang, Nguyen Thi Thuy Duong, Vien Chinh Chien, Phan Trong Lan (2020), "Prevalence and factors associated with chronic Hepatitis B infection among adults in the Central Highland, Vietnam", *AIMS Medical Science*. 7(4): p.337-346.

2. Pham Ngoc Thanh, Nguyen Thi Thi Tho, Tran Dac Phu, Tran Dai Quang, Nguyen Thi Thuy Duong, Phan Trong Lan (2020), "Effectiveness of communication for improving knowledge and behavior preventing Hepatitis B infection in the community in Kon Tum City, Kon Tum province 2019", *Journal of Preventive Medicine*. 30(10), p. 26-34.