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ORIGINAL ARTICLE

Predictors and Association of Hepatitis C Virus Infections Among People Who Injects Drug in Negeri Sembilan

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ABSTRACT

Introduction: Hepatitis C virus (HCV) infection is known as contributing to high morbidity and mortality globally. Major liver complications such as liver failure and liver cancer which can lead to fatality have been associated with persistent HCV infection. Globally, it is estimated that 5.6 million chronically infected HCV are among people who inject drugs (PWID). Malaysia has estimated that 59% HCV infections were among PWID. The aim of this study is to determine the prevalence of HCV infection and its predictors among PWID in Negeri Sembilan. **Methods:** A cross-sectional study based on random proportion to size sampling was conducted among 212 out of 1414 registered Methadone Maintenance Therapy (MMT) clients with PWID attending health clinics in Negeri Sembilan from February 2018 to July 2018. Data were collected using questionnaires administered through face-to-face interviews. Data were analyzed using Statistical Package of IBM SPSS Statistics Version 23 and p-value of <0.05 is considered significant. Independent T test and Chi-square test(χ^2) were used to determine the associations between the variables, and multiple logistic regressions for the predictors. **Results:** Majority of the respondents were infected with HCV infection (89%). HCV infection were associated with their age(p<0.001), low education level(p=0.022), HIV infection(p=0.001), and higher frequency(p=0.001) with longer duration(p=0.026) of drug injections and needle sharing(p=0.001). The predictors of HCV were older age [AOR 1.07, 95% CI(1.032, 1.110)] and higher frequency of injections[AOR 5.98, 95% CI(3.110,11.476)]. **Conclusion:** HCV infection is prevalent among PWIDs. Hence, effective and efficient preventive measures should be targeted to the identified predictors.

Keywords: Hepatitis C Virus, PWID, Prevalence, Predictors

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INTRODUCTION

Hepatitis C Virus (HCV) is an RNA virus derived from the Flaviviridae family (1). HCV can present as acute or chronic infections. In acute HCV infection, it is commonly asymptomatic, and infrequently associated with lethal outcomes (2). World Health Organization (WHO) stated that approximately 15% to 45% of HCV infection, without medical intervention, will be undergoing spontaneously clearance of HCV in a period of 6 months after the first infection. Meanwhile, about 60% to 80% of HCV infection will progress into chronic HCV infections whereby, the risk of developing Hepatocellular Carcinoma (HC) is 15% to 30% in a period of 20 years (3). It is known that the transmission of HCV is through blood borne and based on many studies, among PWIDs, the main transmission is through blood (4), while others are related to occupational hazards such as needle stick injury in medical field, sexually transmission and vertical transmission (5, 6, 7).

Hepatitis C virus (HCV) infection is a global major leading cause of morbidity and mortality among PWID. Globally, it was estimated that 71 million PWIDs were infected with HCV in which 5.6 million were chronically infected (3, 8). According to Larney et al., (2015), PWID are those who have injected an illicit drug at least once in their lifetime. East and Southeast Asia and Eastern Europe contributed to the highest prevalence of HCV seropositive among PWID at 26% and 23% respectively (9). Moreover, there are still high numbers of PWID population in Latin America at 14% and Canada and the United States at 17% (10). HCV infection continues to increase and leading to higher morbidity and mortality among PWID. According to Malaysia's Health Facts between 2012 and 2016, there was an increased trend in both incidence rate and mortality rate of HCV infections from 5.91 per 100,000 population to 8.35 per 100,000 population and 0.11 per 100,000 population to 0.13 per 100,000 population respectively (11). Similarly, a study done by Raihan in 2016 stated that in Malaysia, approximately 2.5% of the adult population are infected with HCV of which 59% (95% CI: 50-68%) were infected

via injection practices. Thus, intensive prevention and control of HCV infection targeting PWID are needed to reduce further burden of HCV infection (12).

According to the National Anti-Drug Agency (NADA), PWID are still high in developing countries, including Malaysia whereby the cumulative numbers of existing PWID are constantly higher by years (13). There were 18, 217 drug users registered and arrested in the period between 1988 and 2015 in Negeri Sembilan (13). Although there a comprehensive harm reduction program, the number of HCV infections among PWID continues to increase. In Negeri Sembilan, based on unpublished reports from Negeri Sembilan Weekly Epidemiology Review (NSWER), from 2016 to 2017, there are increased number of HCV infection from 227 cases (incidence of 26.7%) up to 365 cases (incidence of 35%) in 2017. Meanwhile, mortality due to HCV infections among PWID was 23.8% in 2016 and 22.2% in 2017 (14). There are many challenges related to PWID such as social vulnerabilities including low socioeconomic status, low education level, tendency to commit crimes, issues of discrimination and stigmatization hence their poor access to healthcare services (15, 16).

This study is aimed to determine the prevalence of HCV infection and its predictors among people who inject drugs in Negeri Sembilan. It hypothesizes that there are significant associations between HCV infection with sociodemographic factors, socioeconomic, high risk behavior and coinfections among PWID. A reliable local prevalence data and knowledge of its predictors are useful to ensure more appropriate preventive measures to reduce both mortality and mortality of HCV infection among PWID in studied area.

MATERIALS AND METHODS

Study Design and Samples

This study was conducted in Negeri Sembilan; a state located at southern region Malaysia. Based on the Department of Statistic Malaysia (DOSM), in 2015, the populations of Negeri Sembilan were 1.1 million. In Negeri Sembilan, there were 4 out of 7 hospitals and 32 out of 50 health clinics under the administration of Negeri Sembilan State Health Department (NSSHD) are providing MMT services in view of high numbers of PWID in those area, adequate health facilities to deliver the services such as skilled and trained medical personnel, availability of methadone dispensaries during the treatment given. A cross sectional study was conducted, which involved MMT clients who were PWID and aged above 18 years old in selected government health facilities within Negeri Sembilan.

The sample size (n) in this study was calculated by using the two proportions formula (Lwanga and Lemeshow, 1990) making the final sample size of 212. The sampling frame of this study was taken from a list of cumulative numbers of registered MMT with PWID clients in health facilities for the whole 7 districts under the administration of Negeri Sembilan State Health Department. The individual number was assigned to each active MMT with PWID client in the study population based on the proportion of 212 (sample size) out of 1414 of the potential respondents (study population). The study samples were selected randomly using the SPSS program proportionate to each district.

The list of independent variables in this study were as below:

i. *Sociodemographic factors:* Age, Gender, Ethnicity, Marital status, Education level

ii. *Socioeconomic factors:* Employment, Household income

iii. *High Risk Behaviors:* Needle sharing, age of onset injecting drug, duration of injecting drug, frequency of injections, imprisonment, sexuality, sexual intercourse with sex worker

iv. *Coinfections:* Human Immunodeficiency Virus (HIV) & Hepatitis B Virus (HBV)

The dependent variable was *HCV infection* among PWID who were active clients registered in MMT program under administration of Negeri Sembilan State Health Department.

Study Measures

The study instrument was using both Performa and a validated questionnaire with face to face interview using Malay and English languages. Four sections in the questionnaire were consist of section 1 (sociodemographic characteristics of the respondents), 2 (socioeconomic characteristics of the respondents), 3 (high risk behaviors), and 4 (HCV, HBV and HIV coinfections). In section 1 and 2 the respondents were asked for their age, gender either 'male' or female', ethnicity given several options including 'Malay' or 'Chinese' or 'Indian' or 'others', marital status either 'yes' or 'no' and their highest level of education based on 'no formal education' or 'primary education' or ' secondary education' or 'tertiary education'. Meanwhile, in section 2, the respondents were asked for their current employment status either 'yes' or 'no' and household income in an open-ended column.

Moreover, in section 3, the respondents were asked about their high-risk behavior which includes the respondents needle sharing, age of onset for injecting drug, duration of injecting drug, frequency of injecting drug, imprisoned and attempted sexual intercourse with sex workers. *Needle sharing* were asked for their history of needle sharing while injecting drugs among other PWID either ' yes' or 'no', for *Age of onset for injecting drug* the respondents were asked for their history related to the duration on injecting drug in open ended column, *Frequency of injecting drug* the respondents were asked regarding their history of last injections either 'more than once a day' or 'once a day'. *Imprisoned* were measured

by asking the respondents for history of incarceration due to drug abuse either 'yes' or 'no' and the history having *sexual intercourse with any sex worker* was either 'yes' or 'no'. The Cohen's kappa value in section 3 was (0.717, α<0.001).

Besides, in section 4, all HCV, HBV and HIV result were retrieved based on a confirmatory laboratory result that were available in the clients' manual medical records. *HCV positive* means the respondents' positive PCR for HCV RNA result regardless acute or chronic HCV infection either 'yes' or 'no'. For HBV positive means the respondents' co-infections with positive HBsAg/anti-HBc result regardless acute or chronic HCV infection either 'yes' or 'no'. Finally, for HIV positive means the respondents' co infections with positive anti-HIV1/HIV2 result regardless acute or chronic HCV infection. All three-blood screening were taken based on MMT client for baseline assessment prior to the program entrance.

The instruments were further assessed by two expert physicians from the Public Health. The experts had assessed and gave feedbacks regarding the contents of the questionnaire. All the comments and the recommendations were taken into consideration. The back to back translations was constructed for the questionnaire by linguistic experts in English and Malay language. The pre-testing of the questionnaire was conducted among 23 MMT with PWID clients who came to health facilities in Negeri Sembilan. All the comments were taken for any necessary correction. Participants who were involved in the pre-testing were excluded from the study. The test-retest reliability was measured by Cohen's Kappa with the value at >0.7.

Statistical Analysis

Data analysis utilized the IBM *Statistical Analysis of Social Sciences System* (SPSS) version 23.0. The descriptive analysis performed used percentage and frequencies in all variables studied. The chi square test is used to look for association in the categorical variable of both independent and the dependent variable. This study was using a significance level of 0.05 with confidence interval 95%. Thus, with the p value < 0.05, Null Hypothesis was rejected. Besides that, the multiple logistic regressions were run for the predictors of HCV infection on PWID.

A multiple logistic regression was used to determine the predictors of HCV infection among PWID in Negeri Sembilan. This analysis used three method which were" ENTER" method, "Forward LR" method, and "Backward LR" method to analyze the predictors. In this study, the "Backward LR" method produced the maximum significant variables which were two variables out of ten variables in the preliminary models.

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Ministry of Health's (MOH) Medical Research and Ethic Committee (MREC)(NMRR-18-271-39853) and Ethic Committee for Research Involving Human Subjects Universiti Putra Malaysia or Jawatankuasa Etika Universiti untuk Penyelidikan Melibatkan Manusia (JKEUPM). All the eligible respondents were given the written consent prior to the completion of the study.

RESULTS

A total of 212 face-to-face interview using questionnaire were conducted with eligible respondents based on inclusion and exclusion criteria. There were 212 respondents who completed the questionnaire thus; the response rate was 100%. The normality testing was conducted to the continuous data such as the respondent age, age of onset for injections and duration on injections. In this study, the respondent age showed normal distribution according to visual evidence of histogram and significant value of Kolmogorov-Smirnov was 0.200 and Shapiro-Wilk was 0.249 (P>0.05).

The Prevalence of HCV, HBV and HIV among PWID in Negeri Sembilan

Table I shows the prevalence of HCV, HBV and HIV infections of the respondents. Among 212 respondents, 89.0% of respondents were HCV positive, 27.9% were HBV positive and 7.1% HIV positive. All (100%) respondents have undergone infectious disease blood screening routine for HCV, HBV and HIV, with majority (91.5%) aware of their own infectious status. Unfortunately, only 10.4% had undergone treatment for HCV, HBV and/or HIV.

Table I: The Prevalence of HCV, HBV and HIV among PWID in Negeri Sembilan (n=212)

Characteristics	n	(%)
Hepatitis C Virus		
No	82	(38.7)
Yes	130	(89.0)
Hepatitis B Virus		
No	261	(72.1)
Yes	101	(27.9)
HIV		
No	197	(92.7)
Yes	15	
Ever been screened		(7.1)
Yes	212	(100)
Ever known infectious status		
No	18	(8.5)
Yes	194	(91.5)
Ever had any treatment (HCV/HIV/HBV)		
No	190	(89.6)
Yes	22	(10.4)

Association between Sociodemographic/ Socioeconomic Characteristic and HCV Infection

There was significant difference between HCV infection and age. Older PWID (Mean=44.38, SD= 8.586) was at higher risk to developed HCV infection as compared to younger PWID (Mean=39.41, SD=9.319), t (210) =-3.964, p<0.001. Moreover, this study also found that HCV infection and lower education level was significantly associated (χ^2= 5.221, df = 1, p= 0.022). HCV infection was higher among those who have lower educational level (85.0%) than those who have higher educational level (58.9%). However, marital status, ethnicity, employment status and household income were not associated with HCV infection. Table II shows the association between sociodemographic/ socioeconomic and HCV infection.

Table II: Association between sociodemographic and socioeconomic characteristics and HCV infection (N=212)

Variables	Present of HCV Infections n = 130(%)	Absent off HCV Infections n = 82 (%)	t / X^2	df	P-value
Age group					
Mean ± SD	44.38 ± 8.586	39.41 ± 9.319	-3.964	210	<0.001*
Marital status					
Unmarried	58(59.8)	39 (40.2)	0.176	1	0.777
Married	72 (62.6)	43 (37.4)			
Education					
Lower Education	17(85.0)	3(15.0)	5.221	1	0.022*
Higher Education	113(58.9)	79 (41.1)			
Ethnicity					
Non-Malay	15(71.4)	6 (28.6)	1.004	1	0.316
Malay	115(60.2)	76 (39.8)			
Employment					
Unemployed	18(78.3)	5 (21.7)	3.121	1	0.077
Employed	112(59.3)	77 (40.7)			
Household Income					
Lower Income	39(69.6)	17(30.4)	2.222	1	0.136
Higher Income	91(58.3)	65(41.7)			

* Significant at P < 0.05

Association between High Risk Behavior Characteristics and HCV Infections

There were significant association between duration of injections and HCV infections (χ^2= 9.261, df = 3, p= 0.026). Those who have been injecting drugs longer than 10 years are more likely to develop HCV infection as compared to those injecting shorter than 10 years duration. Moreover, the frequency of injection and HCV infections is also significantly associated (χ^2= 32.204, df = 1, p= 0.001). Besides, there was also significant association between needle sharing behavior and HCV infection (χ^2= 35.115, df = 1, p= 0.001). Table III shows the association between high risk behavior characteristics and HCV infection.

Table III: Association between High Risk Behavior Characteristics and HCV Infections (N=212)

Variables	Present of HCV Infections	Absent of HCV Infections	Test Statistics		
	n = 130 (%)	n = 82 (%)	*X^2*	*df*	*P-value*
Age First injection					
<25 yrs.	93(60.8)	60(39.2)	0.067	1	0.798
≥25yrs	37(62.7)	22(37.3)			
Duration of injections in years					
≤2yr	12(48.0)	13(52.0)	9.261	3	0.026*
3-5yrs	13(41.9)	18(58.1)			
6-10yrs	24(22.7)	13(35.1)			
>10 yrs.	81(73.0)	38(46.0)			
Frequency of injections					
More than once a day	106(74.6)	36 (25.4)	32.204	1	0.001*
Once a day	24(34.4)	46 (65.7)			
Ever shared needle					
No	68 (47.6)	75 (52.4)	35.115	1	0.001*
Yes	62 (89.9)	7 (10.1)			
Ever had sex with sex workers					
No	116(62.24)	70 (37.6)	0.698	1	0.403
Yes	14(53.8)	12 (46.2)			
Ever Imprisoned					
No	17(48.6)	18 (51.1)	2.873	1	0.09
Yes	113(63.8)	64 (36.2)			

* Significant at P < 0.05

Association between HBV, HIV and HCV Coinfections among PWID (N=212)

There were significant association between HIV coinfections with HCV among PWID in Negeri Sembilan (X2= 10.182, df = 1, p= 0.001) but not to HBV (χ^2= 0.753, df = 1, p= 0.651). In this study, all HIV infected PWID were also infected with HCV infections. Table IV shows the association between HBV, HIV and HCV coinfections among the respondents.

Table IV: Association between HBV/HIV and HCV coinfections

Variables	Present of HCV Infections n = 130(%)	Absent off HCV Infections n = 82 (%)	Test Statistics		
			X^2	df	P-value
Hepatitis B Virus					
No	126(60.9)	81(39.1)	0.753	1	0.651
Yes	4(80.0)	1(20.0)			
HIV					
No	115(58.4)	82 (41.6)	10.182	1	0.001*
Yes	15(100)	0(0)			

* Significant at P < 0.05

The Predictors of HCV Infection

The reference group for frequency of injections was at once a day. The full model containing all predictors was statistically significant at (χ^2= 46.785, df = 2, p=<0.001) which indicating that the model was able to distinguish between the significant associated factors with HCV among PWID. This model also fit the sample as shown by Hosmer and Lemeshow goodness of fit test (χ^2= 13.833, df = 8, p=0.086). The predictors in the

model explained 26.9% of the total variance in HCV infection among PWID attending health facilities in Negeri Sembilan (Nagelkerke R2= 0.269). The model is correctly classified about 74.1%. In this study, a year increase in age increase odds of HCV by 1.07 times, while controlling for frequency (AOR=1.0, 95% CI 1.032-1.110). Furthermore, respondents who were frequently injecting more than once a day are 5.975 times more likely infected with HCV in contrast with those who were injecting once a day (AOR= 5.975 95% CI 3.110-11.476) (Table V).

Table V. Predictors of HCV Infection among PWID

Variable	β	SE	Wald	P - value	Adjusted Odds Ratio	(95% CI)	
						Upper	Lower
Age	0.068	0.019	13.256	<0.001*	1.070	1.032	1.110
Frequency of injections							
More than once a day	1.788	0.333	28.809	<0.001*	5.975	3.110	11.476
Constant	-3.519	0.843	17.413	0.000	0.030		

*Significant at P <0.05

The final predictive model derived from the multiple logistic regression analysis is shown below:

Log (probability HCV infection) = -3.519+ (0.068) (age) + (1.788) (frequency of injection more than once a day)

The log (probability of HCV infection is equal to -3.519 (constant) in addition of 0.068 low risk by increasing age and 1.788 more likely contracting HCV infection if the frequency injecting is more than once daily among those PWID.

DISCUSSION

Prevalence of HCV, HBV and HIV among PWID

People who injects drug (PWID) remains as a major worldwide health challenge as they contribute to the blood borne transmission of infections such as HIV and HCV (3). It was estimated that 23% out of 1.7 million incidence of HCV globally in 2015 were related to drug injecting practices among PWID (3, 17-18, 19). This study found that the prevalence of HCV infection was 89.0% among the respondents. Meanwhile, prevalence of HBV and HIV infection were 27.9% and 7.1% respectively. These findings are similar with a study done in China where 71.1% of PWID were infected with HCV (20). It shows that HCV infections are at higher prevalence among PWIDs which may be due to unsafe injecting practices which has been known to be the main route of transmission of HCV (20, 21). Moreover, PWID distributions are still high in most developing countries including Malaysia whereby the cumulative numbers of existing PWID are constantly higher by years (13). A few studies have also identified that PWID are facing a lot of social vulnerabilities such as low socioeconomic status, low education, prone to commit crimes, and issues of discrimination and stigmatization resulting in poor access to healthcare services (15, 16).

Association between Age and HCV infection

Age is a known associated factor for HCV infection. In this study, there was significantly higher HCV infection in the older respondents (Mean=44.38, SD= 8.586) compared to the younger respondents (Mean=39.41, SD=9.319), t (210) = -3.964, p<0.001). These findings are similar to studies done in China whereby HCV infections is higher in the older age group of between 50 and 59 years (25.85% of 2685) and lower in younger age group of between 0 and 9 years (0.93 % of 2685) (22). Another study done in Iran also reported higher HCV prevalence among people over 30 years old with a peak at 50 to 59 years old (3.8%) (23). Age is likely related to the natural history of the disease. A person will only seek medical attention after having signs and symptoms which are associated with chronicity of the disease. Furthermore, immunity factors deteriorate with increasing age.

Association between Education and HCV Infection

HCV infections vary depending on the level of education of the PWID. In this study, education and HCV infection was significantly associated (p = 0.022). Among 20 respondents with lower education, 85.0% were HCV positive. Similarly, a cross-sectional study done in Yemen revealed that PWID with lower educational level was significantly associated with HCV infection (p <0.001) (24). It may be that those with lower education may have poorer health-related decision making which is crucial to ensure good compliance to medications and follow-up (25). For example, in lower educated PWID, they might face difficulty to understand the purpose of having safe injecting practices thus making them more susceptible to the blood-borne infections.

Association between Duration of Injection in HCV Infection

The duration of injection was also significantly associated with HCV infections (p=0.01). This study findings are similar to a study conducted in New York that revealed that those who injected longer were at higher risk of being HCV seropositive whereby 80.4% of samples had been given their first injection by others (26). Research has shown that the longer duration of injecting leads to a greater risk of contracting HCV. According to McFall et al., 2017, in North West India, PWID with longer duration of injecting drugs are 70% more likely to have HCV infections (AOR per 10 years = 1.70, 95% CI = 1.25-2.27) (4). The finding is also supported by a study done in China where they reported that those with longer duration of injecting drugs were 2.22 times more likely to be infected by HCV (AOR per 15 years = 2.22, 95% CI = 1.99 to 3.46) (27). Prolonged use of unsterile and contaminated needles and syringes will expose them to HCV infection and other related comorbidities.

Association between Frequency of Drug Injection and HCV Infection

In this study, there was significant association between

frequency of injection and HCV infection. Among106 respondents with frequency of drug injection of more than once a day, a total 74.6% were HCV positive which is higher than those who inject less (i.e. around 34.4%). This finding is similar to a study done by Eckhardt et al 2017, where they concluded that the more frequent a person is injecting themselves, the more likely they are practising unsafe injections such as frequent usage of HCV contaminated needles or equipment shared by another person that may be HCV seropositive (26).

Association between Needle Sharing and HCV Infection
There was a significant association between needle sharing and HCV infection. Among 212 respondents with needle sharing, a total of 88.9 % were HCV positive, which is higher than those who were not (47.6%). This study was similar to a study done by McFall et al in 2017, where they stated that the likelihood to get HCV infections among those who share needles was 2.46 times more than those who does not (AOR = 2.46, CI = 1.29-4.56) [4]. Similarly, in China, a study reported that the likelihood of having HCV infection among needle sharing PWID were 4 times more as compared those who does not (AOR 1.30, 95%CI 1.11 to 1.52) (27). This may be due to more exposure to contaminated needles, poor hygiene, unsafe repeated practices while sharing needles and equipment for self-inject.

Despite the availability of comprehensive harm reduction program in Malaysia which includes the Needle Syringe Exchange Program (NSEP) which is a program that provides free sterile needle syringes in exchange of the contaminated ones, the coverage is still low among the PWIDs. Other programs include the MMT program which is a program that uses opiate replacement by replacing heroin injection to oral methadone. Some studies have reported that the primary challenge to the NSEP implementation was police discrimination towards the PWID as they were labeled as criminals and not patients who have rights of access to health services (28, 29). In these studies, it is reported that PWIDs were often harassed and arrested by the police due to the fact that it is technically against the law to possess needles containing traces of illegal drugs (28, 29). Malaysia faces similar challenges, even though the NSEP has been a national agenda since the past decade. Majority of the clients have poor access to the harm reduction program due to lack of awareness on the NSEP among the police. A local study reported that implementers have misinterpretations of the NSEP as they feel that the authorities are encouraging the PWIDs to continue injecting drugs by offering free sterile syringe and needles (29). Consequently, this has led to continued discrimination and stigmatization of the clients while managing them.

Association between HIV and HCV Coinfections
Several studies have reported that HIV infection was prevalent among PWIDs with HCV infection and mortality among the HIV-infected person was higher among those coinfected with HCV (30, 31). A study by Kakchapati et al. in 2017 stated that the PWIDs infected with HIV were significantly associated with HCV coinfections (p<0.001) (31). Similarly, this study identified that all 15 HIV-infected respondents were significantly associated with HCV coinfection (p=0.001). This may be due to the fact that both HCV and HIV share similar risk factors such as injecting drugs and sexual risk-taking behaviors (i.e. multiple partners and promiscuity). Therefore, preventive measures and treatment should be targeted to both HCV and HIV (32).

Age Encounter HCV Infection as The Predictors
In this study, a year increase in age increases the odds of HCV infection by 1.07 times, while controlling for frequency (AOR=1.0, 95% CI=1.032-1.110). Thus, increasing age among PWID increases their likelihood of HCV infections. Similarly, a study done in Brazil concluded that with increase in age, the likelihood of becoming infected increases by 0.02% for each year of life (AOR = 1.02; 95% CI=1.01–1.04 (33). Another study in Afghanistan identified similar results whereby with a year of drug injecting, the risk of contracting HCV infection is at 4.72 higher (AOR= 4.72) (34). This is probably due to the fact that older respondents were likely to have injected drugs for a longer period of time and therefore had more opportunities to become infected. Thus, if left uncontrolled, this may lead to prolonging of the duration of injections, exposing them to higher risk of developing HCV as well as higher morbidity and mortality among the PWIDs, especially due to liver complications. A previous study has identified that age is a predictor for the progression of liver fibrosis among HCV infected person whereby the study estimated that after 20 years of infection, 91% of them developed liver fibrosis without cirrhosis (95% CI=90-92%) (35).

Frequency of Injections as the Predictor of HCV Infection
The other predictor on HCV infections in this study is the frequency of injections. The findings indicated that the respondents with more frequency in injecting drug were at six times more likely to be infected with HCV compared to those with less frequency of injections (AOR 5.975, 95%CI= 3.110-11.476). These finding is supported by a study done in China which found that injecting more than 4 times daily increases the odds of HCV infection by 1.36 times as compared to those injecting less than 4 times per day (AOR 1.36, 95% CI = 1.16 to 1.60) (27). Thus, people who frequently inject themselves have a higher risk of contracting HCV. This may be due to more exposure to contaminated needles, poor hygiene, and unsafe repeated practices while self-injecting.

From the findings, the associations and predictors of HCV infection among PWID were age, low education level, HIV infection, and high-risk behaviors related to drug injection including higher injection frequency, needle

sharing and longer duration of injecting drugs. The preventive measures should be targeted to the identified predictors and associations. It is recommended that the preventive measures be strengthened by enhancing health education among the younger generation on the harmful health impacts of taking illicit drugs so that they can make better decisions. PWIDs should be given appropriate health promotion materials that are easy to comprehend on the HCV risk factors, complications, impact of HCV and HIV co-infections, safe practices of injecting such as needle sharing and prolonged injecting practices. They should be informed that registering themselves in the MMT program and reducing their frequency of injection may lower their risk of contracting HCV infections.

For future research, the knowledge gained in this study can be utilized to enhance primary care-based HCV prevention programs. These programs may focus on individual behavioral change which are systematically introduced to minimize their high-risk behavior. For example, through development of a theory-based HCV intervention program among younger PWIDs and focusing on strengthening the harm reduction program to prevent further drug injections through opiate substitution therapy. The other recommendation is that this study can be expanded to a bigger scale to produce results which could represent the whole population.

This study provides baseline information regarding the status and factors associated with HCV infection among PWID in Negeri Sembilan as this is the first study on HCV infection and its associated factors among PWID. The data presented in this study would be useful for future studies, especially for the purpose of making comparisons. Additionally, the tool used in this study to measure the factors associated with HCV among PWID can be utilized in future studies as it has been validated and shown to be reliable. However, this is a cross-sectional study which can only study the relationship and associations between independent variables and dependent variable. The temporal relationship between the causative factors and dependent variables cannot be determined as this study only looked at one point in time. Furthermore, this study cannot represent the entire population of PWIDs in Negeri Sembilan as only selected clinics were chosen during data acquisition.

CONCLUSION

The predictors of HCV infection are older age [AOR 1.07, 95% CI (1.032, 1.110), p<0.001] and higher frequency of injections [AOR 5.98, 95% CI (3.110, 11.476), p<0.001]. In this study, PWIDs with higher age are more likely to have higher risk exposure to HCC. This may be due to the prolonged and repetitive behaviour of self-injecting, apart from being less educated, resulting in the lack of understanding on the safe way of self-inject. Furthermore, they may be less aware of the available health resources in terms of harm reduction which leads to delay in treatment, despite the existence of various prevention and control measures for HCV.

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