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Seroprevalence, Knowledge, Attitude and Practice Regarding Prevention of Hepatitis C among Municipal Waste Collectors in Penang Island, Malaysia

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ABSTRACT

Introduction: This study aimed to determine the prevalence of Hepatitis C infection and the level of knowledge, attitude and practice regarding Hepatitis C prevention among municipal waste collectors in Penang Island, Malaysia. **Methods:** A cross-sectional study was conducted among a convenient sample of 184 adult male municipal waste collectors in Penang Island from January to May 2018. Respondents' blood samples were obtained and evaluated for antibodies to Hepatitis C virus (anti-HCV), and questionnaires administered to them to collect information on sociodemographic variables and knowledge, attitude and practice regarding Hepatitis C prevention. The seroprevalence of Hepatitis C virus was estimated, and the association between sociodemographic variables and respondents' level of knowledge, attitude and practice regarding Hepatitis C prevention was explored using a range of parametric and non-parametric statistical tests in SPSS version 23. Results were considered significant at $p<0.05$. **Results:** The seroprevalence of Hepatitis C infection among our study sample was 0%. Majority had good attitude (60.9%) and good practice (70.1%) but poor knowledge (72.8%) of Hepatitis C. Respondents' income was significantly predictive of knowledge ($p=0.033$) and attitude ($p=0.005$) regarding Hepatitis C prevention. There were no significant associations between sociodemographic factors and practice regarding Hepatitis C prevention. There was a significant positive correlation between respondents' knowledge and practice regarding Hepatitis C prevention ($r=0.169$, $p=0.022$). **Conclusions:** Knowledge of Hepatitis C prevention is significantly lacking among Municipal waste collectors in Penang Island, and their income appears to play a significant role in determining their level of knowledge and attitude regarding Hepatitis C prevention.

KEYWORDS: Hepatitis C, Prevalence, Knowledge, Attitude, Practice, Municipal waste collectors

INTRODUCTION

Hepatitis C virus (HCV) is a blood-borne virus that causes infection and inflammation of the liver. It causes both acute and chronic hepatitis, with significant variability in presentation, course and severity of the disease between individuals. It has an estimated global prevalence of 3%, with approximately 170 million people infected worldwide [1]. According to 2018 data from World Health Organization (WHO), an estimated 71 million people are afflicted with chronic Hepatitis C infection worldwide, and approximately 399,000 people die yearly from cirrhosis or liver cancer [2]. There are 6 known serotypes of HCV, and prevalence varies by region [3]. In Southeast Asian countries, prevalence of Hepatitis C is believed to range from 0.5% in Singapore to 10% in Myanmar [4]. Despite being a growing public health problem, country-specific data on Hepatitis C prevalence are lacking in Malaysia [5], and a recent prevalence estimate from multi-parameter evidence synthesis suggests that 2.5% of the adult population are anti-HCV positive, 59% of which is transmitted through injection [6].

HCV is mainly transmitted through injection drug use, unsafe injection practices, unsafe health care, and the transfusion of unscreened blood and blood products, although sexual and vertical transmission have also been less commonly reported. In Malaysia, the key driver of HCV infection appeared to be

injection drug use [7]. Higher incidence of HCV co-infection with Hepatitis B and Human Immunodeficiency Virus (HIV) infection has been reported among high risk groups including people who inject drugs, recipients of infected blood products, prisoners and persons who engage in unprotected sex [8].

Like medical waste handlers, municipal waste handlers are among those at significant risk of HCV infection, owing to their occupational exposure to biohazards [9]. The prevalence of Hepatitis C was 1.6% among recyclable waste collectors in Brazil [10], 8.3% among a community of mainly garbage collectors in Egypt [11], 8.5% among garbage scavengers in Pakistan [12], and 43.3% among municipal waste collectors in Egypt [13]. One major reason for the apparently higher prevalence of Hepatitis C infection among municipal waste handlers is limited public awareness, poor knowledge, attitude and practice (KAP) regarding Hepatitis C prevention, their personal risk perception towards the disease, cultural practices and beliefs, myths regarding the disease, as well as socio-economic determinants of disease transmission among the population.

Similar to the situation among the general public, there is dearth of research evidence on the prevalence of Hepatitis C infection among municipal workers in Malaysia. The awareness on Hepatitis C was reported to be generally low in Malaysia [6] and little or no previous studies have been conducted to estimate the level of knowledge, attitude and practice regarding Hepatitis prevention among municipal waste handlers anywhere in Malaysia [14]. This paper describes the prevalence of Hepatitis C infection and the level of knowledge, attitude and practice regarding Hepatitis C prevention among municipal waste collectors in Penang Island, Malaysia.

METHODS

Study Location and Context

Penang is one the 14 states in Peninsular Malaysia. It is located in the North-western part of the country (Latitudes 5° 19' Longitudes 100° 19') and divided into two parts – Penang Island and Seberang Perai, separated by the Straits of Malacca. According to the official report by Department of Statistics Malaysia, it has an estimated cosmopolitan population of approximately 1.77 million, majority Bumiputeras (42%) and about 9% foreigners [15].

The waste management sector is a significant employer of foreign workers from neighbouring South and Southeast Asian countries with an estimated population of 221 working for 9 private waste management companies as at January 2018. These municipal waste collectors operate a 12-hour working shift pattern during which they are driven around in trucks to collect and process solid waste from every nook and cranny of the metropolis. In the course of their daily work routine (waste collection, segregation and disposal) they are often exposed to skin and blood infections from direct exposure to open wounds, sharp injuries, animal wastes (zoonotic infections) and other ergonomic issues.

Study design and population

This was an analytical cross-sectional study conducted among a convenient sample of 184 adult male municipal waste collectors in Penang Island from January to May 2018. We included waste collectors who had been working in Malaysia for at least 6 months and able to understand either Malay or English language. Those who did not turn up during data collection period and those unable to give their blood sample were excluded from the study. For the purposes of this study, our definition of waste collectors included employees of private enterprises contracted to collect and remove waste and recyclables from residential, commercial, industrial or other collection sites for further processing and disposal to sanitary landfills. They are trained and provided with necessary personal protective equipment (PPE) by the private firm that hired them. The findings presented in this paper is part of a larger survey which aimed to determine the knowledge, attitude and practices regarding prevention of Hepatitis B, Hepatitis C and Leptospirosis among municipal waste handlers in Penang Island.

Sample size estimation

We determined using formula for two proportions in Stata 13.0 that a sample of 140 will provide at least 90% power to detect a difference of 25% lower

prevalence of Hepatitis C among our population (compared to a previous study by El-Gilany et al., 2013 [13]), given type 1 error rate of 5%. We further adjusted for a 30% non-response rate and arrived at a final sample size of 184.

Data collection and analysis

Under strict aseptic procedures, two trained laboratory scientists obtained 5ml of venous blood from each respondent into EDTA bottles which were then transported to the laboratory (average transit time of 30 minutes) and the serum screened for presence of antibodies to Hepatitis C virus (anti-HCV) using Enzyme Immunoassay (EIA) technique following standard procedures. The presence of anti-HCV antibodies in the serum was considered indicative of current Hepatitis C infection.

Additionally, we designed and administered pre-tested structured questionnaires (majorly in Malay language) to respondents (i.e interviewer-administered) to collect information on their sociodemographic variables and knowledge, attitude and practice regarding Hepatitis C prevention. Being part of a larger study, the questionnaire was also used to collect similar information on KAP regarding Hepatitis B and leptospirosis prevention. The psychometric properties of the study instrument include a Cronbach's alpha of 0.8 and construct validity with each sub-scale inter-item correlation of $p<0.05$.

The questionnaire consisted of four sections. Section 1 consisted of 9 items on socio-demographic factors, duration of work as waste collector in Malaysia, and vaccination status. Section 2 comprised of 24 items that specifically assessed respondents' knowledge on Hepatitis C prevention (constructs included knowledge of the causative agent, modes of transmission, clinical manifestations, complications, general aspects of management eg vaccination, alcohol/diet restriction etc) with response options 'Yes' 'No' and 'Unsure'. We scored each correct response 1, and 0 for an incorrect or unsure response. We aggregated the knowledge score for each respondent and examined the overall distribution of the knowledge scores of our sample population. Based on the normality of the knowledge score distribution, we categorized respondents' knowledge into two levels – Good and Poor knowledge, using the mean knowledge score as a cut-off point.

Sections 3 and 4 comprised of 8 and 10 items that assessed respondents' attitude (with constructs such as personal risk perception and beliefs, disposition towards use of personal protective equipment and incident reporting) and practice (constructs included actual measures taken to prevent, manage and report potential exposures) regarding Hepatitis C prevention, respectively. Attitude regarding Hepatitis C prevention was graded on a 5-point Likert scale (Strongly Agree, Agree, Neither Agree nor Disagree, Disagree & Strongly Disagree) with scores ranging from 10 to 40. We assessed practice regarding Hepatitis C prevention with response options 'Yes' 'No' and 'Unsure' to each of the 10 items. We scored every correct response 1, and 0 for an incorrect or unsure response. As with knowledge scores, we aggregated and examined the distribution of respondents' attitude and practice scores and further classified them into Good and Poor Attitude and Practice categories using the respective mean scores as a cut-off point.

Data analysis was performed using SPSS version 23, and descriptive statistics were presented for all variables. We examined the association between socio-demographic variables and knowledge, attitude and practice regarding Hepatitis C prevention using a range of statistical tests including t-tests, one-way ANOVA, Chi-square and Fisher's exact test, as well as linear and logistic regression analyses. Based on the result of simple logistic regression analyses and principle of biological plausibility, we built three separate multivariate logistic regression models to explain the predictive association between the sociodemographic variables in this study and each of our outcomes (i.e knowledge, attitude and practice regarding Hepatitis C prevention). We presented Odds Ratio (OR) and 95% CI for each association. Statistical significance for all analyses was set at $p<0.05$.

Ethics approval and consent to participate

This research was conducted in accordance with the provisions of the Helsinki Declaration. Ethical approval was obtained from Penang Medical College Institutional Research and Ethics Committee (approval

number PMC RC-14) prior to study commencement. Written informed consent was obtained from all respondents.

RESULTS

Sociodemographic characteristics of participants

The response rate for this study was 83.3%. The sample comprised of 184 male respondents with a mean age of 35.37 (± 7.2 SD) years and slightly over half of them in the 30-39yrs age group. Majority were married (n=141, 76.6%), Bangladeshi nationals (n=138, 75%), and attained at least primary education (n=151, 82.1%). About half of the respondents had previous hepatitis vaccination (n=93, 50.5%) and had worked as a waste collector in Malaysia for less than 5 years (n=95, 51.6%). The mean income of the respondents was RM 1123.56 (± 210.7 SD) (Table 1).

Table 1 Sociodemographic characteristics of participants (N=184)

Variables	Frequency (n)	Percentage (%)
Age (years)	35.37 ± 7.2*	
<30yrs	39	21.2
30 – 39yrs	98	53.3
40 – 49yrs	45	24.5
>50yrs	2	1.0
Gender		
Male	184	100
Female	0	0
Marital status		
Single	43	23.4
Married	141	76.6
Nationality		
Bangladesh	138	75.0
Indonesia	38	20.7
Nepal	3	1.6
Others	5	2.7
Education Level		
Illiterate	21	11.4
Informal	12	6.5
Primary	78	42.4
Lower Secondary	23	12.5
Upper Secondary	46	25.0
Tertiary	4	2.2
Previous Hepatitis vaccination		
Yes	93	50.5
No	91	49.5
Duration of work as waste collector in Malaysia (years)	5.66 ± 4.2*	
<5yrs	95	51.6
5-10yrs	36	19.6
≥10yrs	53	28.8
Income (RM)	1123.56 ± 210.7*	

*Mean ± SD; RM = Ringgit Malaysia

Prevalence of Hepatitis C and level of respondents' knowledge, attitude and practice regarding Hepatitis C

The results highlighted in Table 2 revealed that the overall prevalence of Hepatitis C in our sample was 0%. The mean knowledge score on Hepatitis C was 4.67 (± 5.5 SD) while the mean attitude and practice scores were 32.95 (± 4.4 SD) and 6.85 (± 1.1 SD) respectively. Majority of the respondents had poor knowledge on Hepatitis C (n=134, 72.8%). Conversely, majority had good attitude (n=112, 60.9%) and good practice (n=129, 70.1%) (Table 2). We also found a weak, significant positive correlation between knowledge and practice scores (Pearson correlation coefficient = 0.169, p=0.022).

Table 2 Prevalence of Hepatitis C and level of respondents' knowledge, attitude and practice regarding Hepatitis C (N=184)

Variable	Frequency (n)	Percentage (%)
Prevalence of Hepatitis C		
Positive	0	0
Negative	184	100
Knowledge on Hepatitis C	4.67 ± 5.5*	
Good	50	27.2
Poor	134	72.8
Attitude regarding Hepatitis C	32.95 ± 4.4*	
Good	112	60.9
Poor	72	39.1
Practice regarding Hepatitis C	6.85 ± 1.1*	
Good	129	70.1
Poor	55	29.9

*Mean ± SD

Association between sociodemographic factors and knowledge, attitude and practice regarding Hepatitis C

In order to elicit the association between sociodemographic factors and respondents' KAP regarding Hepatitis C, both parametric (independent samples t-test, One-way ANOVA) and non-parametric tests (Chi-square test) were performed. We interpreted the Fisher's Exact Test results in situations where more than 20% of the cell distribution had an expected count of less than 5 during Chi-square analysis. The results presented in Table 3 showed that of all the sociodemographic variables considered in the analysis,

only nationality (p<0.05), education level (p=0.014), and duration of work as waste collector in Malaysia (p<0.05) were significantly associated with knowledge and attitude regarding Hepatitis C. Additionally, in a simple linear regression analysis, we found that income of respondents was significantly (p=0.006) associated with their attitude scores. None of the sociodemographic variables was significantly associated with practice regarding Hepatitis C (Table 3).

We further explored the nature of association between the sociodemographic variables and each of our outcomes (KAP) through separate simple binary logistic and multiple logistic regression models. Results presented in Table 4 showed that at univariate level, only duration of work as waste collector in Malaysia was significantly (p=0.026) associated with knowledge on Hepatitis C. We found that respondents who had worked for 5-10 years as waste collector in Malaysia had about 2.5 times higher odds of having good knowledge on Hepatitis C compared to those who had worked less than 5 years. None of the other sociodemographic variables showed significant univariate association with knowledge on Hepatitis C.

We explored a multivariate binary logistic regression model to predict the odds of having good knowledge on Hepatitis C given a combination of sociodemographic variables. Variable selection into the multivariate model was based on principle of fit, principle of parsimony and biological plausibility. We included all variables that showed a univariate association with knowledge on Hepatitis C at p<0.25 and explored the performance of the predictive model using the 'Enter', 'Backward LR', 'Forward LR' and 'Stepwise' methods. The result of the best predictive model – the Enter method – presented in Table 4, revealed that income was the only significant (p=0.033) predictor of knowledge on Hepatitis C in the model. We found that for every unit increase in income, the odds of having good knowledge on Hepatitis C increased by 0.2%. The model was statistically significant (p<0.001), predicted 75.5% of the outcome category correctly and explained 25.4% of the variance in the outcome variable (Nagelkerke R square = 0.254).

We obtained results similar to those described above for knowledge, when we tested the association between the sociodemographic variables and attitude regarding Hepatitis C, the difference being that income was the only predictor that showed a significant association with attitude regarding Hepatitis C at both univariate and multivariate levels. Additionally, as opposed to the direction of association between income and knowledge explained above, we found that for every unit increase in income of respondents, the odds of having good attitude significantly decreased by 99.8% (p=0.005). The model was statistically significant (p=0.007), predicted 64.7% of the outcome category correctly and explained 13.7% of the variance in the outcome variable (Nagelkerke R square = 0.137) (Table 5).

We found no statistically significant associations between any of the sociodemographic variables and practice regarding Hepatitis C at both univariate and multivariate levels.

Table 3 Association between sociodemographic factors and Knowledge, attitude and practice regarding Hepatitis C (N=184)

Variable	Knowledge				Attitude				Practice			
	Score	Good n(%)	Poor n(%)	P value	Score	Good n(%)	Poor n(%)	P value	Score	Good n(%)	Poor n(%)	P value
Age (years)												
<30yrs	5.38 ± 5.5	12 (24.5)	27 (20.3)	0.462[b]	33.38 ± 5.5	25 (22.5)	14 (19.2)	0.281[b]	7.10 ± 1.0	29 (22.3)	10 (18.5)	0.428[b]
30 – 39yrs	4.85 ± 6.2	30 (60.0)	68 (50.7)	0.229[c]	33.18 ± 4.1	61 (54.9)	37 (50.7)	0.343[c]	6.78 ± 1.1	68 (52.3)	30 (55.6)	0.871[c]
40 – 49yrs	3.73 ± 3.9	7 (14.3)	38 (28.6)		31.89 ± 4.1	23 (20.7)	22 (30.1)		6.80 ± 0.9	32 (24.6)	13 (24.1)	
>50yrs	4.50 ± 0.7	1 (2.0)	1 (0.8)		35.50 ± 2.1	2 (1.8)	0 (0)		7.00 ± 1.4	1 (0.8)	1 (1.9)	
Marital status												
Single	5.42 ± 6.0	13 (26.0)	30 (22.4)	0.309[a]	33.23 ± 4.8	27 (24.1)	16 (22.2)	0.635[a]	6.95 ± 0.9	30 (23.3)	13 (23.6)	0.452[a]
Married	4.45 ± 5.3	37 (74.0)	104 (77.6)	0.607[c]	32.87 ± 4.3	85 (75.9)	56 (77.8)	0.767[c]	6.82 ± 1.1	99 (76.7)	42 (76.4)	0.955[c]
Nationality												
Bangladesh	3.78 ± 4.5	27 (54.0)	111 (82.8)	0.029[b]*	32.64 ± 4.3	80 (71.4)	58 (80.6)	0.338[b]	6.74 ± 0.9	96 (74.4)	42 (76.4)	0.175[b]

Indonesia	8.24 ± 7.4	21 (42.0)	17 (12.7)	<0.001[c]*	33.92 ± 5.1	27 (24.1)	11 (15.3)	0.535[c]	7.21 ± 1.2	27 (20.9)	11 (20.0)	0.963[c]
Nepal	1.33 ± 2.3	0 (0)	3 (2.2)		35.33 ± 3.5	2 (1.8)	1 (1.4)		6.00 ± 1.7	2 (1.6)	1 (1.8)	
Others	4.40 ± 1.1	2 (4.0)	3 (2.2)		32.80 ± 3.0	3 (2.7)	2 (2.8)		7.60 ± 1.1	4 (3.1)	1 (1.8)	
Education level												
Illiterate	4.57 ± 5.6	4 (8.0)	17 (12.7)	0.144[b]	31.43 ± 5.2	11 (9.8)	10 (13.9)	0.014[b]	6.57 ± 1.1	13 (10.1)	8 (14.5)	0.357[b]
Informal	2.08 ± 1.6	1 (2.0)	11 (8.2)	0.284[c]	31.92 ± 2.7	5 (4.5)	7 (9.7)	0.116[c]	6.58 ± 0.5	7 (5.4)	5 (9.1)	0.486[c]
Primary	4.17 ± 4.9	20 (40.0)	58 (43.3)		33.15 ± 4.5	48 (42.9)	30 (41.7)		6.78 ± 0.9	52 (40.3)	26 (47.3)	
Lower secondary	4.57 ± 5.9	6 (12.0)	17 (12.7)		31.04 ± 5.0	11 (9.8)	12 (16.7)		7.17 ± 1.3	17 (13.2)	6 (10.9)	
Upper secondary	6.41 ± 6.4	17 (34.0)	29 (21.6)		34.59 ± 3.5	35 (31.3)	11 (15.3)		6.98 ± 1.2	37 (28.7)	9 (16.4)	
Tertiary	3.50 ± 2.9	2 (4.0)	2 (1.5)		32.25 ± 3.1	2 (1.8)	2 (2.8)		7.00 ± 0.8	3 (2.3)	1 (1.8)	
Previous Hepatitis C vaccination												
Yes	4.14 ± 4.8	24 (48.0)	69 (51.5)	0.183[a]	32.89 ± 4.6	59 (52.7)	34 (47.2)	0.857[a]	6.92 ± 0.9	67 (51.9)	26 (47.3)	0.316[a]
No	5.22 ± 6.1	26 (52.0)	65 (48.5)	0.673[c]	33.01 ± 4.2	53 (47.3)	38 (52.8)	0.470[c]	6.77 ± 1.2	62 (48.1)	29 (52.7)	0.562[c]
Duration of work as waste collector in Malaysia												
<5yrs	3.98 ± 4.4	23 (46.0)	72 (53.7)	0.030[b]*	33.09 ± 4.2	56 (50.0)	39 (54.2)	0.243[b]	6.92 ± 0.9	69 (53.5)	26 (47.3)	0.665[b]
5 – 10yrs	7.69 ± 7.9	16 (32.0)	20 (14.9)	0.031[c]*	33.72 ± 4.8	24 (21.4)	12 (16.7)	0.719[c]	6.78 ± 0.9	22 (17.1)	14 (25.5)	0.418[c]
>10yrs	3.88 ± 4.6	11 (22.0)	42 (31.3)		32.17 ± 4.5	32 (28.6)	21 (29.2)		6.77 ± 1.3	38 (29.5)	15 (27.3)	
Income	1123.56 ± 210.7			0.155[d]	1123.56 ± 210.7			0.006[d]*	1123.56 ± 210.7			0.671[d]

[a]P-value obtained from student t-test for independent samples
[b]P-value obtained from One-way ANOVA
[c]P-value obtained from Chi-square test or Fisher's Exact Test
[d]P-value obtained from Simple Linear Regression
*Significant at P<0.05

Table 4 Results of binary logistic regression analysis showing association between sociodemographic factors and Knowledge on Hepatitis C

Variable	Simple Logistic Regression		Multiple Logistic Regression		
	Crude OR	P value	Adjusted OR	95% CI for OR	P value
Age (years)					
<30yrs	0.444	0.444	0.193	0.015 – 2.476	0.206
30 – 39yrs	0.433	0.433	0.201	0.017 – 2.412	0.206
40 – 49yrs	0.184	0.118	0.084	0.006 – 1.140	0.063
>50yrs	Reference				
Marital status					
Single	1.218	0.607	0.715	0.247 – 2.072	0.537
Married	Reference				
Nationality					
Bangladesh	0.365	0.282	0.575	0.057 – 5.813	0.639
Indonesia	1.853	0.525	4.346	0.363 – 52.036	0.246
Nepal	0.001	0.999	0.001	-	0.999
Others	Reference				
Education level					
Primary and below	Reference				
Secondary and above	1.792	0.082	1.178	0.510 – 2.718	0.701
Previous Hepatitis C vaccination					
Yes	0.870	0.673	0.458	0.203 – 1.034	0.060
No	Reference				
Duration of work as waste collector in Malaysia					
<5yrs	Reference				
5 – 10yrs	2.504	0.026*	1.976	0.774 – 5.045	0.154
>10yrs	0.820	0.632	0.974	0.375 – 2.533	0.958
Income	1.001	0.250	1.002	1.000 – 1.004	0.033*

*Significant at P<0.05
Multivariate Model fitness (Hosmer Lemeshow Test): χ^2 (df=8) = 3.940, p=0.863
Multivariate Model performance:
Significance (p value) = p<0.001
Nagelkerke R square = 0.254
Percentage of outcome predicted correctly = 75.5%

Table 5 Results of binary logistic regression analysis showing association between sociodemographic factors and Attitude regarding Hepatitis C

Variable	Simple Logistic Regression		Multiple Logistic Regression		
	Crude OR	P value	Adjusted OR	95% CI for OR	P value
Age (years)					
<30yrs	0.001	0.999	0.001	-	0.999
30 – 39yrs	0.001	0.999	0.001	-	0.999
40 – 49yrs	0.001	0.999	0.001	-	0.999
>50yrs	Reference				
Marital status					
Single	1.112	0.768	0.736	0.272 – 1.997	0.548
Married	Reference				
Nationality					
Bangladesh	0.920	0.928	2.533	0.208 – 30.848	0.466
Indonesia	1.636	0.615	2.983	0.218 – 40.818	0.413
Nepal	1.333	0.851	3.740	0.117 – 119.269	0.455
Others	Reference				
Education level					
Primary and below	Reference				
Secondary and above	1.410	0.272	1.804	0.844 – 3.855	0.128
Previous Hepatitis C vaccination					
Yes	1.244	0.470	0.979	0.503 – 1.907	0.951
No	Reference				
Duration of work as waste collector in Malaysia					
<5yrs	Reference				
5 – 10yrs	1.393	0.420	1.320	0.543 – 3.208	0.540
>10yrs	1.061	0.865	1.156	0.525 – 2.542	0.719
Income	0.998	0.003*	0.998	0.996 – 0.999	0.005*

*Significant at P<0.05
Multivariate Model fitness (Hosmer Lemeshow Test): χ^2 (df=8) = 5.194, p=0.737
Multivariate Model performance:
Significance (p value) = p=0.007
Nagelkerke R square = 0.137
Percentage of outcome predicted correctly = 64.7%

DISCUSSION

Summary of main findings

The seroprevalence of Hepatitis C infection among our study sample was 0%. Majority had good attitude (60.9%) and good practice (70.1%) but poor knowledge (72.8%) of Hepatitis C. Of all the sociodemographic variables, only respondents' income was significantly predictive of knowledge and attitude regarding Hepatitis C prevention. There were no significant associations between sociodemographic factors and practice regarding Hepatitis C prevention. We also found a significant correlation between respondents' knowledge and practice regarding Hepatitis C prevention.

Comparison with existing literature

Prevalence of Hepatitis C infection

Surprisingly, we found that none of our respondents tested positive for antibodies to HCV (anti-HCV), despite significant occupational risk of Hepatitis infection among them as established in previous literature [14], [16-18]. The differences in prevalence of Hepatitis C between our study and earlier studies conducted in other parts of the world [10-13] is

probably due to improved waste management practices (segregation, treatment and disposal) currently being implemented and enforced among residents and waste workers in Penang Island since 2016 [19]. In particular, waste segregation at source has been shown to reduce the risk of injuries and infections from sharps and other materials contaminated with human blood and blood products, and consequently reduce the transmission of Hepatitis among waste workers [16]. Perhaps, the results of these combined efforts and the enforcement of use of Personal Protective Equipment (PPE) such as gloves, masks and safety boots among waste collectors in Penang Island is beginning to yield positive results. Further, the overall prevalence of hepatitis C among Bangladeshi population - where majority (75%) of our respondents were from, has been previously reported to be as low as 0.2% [20] in the general population, 1% among medical waste handlers [21], and as high as 24.8% among injecting drug users (IDUs) [22].

Knowledge, attitude and practice regarding Hepatitis C prevention

Our findings revealed overall poor knowledge regarding Hepatitis C prevention among the respondents. Aside the background of general low awareness of Hepatitis C among the general population of Malaysia [6], this finding is consistent with previous reports among municipal solid waste handlers in Kathmandu, Nepal [23], and scavengers in Thailand [24]. In Malaysia, previous KAP studies on Hepatitis C among university students showed similar pattern [25]. The main gap in knowledge among our respondents was in the recognition of Hepatitis C symptoms, modes of transmission and management (treatment options, vaccination, care & support).

Our respondents displayed reasonably good attitude and even better practices regarding Hepatitis C prevention. This is also consistent with previous reports among municipal solid waste handlers in Kathmandu, Nepal [23], and among university students in Malaysia [25]. It is likely that the enforcement of improved waste management practices and mandatory use of PPEs by waste collectors in Penang Island (as demonstrated by 98% of respondents in this study) has contributed significantly to this. Additionally, the City Council of Penang Island has been partnering with stakeholders to improve awareness on proper waste management practices among the population.

Municipal waste workers are generally an understudied population in Malaysia, with particular regards to their occupational health and safety as well as their knowledge, attitude and practice regarding prevention of occupational injuries and infections. Most previous studies were focused on medical waste handlers, healthcare workers and patients within hospital settings, or among university/college students [25, 26].

While knowledge of symptoms and modes of transmission are very germane to prevention, knowledge of severity, monitoring and treatment options are believed to be essential for appropriate self-care, adherence to follow up, early recognition of red flag signs and seeking timely treatment [27, 28]. It is therefore unsurprising that we found a positive correlation between respondents' knowledge and practice regarding Hepatitis prevention, similar to what has been documented in previous literature [25].

Factors associated with knowledge, attitude and practice regarding Hepatitis C prevention

We found in this study that respondents' income was the only sociodemographic factor that was significantly predictive of their knowledge and attitude regarding Hepatitis C prevention. This is consistent with findings of a previous study in Malaysia which reported significantly higher awareness of Hepatitis among people with higher income and education status [29]. Given that majority of respondents in our study earned a monthly income ranging from RM1000 – 2000, the exact pathway through which the observed marginal differences in income leads to variations in their knowledge and attitude regarding Hepatitis C prevention remains unclear and is therefore an area requiring further in-depth exploratory research.

In contrast to other studies [23] [25] [30], the current study failed to find an association between factors such as gender, age, race, education level, work experience and other lifestyle factors with respondents' knowledge, attitude and practice regarding Hepatitis C prevention. This is probably because of relative homogeneity of our study sample with regards to gender, and minimal variability with

respect to nationality, age and marital status of the respondents in the current study.

Strengths and Limitations

To the best of our knowledge, this is the first Malaysian study to report prevalence of Hepatitis C infection and the level of knowledge, attitude and practice regarding Hepatitis C prevention among municipal waste collectors in Penang Island. Our findings provide an important reference point upon which future research and interventions could be premised.

We note that the relatively small sample size of this study might have limited the potential to expose significant relationships between the variables. Additionally, we used a convenient sampling method which may limit the external validity and generalizability of our findings. To this extent, the findings of this study should be interpreted with caution.

CONCLUSION

The seroprevalence of Hepatitis C among our study population was 0%. Our findings revealed an overall poor knowledge of Hepatitis C among municipal waste collectors in Penang Island, although they displayed reasonably good attitude and even better practices regarding Hepatitis C prevention. Their income appears to play a significant role in determining their level of knowledge and attitude regarding Hepatitis C prevention, although the exact pathway underlying this association requires further in-depth exploratory analysis. Whereas almost all of the respondents used PPE for their routine work, the identified knowledge gaps were predominantly in recognition of Hepatitis C symptoms, modes of transmission and management (treatment options, vaccination, care & support). These findings underscore the need for targeted awareness creation as well as education and training of the waste workers in Penang Island on occupational health and safety, with specific focus on prevention of occupational injuries and infections. Further, our findings suggest that improved waste management practices and enforcement of occupational health standards by local councils can demonstrably reduce the prevalence of Hepatitis C infection.

Conflict of Interest

Authors declare none.

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REFERENCES

1. Zawawi MM. Management of Hepatitis C [Internet]. Malaysian Society of Gastroenterology and Hepatology. p.1-3 Available at http://www.msgh.org.my/resources/managementhepatitisc.htm Accessed on 24 September 2018.
2. World Health Organization. Hepatitis C: Key facts. July 2018. Available at http://www.who.int/news-room/fact-sheets/detail/hepatitis-c. Accessed on 24 September 2018.
3. Karoney MC, Siika AM. Hepatitis C virus (HCV) infection in Africa: a review. Pan Afr Med J. 2013;14:44. doi:10.11604/pamj.2013.14.44.2199
4. Doan TQ. Hepatitis C in Developing Countries in Southeast Asia. In: Hepatitis C in Developing Countries: Current and Future Challenges. Academic Press, London, UK. 2018. pp 97–104. doi:10.1016/b978-0-12-803233-6.00009-6
5. Raihan R, Mohamed R, Radzi Abu Hassan M, Md Said R. Chronic Viral Hepatitis in Malaysia: “Where are we now?” Euroasian J Hepatogastroenterol. 2017;7(1):65-67. doi:10.5005/jp-journals-10018-1214.
6. McDonald SA, Mohamed R, Dahlui M, Naning H. Kama-rulzaman A. Bridging the

data gaps in the epidemiology of hepatitis C virus infection in Malaysia using multi-parameter evidence synthesis. BMC Infect Dis. 2014 Nov;14:564.
7. Raihan R. Hepatitis in Malaysia: Past, Present, and Future. Euroasian J Hepatogastroenterol. 2016;6(1):52-55. doi:10.5005/jp-journals-10018-1167.
8. Anagaw B, Shiferaw Y, Anagaw B, Belyhun Y, Erku W, Biadgelegn F, Moges B, Alemu A, Moges F, Mulu A. Seroprevalence of hepatitis B and C viruses among medical waste handlers at Gondar town Health institutions, Northwest Ethiopia. BMC Res Notes. 2012;5(1):55.
9. Franka E, El-Zoka A, Hussein A, Elbakosh M, Arafa A, Ghenghesh K: Hepatitis B virus and hepatitis C virus in medical waste handlers in Tripoli, Libya. J Hospital Infect. 2009, 72: 258-261. 10.1016/j.jhin.2009.03.019.
10. Marinho TA, Lopes CL, Teles SA, Reis NR, Carneiro MA, Andrade AA, Martins RM. Prevalence of hepatitis C virus infection among recyclable waste collectors in Central-West Brazil. Mem Inst Oswaldo Cruz. 2013;108(4):519-22.
11. Nakhla IA, Sanders JW, Mohareb EW, Samy S, Cosby MT, Mostafa MM, Riddle MS, Frenck RW. A cross-sectional household cluster serosurvey of hepatitis C virus antibodies in an urban slum of Cairo, Egypt in 2004. Trop Dis Travel Med Vaccines. 2015;1(1):9.
12. Rauf MU, Saleem MD, Anwer MO, Ahmed G, Aziz S, Memon MA. HIV, hepatitis B and hepatitis C in garbage scavengers of Karachi. J Pak Med Assoc. 2013;63(6):798-802.
13. El-Gilany AH, Abou-ElWafa HS, El-Bestar SF, El-Sayed Zaki M. Prevalence of Hepatitis C Virus Antibodies among Municipal Solid Waste Collectors in Mansoura, Egypt. Occup Med Health Aff 2013;1:133. doi: 10.4172/2329-6879.1000133
14. Sekhon PS, Karthigesu IT. Awareness On Health And Safety Among Municipal Workers On Solid Waste Collections: A Case Study In Malaysia. Malaysian Journal of Public Health Medicine. 2017;(1):19-27.
15. Department of Statistics Malaysia, Official Portal: Pulau Pinang. Available at https://www.dosm.gov.my/v1/index.php?r=column/cone&menu_id=SEFobmo1N212cXc5TFlLVTVxWUFXZz09 Accessed 24 September 2018
16. Sawyerr HO, Yusuf RO, Adeolu AT. Risk Factors and Rates of Hepatitis B Virus Infection among Municipal Waste Management Workers and Scavengers in Ilorin, Kwara State, Nigeria. Journal of Health and Pollution. 2016;6(12):1-6.
17. Rachiotis G, Papagiannis D, Markas D, Thanasias E, Dounias G, Hadjichristodoulou C. Hepatitis B virus infection and waste collection: prevalence, risk factors, and infection pathway. Am J Ind Med 2012; 55: 650-5.
18. Akinbode F. Impacts of solid waste on health and the environment. Available from https://www.powershow.com/view/3b03be-MmNmO/IMPACT_OF_SOLID_WASTE_ON_HEALTH_AND_THE_ENVIRONMENT_powerpoint_ppt_presentation. Accessed 24 September 2018.
19. City Council of Penang Island. Guide to waste segregation and recycling in Penang [Internet]. Available from http://www.mbpp.gov.my/en/mbpp/media-centre/news/guide-waste-segregation-and-recycling-penang Accessed 25 September 2018
20. Ashraf H, Alam NH, Rothermundt C, Brooks A, Bardhan P, Hossain L, Salam MA, Hassan MS, Beglinger C, Gyr N. Prevalence and risk factors of hepatitis B and C virus infections in an impoverished urban community in Dhaka, Bangladesh. BMC Infect Dis. 2010;10(1):208.
21. Uddin MS, Islam MN, Khan ME, Yeasmin S, Ahmed F, Amiruzzaman M. Frequency of Hepatitis B and C Viral Infection among the Medical Waste Handlers. Bangladesh J Infect Dis. 2017;4(1):3-9.

22. Shirin T, Ahmed T, Iqbal A, Islam M, Islam MN: Prevalence and risk factors of hepatitis B virus, hepatitis C virus, and human immunodeficiency virus infections among drug addicts in Bangladesh. J Health Popul Nutr. 2000, 18: 145-50.
23. Marahatta SB, Katuwl D, Adhikari S, Rijal K. Knowledge on occupational health hazard and safety practices among the municipal solid waste handler. Journal of Manmohan Memorial Institute of Health Sciences. 2017;3(1):56-72.
24. Thirarattanasunthon P, Siriwong W, Robson M, Borjan M. Health risk reduction behaviors model for scavengers exposed to solid waste in municipal dump sites in Nakhon Ratchasima Province, Thailand. Risk Manag Healthc Policy. 2012;5:97.
25. Ahmad A, Munn Sann L, Abdul Rahman H. Factors associated with knowledge, attitude and practice related to hepatitis B and C among international students of Universiti Putra Malaysia. BMC Public Health. 2016;16:611. doi:10.1186/s12889-016-3188-5.
26. Mohamed R, Ng CJ, Tong WT, Abidin SZ, Wong LP, Low WY. Knowledge, attitudes and practices among people with chronic hepatitis B attending a hepatology clinic in Malaysia: A cross sectional study. BMC Public Health. 2012;12:601. doi:10.1186/1471-2458-12-601.
27. Bosan A, Qureshi H, Bile KM, Ahmad I, Hafiz R. A review of hepatitis viral infections in Pakistan. J Pak Med Assoc 2010; 60: 1045-58.
28. Zevin B. Managing chronic hepatitis C in primary-care settings: more than antiviral therapy. Public Health Rep. 2007;122(Suppl 2):78–82
29. Khairullah NS, Merican DI. Hepatitis disease management programs in Malaysia. J Gastroenterol Hepatol. 2004;19(Suppl):S13–16
30. Gebremedhin F, Debere MK, Kumie A, Tirfe ZM, Alamdo AG. Assessment of Knowledge, Attitude and Practices Among Solid Waste Collectors in Lideta Sub-city on Prevention of Occupational Health Hazards, Addis Ababa, Ethiopia. Science Journal of Public Health. 2016;4(1): 49-56. doi: 10.11648/j.sjph.20160401.17