HBV and HCV test uptake and correlates among men who have sex with men in China: A nationwide cross-sectional online survey

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ABSTRACT

Objectives:

Hepatitis B virus (HBV) and hepatitis C virus (HCV) cause substantial morbidity and mortality in low- and middle-income countries (LMICs), including China. WHO guidelines recommend men who have sex with men (MSM) receive HBV and HCV screening. The purpose of this study was to determine the proportion of MSM in China who have HBV and HCV tested and identify correlates of test uptake.

Methods:

We conducted an online cross-sectional survey of young MSM in China. Respondents were asked to report previous HBV and HCV testing, sociodemographic information, sexual risk factors for hepatitis infection, other STI testing, and primary care physician (PCP) status. Associations were analysed by logistic regression.

Results:

503 eligible MSM completed the survey. 41.0% (206/503) of MSM had HCV tested, and 38.2% (60/157) of MSM with no or uncertain HBV vaccination had HBV tested. In multivariate analysis, HCV testing was correlated with HBV testing (aOR 22.98, 12.11 - 43.60), HIV testing (aOR 3.64, 1.92 - 6.91), HIV-positive status (aOR 1.78, 1.07 – 2.98), and having a PCP (aOR 2.40, 1.44 - 3.98). Among MSM with no or uncertain HBV vaccination, HBV testing was correlated with HCV testing (aOR 80.85, 20.80 - 314.33), HIV testing (aOR 5.26, 1.81 - 15.28), HIV-positive status (aOR 3.00, 1.22 – 7.37), and having a PCP (aOR 2.69, 1.00 - 7.26).

Conclusions:

Our data suggest many young MSM in China have not received hepatitis testing. HCV testing rates were lower than those recently reported among MSM in Australia and the United States. The strong correlation between HBV and HCV testing suggests bundled testing interventions may be useful for MSM in China. Men with a PCP were more likely to have received hepatitis testing, consistent with literature demonstrating the importance of primary care in expanding access to testing.

Key words:

Hepatitis, Hepatitis B, Hepatitis C, Men Who Have Sex with Men, Risk Factors, China

Key messages:

• Rates of HBV and HCV testing are low among young MSM in China.

• MSM who have tested for HIV and syphilis, and those who have a PCP, are more likely to have HBV and HCV tested.

• Bundled HBV, HCV, and HIV testing interventions may be useful for previously untested MSM.

INTRODUCTION

Chronic viral hepatitis is a major contributor to morbidity and mortality. Globally 257 million and 71 million people live with hepatitis B virus (HBV) and hepatitis C virus (HCV), respectively.[1] Together HBV and HCV were responsible for more than 1.28 million deaths in 2015, greater than human immunodeficiency virus (HIV) and nearly equal to *Mycobacterium tuberculosis*.[2] The majority of infected individuals live in low- and middle-income countries (LMICs).[1] China is particularly impacted. As many as 120 million and 9 million people in China live with HBV and HCV, respectively, with chronic viral hepatitis accounting for the majority of the nation's liver-related deaths.[3, 4]

Testing is the key initial step in the chronic viral hepatitis care continuum. Prompt HBV and HCV testing allows for earlier diagnosis, linkage to care, and treatment initiation for those who are chronically infected. Receiving appropriate antiviral treatment can prevent or delay the development of liver disease among people living with HBV, and new direct acting agents (DAAs) can cure the large majority of those with HCV.[1] Moreover, HBV testing can identify those susceptible to future infection and facilitate linkage to HBV vaccination. Despite the importance of testing, rates of HBV and HCV test uptake are poorly documented. Existing literature suggests few receive appropriate hepatitis testing. Only an estimated 10% of people living with HBV and HCV in Europe have been diagnosed, and testing is less common in LMICs where as few as 5% of chronically infected persons may know their hepatitis status.[5, 6]

Men who have sex with men (MSM) may be at increased risk of HBV and HCV infection. HBV and HCV prevalence are higher among MSM than the general population in China.[7] Among

MSM, those reporting history of ulcerative sexually transmitted infection (STI), greater number of male sex partners, condomless receptive anal sex, and living with HIV are more likely to be HBV and HCV infected.[7-9] Because of increased risk of infection, WHO guidelines recommend all MSM be screened for both HBV and HCV.[5] Screening efforts targeting younger MSM allow infected persons to be diagnosed and linked to treatment earlier, thereby preventing or delaying the development of hepatitis-related liver disease. Few studies have investigated MSM hepatitis testing behaviours, particularly in LMICs. This study aims to address this gap by measuring the proportion of young MSM in China who have previously tested for HBV and HCV and identifying correlates of hepatitis testing.

METHODS

Design

We conducted a cross-sectional online survey among MSM in May 2017. Men were recruited by convenience sampling using the social media accounts of a popular gay dating app (Blued) and two large community-based organizations that serve MSM in China (Danlan Gongyi and Qingdao Tongzhi). Blued is the world's largest gay dating app with 40 million registered users as of February 2018, the majority of whom reside in China.[10] Danlan Gongyi and Qingdao Tongzhi provide health counselling, education, and outreach services to MSM and people living with HIV in China. An advertisement with a link to the online survey was promoted through each organization's WeChat account. WeChat is a multi-functional social media platform based in China with 902 million daily active users.[11] All participants read a consent form and selected 'agree' before beginning the survey. Eligible participants were born biologically male, were between 16 and 30 years old, and reported previous anal or oral sex with another man. The

survey was also used to collect information for a separate study of young MSM experiences with culturally-competent physicians; consequently, inclusion criteria also included having seen a physician in the past 24 months. We excluded individuals who resided outside China and did not provide informed consent. Recruitment was stopped after a pre-specified sample of 500 eligible MSM completed the survey.

Measures

All data were collected through Wenjuanxing, a Chinese-language online survey platform. Participants were required to provide a unique mobile phone number to identify duplicate entries and distribute incentives. No personal identifying information was collected. The survey instrument was field tested among 20 Chinese MSM and feedback was incorporated before beginning enrolment.

The primary outcomes of interest were previous HBV and HCV test uptake. Participants were asked to self-report whether they had ever tested for HCV or HBV. The survey instrument also asked about potential correlates of HBV and HCV test uptake. We collected sociodemographic information, including age, current residence, household registration, occupation, marital status, education, annual income, and sexual orientation. Province of residence was categorized into seven regions according to previous research on HBV and HCV prevalence.[7] Participants were asked to self-report HBV vaccination status, lifetime HIV and syphilis test uptake, syphilis test uptake in the past three months, and whether they had an established primary care physician (PCP). Sexual risk factors for viral hepatitis infection included self-reported HIV status, anal sex

position, condom use during last anal sex, previous syphilis diagnosis, and total number of male anal sex partners in the past three months.

Analysis

Descriptive statistical analysis was used to summarize HBV and HCV test uptake as well as sociodemographic information and potential correlates of testing behaviour. Associations between HBV and HCV test uptake and correlates were analysed using bivariate logistic regression, and results were reported as odds ratios (ORs) with corresponding 95% confidence intervals (CI). Correlates of HBV and HCV test uptake were further analysed through multivariate models that adjusted for four potential cofounders selected a priori: age, current residence, income, and level of education. Results were reported as adjusted ORs (aOR) with corresponding 95% CI. Both bivariate and multivariate analyses of HBV testing only included men who reported no or uncertain HBV vaccination status. All analyses were performed using SAS Version 9.4.

RESULTS

Overall, 503 eligible MSM completed the online survey. The mean age of participants was 23.9 years, and most lived in an urban area (85.9%) and self-identified as gay (83.5%). 45.3% (228/503) of men had some college education or an advanced professional degree, 34.4% (173/503) were currently students, and 79.5% (400/503) had a monthly income of $752 USD or less.

41.0% (206/503) and 64.2% (323/503) of MSM had previously HCV and HBV tested, respectively. 31.2% (157/503) reported no or uncertain HBV vaccination status, and 38.2% (60/157) of men with no or uncertain HBV vaccination had previously HBV tested.

Sociodemographic characteristics of participants and potential correlates of hepatitis testing, including HIV and syphilis test uptake, sexual risk factors for hepatitis infection, and PCP status, are summarized in Table 1.

	No. / Mean (n = 503)	**% / SD**
Sociodemographic characteristics		
Age		
Age (years)	23.9	3.5
Current residence		
Urban	432	85.9
Rural	71	14.1
Household registration		
Urban	289	57.5
Rural	214	42.5
Region		
East	174	34.6
Southcentral	142	28.2
North	75	14.9
Southwest	61	12.1
Northeast	31	6.2
Northwest	18	3.6
Other	2	0.4
Education level		
High school or lower	134	26.6
Technical school	141	28.0
College	208	41.4
Advanced professional degree	20	4.0
Occupation		
Student	173	34.4
Non-student	330	65.6
Monthly income (USD)		
≤$225	111	22.1
$225 - $452	116	23.1
$453 - $752	173	34.4
$753 - $1203	65	12.9
≥$1204	38	7.6
Sexual orientation		
Gay	420	83.5
Other (e.g., bisexual, heterosexual)	83	16.5

Hepatitis test uptake		
Previous HCV test	206	41.0
Previous HBV test (all)	323	64.2
Previous HBV test (no or uncertain HBV vaccination)[1]	60	38.2
Other STI test uptake		
Previous HIV test	431	85.7
Previous syphilis test	277	55.1
Syphilis test in past 3 months	166	33.0
Sexual risk factors for hepatitis infection		
HIV positive	73	14.5
Receptive anal sex position	202	42.6
No condom use during last anal sex[2]	117	24.7
Previous syphilis diagnosis	40	8.0
Number male anal sex partners in past 3 months	1.6	5.0
Healthcare provider characteristics		
Has an established PCP	74	14.7

1 Includes men reporting no or uncertain HBV vaccination status.
2 Includes men reporting previous anal sex and excludes men who exclusively engage in oral sex.

United States Dollar (USD), Hepatitis C Virus (HCV), Hepatitis B Virus, (HBV), Sexually Transmitted Infection (STI), Primary Care Provider (PCP), Standard Deviation (SD)

Table 1: Sociodemographic characteristics, hepatitis and STI test uptake, risk factors for hepatitis infection, and healthcare provider characteristics of young men who have sex with men in China participating in a nationwide online survey, 2017 (n = 503)

There was considerable overlap among men who had previously tested for HBV, HCV, and HIV. Among the 323 men who had HBV tested, 60.1% (194/323) and 91.6% (296/323) had also been tested for HCV and HIV, respectively. 94.2% (194/206) and 93.7% (193/206) of men who had HCV tested had also received HBV and HIV testing, respectively. Overall, 36.4% (183/503) of all MSM had tested for HBV, HCV, and HIV.

In multivariate analysis, HCV test uptake was positively associated with lifetime HBV testing (aOR 22.98, 95% CI 12.11 - 43.60), HIV testing (aOR 3.64, 95% CI 1.92 - 6.91), and syphilis

158 testing (aOR 4.25, 95% CI 2.86 - 6.33), as well as syphilis testing in the past three months (aOR
159 3.23, 95% CI 2.19 – 4.77). Men with an established PCP were more than twice as likely to have
160 HCV tested (aOR 2.40, 95% CI 1.44 - 3.98), as were men previously diagnosed with syphilis
161 (aOR 2.22, 95% CI 1.13 – 4.34). Men living with HIV were also more likely to have HCV tested
162 (aOR 1.78, 95% CI 1.07 – 2.98). Results of bivariate and multivariate analyses for HCV testing
163 uptake are summarized in Table 2.

	HCV test uptake unadjusted OR	**HCV test uptake 95% CI**	**HCV test uptake adjusted OR[1]**	**HCV test uptake 95% CI**
Sociodemographic characteristics				
Age				
Age (years)	1.00	0.95 - 1.05	0.97	0.92 - 1.03
Current residence				
Urban	1.43	0.84 - 2.42	1.29	0.75 - 2.22
Rural	Reference		Reference	
Household registration				
Urban	1.25	0.87 - 1.80	1.10	0.74 - 1.64
Rural	Reference		Reference	
Level of Education				
Technical school or below	Reference		Reference	
College or above	1.25	0.87 - 1.78	1.22	0.85 - 1.76
Occupation				
Student	Reference		Reference	
Nonstudent	1.07	0.74 - 1.56	1.06	0.63 - 1.81
Monthly Income (USD)				
≤$452	Reference		Reference	
>$452	1.35	0.94 - 1.93	1.46	0.97 - 2.20
Other test uptake				
Previous HBV test				
Yes	21.05*	11.25 - 39.39	22.98*	12.11 - 43.60
No	Reference		Reference	
Previous HIV test				
Yes	3.68*	1.96 - 6.91	3.64*	1.92 - 6.91
No	Reference		Reference	
Previous syphilis test				
Yes	4.19*	2.84 - 6.19	4.25*	2.86 - 6.33
No	Reference		Reference	
Syphilis test in past 3 months				
Yes	3.30*	2.24 - 4.86	3.23*	2.19 - 4.77
No	Reference		Reference	

Sexual risk factors for hepatitis infection				
HIV status				
Positive	1.59	0.97 - 2.61	1.78*	1.07 - 2.98
Negative or never tested	Reference		Reference	
Sex position				
No anal sex	1.17	0.53 - 2.59	1.09	0.49 - 2.44
Receptive anal sex	0.69	0.45 - 1.05	0.68	0.45 - 1.05
Versatile	0.54*	0.33 - 0.90	0.55*	0.33 - 0.92
Insertive anal sex	Reference		Reference	
Condom use during last anal sex[2]				
Yes	1.48	0.96 - 2.30	1.45	0.93 - 2.25
No	Reference		Reference	
Previous syphilis diagnosis				
Yes	2.07*	1.08 - 3.98	2.22*	1.13 - 4.34
No	Reference		Reference	
Number male anal sex partners				
Past 3 months	0.99	0.95 - 1.03	0.99	0.95 - 1.03
Healthcare provider characteristics				
Have an established PCP	2.42*	1.46 - 4.00	2.40*	1.44 - 3.98
No established PCP	Reference		Reference	

1 Multivariate logistic regression adjusts for age, income, education level, and current residence.
2 Includes men reporting previous anal sex and excludes men who exclusively engage in oral sex.

United States Dollar (USD), Hepatitis C Virus (HCV), Hepatitis B Virus, (HBV), Sexually Transmitted Infection (STI), Primary Care Provider (PCP)

* Indicates statistically significant result ($p < 0.05$)

Table 2: Bivariate and multivariate logistic regression of correlates of HCV test uptake among young men who have sex with men in China (n = 503).

Similar associations were found in multivariate analysis of HBV test uptake. Among men reporting no or uncertain HBV vaccination, HBV test uptake was positively correlated with lifetime HCV testing (aOR 80.85, 95% CI 20.80 - 314.33), HIV testing (aOR 5.26, 95% CI 1.81 - 15.28), and syphilis testing (aOR 3.57, 95% CI 1.78 - 7.17), as well as syphilis testing in the past 3 months (aOR 5.03, 95% CI 2.32 – 10.90). Men who had a PCP were also more likely to have HBV tested (aOR 2.69, 95% CI 1.00 - 7.26). HBV testing was more common among men living with HIV (aOR 3.00, 95% CI 1.22 – 7.37) and those previously diagnosed with syphilis

(aOR 4.82, 95% CI 1.50 – 15.51). Results of bivariate and multivariate analyses for HBV testing uptake are summarized in Table 3.

	HBV test uptake unadjusted OR	HBV test uptake 95% CI	HBV test uptake adjusted OR[1]	HBV test uptake 95% CI
Sociodemographic characteristics				
Age				
Age (years)	1.05	0.96 - 1.15	1.06	0.95 - 1.18
Current residence				
Urban	2.34	0.88 - 6.21	2.41	0.88 - 6.66
Rural	Reference		Reference	
Household registration				
Urban	1.92	0.99 - 3.70	1.67	0.82 - 3.38
Rural	Reference		Reference	
Level of Education				
Technical school or below	Reference		Reference	
College or above	1.76	0.90 - 3.46	1.62	0.81 - 3.25
Occupation				
Student	Reference		Reference	
Nonstudent	1.62	0.77 - 3.43	1.80	0.63 - 5.09
Monthly Income (USD)				
≤$452	Reference		Reference	
>$452	1.30	0.70 - 2.54	1.19	0.54 - 2.61
Other test uptake				
Previous HCV test				
Yes	46.50*	14.94 - 144.77	80.85*	20.80 - 314.33
No	Reference		Reference	
Previous HIV test				
Yes	4.92*	1.79 - 13.54	5.26*	1.81 - 15.28
No	Reference		Reference	
Previous syphilis test				
Yes	3.66*	1.85 - 7.23	3.57*	1.78 - 7.17
No	Reference		Reference	
Syphilis test in past 3 months				
Yes	4.40*	2.13 - 9.12	5.03*	2.32 - 10.90
No	Reference		Reference	
Sexual risk factors for hepatitis infection				
HIV status				
Positive	2.15	0.94 - 4.92	3.00*	1.22 - 7.37
Negative or never tested	Reference		Reference	
Sex position				
No anal sex	0.46	0.11 - 2.00	0.40	0.09 - 1.78
Receptive anal sex	0.86	0.39 - 1.87	0.89	0.39 - 2.03
Versatile	0.31*	0.13 - 0.76	0.27*	0.11 - 0.70

Insertive anal sex	Reference		Reference	
Condom use during last anal sex[2]				
Yes	1.78	0.84 - 3.79	1.75	0.80 - 3.83
No	Reference		Reference	
Previous syphilis diagnosis				
Yes	4.13*	1.36 - 12.56	4.82*	1.50 - 15.51
No	Reference		Reference	
Number male anal sex partners				
Past 3 months	0.77	0.57 - 1.06	0.76	0.53 - 1.07
Healthcare provider characteristics				
Have an established PCP	2.78*	1.06 - 7.27	2.69*	1.00 - 7.26
No established PCP	Reference		Reference	

1 Multivariate logistic regression adjusts for age, income, education level, and current residence.
2 Includes men reporting previous anal sex and excludes men who exclusively engage in oral sex.

United States Dollar (USD), Hepatitis C Virus (HCV), Hepatitis B Virus, (HBV), Sexually Transmitted Infection (STI), Primary Care Provider (PCP)

* Indicates statistically significant result ($p < 0.05$)

Table 3: Bivariate and multivariate logistic regression of correlates of HBV test uptake among young men who have sex with men in China who report no or uncertain HBV vaccination (n = 157).

DISCUSSION

The proportion of men who had tested for HBV and HCV was low in this nationwide cross-sectional online survey, and our data suggest young MSM in China do not frequently receive hepatitis testing. We also identified several correlates of increased HBV and HCV test uptake among MSM, including other hepatitis and HIV testing, having a PCP, and living with HIV. Previous studies investigating hepatitis testing among MSM were undertaken in high-income countries and only reported HCV test uptake.[12-14] Our findings extend the existing literature by reporting both HBV and HCV testing behaviours among MSM in a middle-income country with a high burden of hepatitis.

We found low HBV and HCV testing rates among MSM in China. Our observed rates of HCV testing were lower than those recently reported among MSM in Australia and the United States, where 68% and 48% of men had previously HCV tested, respectively.[13, 14] Female sex workers in a large Canadian city also had higher rates of HCV testing, with more than half of women reporting a recent HCV test.[15] HBV test uptake is less well documented than HCV. Despite literature supporting an increased risk of HBV among MSM, we were unable to find any published research on HBV test uptake in this population.[5, 7, 8] Studies of testing behaviours among populations at high risk of HBV infection in the United States suggest MSM in China may be somewhat more likely to have HBV tested than Chinese migrants living in high-income countries.[16, 17]

HBV and HCV test uptake were strongly correlated among MSM. Our results indicate most MSM who have HBV tested have also HCV tested, and vice versa. The significant overlap between HBV and HCV test uptake may suggest facilities or physicians in China are already providing linked hepatitis testing to MSM. Facility-based integrated hepatitis testing has been shown to substantially improve HBV and HCV screening in the United States.[18] Additionally, the WHO recommends integrating hepatitis and HIV testing to more effectively reach populations at risk of coinfection, including MSM.[5] Innovative models of combined hepatitis and HIV testing services have been demonstrated in both high- and low-income countries.[5] Bundling HCV, HBV, and HIV screening may increase testing rates in MSM.

MSM were more than twice as likely to have HBV and HCV tested if they had an established PCP. The potential for expanding access to disease testing services through primary care has

been previously documented, including for viral hepatitis.[19, 20] The trend between having a PCP and increased hepatitis testing may indicate some PCPs in China are already promoting hepatitis services to MSM patients. As China and other LMICs increase investment in primary healthcare delivery systems, PCPs may play a significant role in optimizing engagement and retention in the hepatitis care continuum. This includes not only increased access to testing but also linkage to treatment for those diagnosed with HBV or HCV and vaccination for those found to be HBV susceptible.

Several risk factors for hepatitis infection were not correlated with HBV or HCV test uptake in our analysis. Previous research has shown certain sex behaviours, including greater number of male sexual partners[21] and receptive anal intercourse,[8, 9] to be associated with increased risk of HBV and HCV infection. Despite increased risk, young MSM in China reporting these behaviours were not more likely to have received hepatitis testing. Our results suggest that MSM in China who engage in risker sex may not be effectively prioritized in current HBV and HCV screening efforts.

Finally, MSM in China living with HIV were nearly twice as likely to have HCV tested and three times as likely to have HBV tested than HIV-negative peers. MSM living with HIV in the U.S. and Australia also had higher rates of HCV testing compared to men without HIV.[12, 13] Despite the observed association between HIV status and hepatitis testing, the proportion of men living with HIV who had hepatitis tested was low. Only half (37/73) of respondents living with HIV had HCV tested. Living with HIV is a major risk factor for HCV infection and is associated with accelerated development of liver disease and increased mortality.[1] Effective linkage to

hepatitis testing and treatment is therefore critical for this segment of the MSM population, and further research is needed to identify interventions that improve hepatitis testing among MSM living with HIV.

There are a number of limitations to the current study. The primary outcomes of interest and associated correlates were self-reported. Participants may not correctly remember previous testing (recall bias) or may not have been informed of previous testing by providers (ascertainment bias), resulting in under-reporting of hepatitis test uptake. Additionally, enrolment was restricted to MSM aged 16 to 30, many of whom were born after the implementation of China's universal HBV vaccination program.[3] This may explain why few participating men reported no or uncertain HBV vaccination, and multivariate regression modelling of HBV test uptake was limited by the resulting small sample size. Older MSM in China are more likely to be HBV infected, and testing behaviours among this demographic should be investigated in future research.[3]

Despite international guidelines recommending all MSM be screened for HBV and HCV, rates of hepatitis testing among MSM are low globally, and our findings demonstrate hepatitis testing among MSM in China is particularly uncommon. The success of current global efforts to eradicate viral hepatitis depends on effective strategies to promote testing and linkage to treatment among groups at greatest risk of infection, including MSM. Our study advances the understanding of HBV and HCV testing among MSM in China. However, further investigation of hepatitis testing behaviours, especially in LMIC with a high burden of hepatitis, is essential to

253 better understand current barriers to testing and inform interventions to optimize engagement in
254 the chronic viral hepatitis care continuum.
255
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268
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270 We encourage interested parties to contact the corresponding author with data sharing requests,
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272
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274 Institutional Review Board (IRB) approval was obtained from the following institutions prior to
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Competing interests

The authors declare they have no financial or competing interests.

Author's contributions

TF and JDT conceived the study. TF, JDT, WT, JW, WG contributed to survey development. SWP and WT provided statistical expertise. JDT provided oversight. TF wrote the initial drafts of the paper and oversaw the editing process with input from JDT, SWP, and WT. All authors read and authorized the final manuscript before submission. Authors would like to acknowledge the following persons for their contributions to this research project and manuscript: Jason Ong, Cedric Bien, Zhenzhou Luo, Peipei Zhao, and Julia Watson.

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