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## Validity of the CAGE questionnaire for men who have sex with men (MSM) in China

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### Abstract

**Background**—Detection of heavy drinking among men who have sex with men (MSM) is crucial for both intervention and treatment. The CAGE questionnaire is a popular screening instrument for alcohol use problems. However, the validity of CAGE for Chinese MSM is unknown.

**Method**—Data were from three waves of cross-sectional assessments among general MSM (n=523) and men who sell sex to other men (“money boys” or MBs, n=486) in Shanghai, China. Specifically, participants were recruited using respondent-driven, community popular opinion leader, and venue-based sampling methods. The validity of the CAGE was examined for different cutoff scores and individual CAGE items using self-reported heavy drinking (≥ 14 drinks in the past week) as a criterion.

**Results**—In the full sample, 75 (7.4%) of participants were classified as heavy drinkers. 32 (6.1%) of general MSM and 43 (8.9%) of MBs were heavy drinkers. The area under curve statistics for overall sample was 0.7 (95% CI: 0.36–0.77). Overall, the sensitivities (ranging from 18.7 to 66.7%), specificities (ranging from 67.5 to 95.8%), and positive predictive values (ranging from 14.1 to 26.4%) for different cutoff scores were inadequate using past week heavy drinking as the criterion. The ability of CAGE to discriminate heavy drinkers from non-heavy drinkers was limited.

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#### Conflict of Interest

No conflict declared

#### Contributors

Drs. Wong and He designed the study and wrote the protocol. Mr. Zheng managed participant recruitment and the data used in the study. Dr. Nehl assisted with the design and completion of the statistical analysis. Ms. Chen and Mr. Ibragimov analyzed the data and participated in the writing of the manuscript. All the authors contributed to and approved the final manuscript.

**Conclusions**—Our findings showed the inadequate validity of CAGE as a screening instrument for current heavy drinking in Chinese MSM. Further research using a combination of validity criteria is needed to determine the applicability of CAGE for this population.

### Keywords

CAGE; MSM; China; Validity

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## 1. INTRODUCTION

Alcohol use among men who have sex with men (MSM) is a major health problem worldwide. Global evidence shows that gay and bisexual men face higher risks of alcohol dependence than their heterosexual counterparts do (King et al., 2008). Alcohol use has been found to be prevalent among MSM in various countries of the world, including the USA (Pollock et al., 2012; Salomon et al., 2009; Santos et al., 2015), India (Mimiaga et al., 2011; Yadav et al., 2014), Peru (Deiss et al., 2013), Russia (Wirtz et al., 2015), and Spain (Folch et al., 2009). Chinese MSM have also been found to be at higher risk for reporting frequent drinking, alcohol abuse and dependence as compared to general male population (Nehl et al., 2012; Yu et al., 2013).

Globally, high-risk drinking (e.g., heavy alcohol use and drinking before or during sex) among MSM has been shown to be associated with increased prevalence of risky sexual practices, including larger numbers of male sex partners (Greenwood et al., 2001), unprotected anal intercourse (UAI; Colfax et al., 2004; Folch et al., 2009; Hirshfield et al., 2004; Koblin et al., 2003), and inconsistent condom use with a male partner (Yadav, 2014). A study by Koblin et al. (2006) has also reported a positive association between problem drinking and positive HIV serostatus in MSM. Several studies among Chinese MSM found associations between various types of alcohol misuse and other risky practices and negative health outcomes. In particular, Lu et al. (2013) reported an association between problem drinking (i.e., heavy or hazardous drinking, alcohol abuse or dependence) and positive HIV serostatus and a larger number of male sex partners; Li et al. (2010) found that drinking four or more times a month is associated with a higher risk of syphilis seroconversion; Liao et al. (2014) found that MSM reporting drinking more than three times a week in the past six months are also more likely to report UAI and drug use.

Given the scale of alcohol abuse and dependence among the MSM population in China and its health impact, early detection of potential alcohol use disorder in community settings is important to aid intervention and treatment. CAGE is a 4-item instrument developed as a screening tool for serious alcohol misuse developed in 1968 (Ewing, 1984). Its brevity and simplicity have made it a popular screening tool that can be used by prevention and treatment service providers with no professional training in diagnosing alcohol use disorders. This instrument has been applied to a wide range of populations in various regions of the world (Aalto et al., 2009; Akvardar et al., 2004; Bühler et al., 2004; Bisson et al., 1999; Chan et al., 1994; Devos-Comby and Lange, 2008; Ewing, 1984; Malet et al., 2005; Mdege and Lang, 2011), including studies of MSM in the US and China (Ross et al., 2001; Seage et al., 1998; Wong et al., 2008; Woody et al., 1999). It has been used to screen

patients in clinics and primary care, to estimate population prevalence of severe alcohol misuse, and to measure alcohol abuse and dependence as a risk factor for other outcomes (Akvardar et al., 2004; Bobak et al., 2004; Campo-Arias et al., 2009; Cherpitel, 1998; Cherpitel et al., 2005; Deiss et al., 2013; Dhalla and Kopec, 2007; Etter and Gmel, 2011; Kerr-Corrêa et al., 2007; Kooptiwoot et al., 2010; Messiah et al., 2008; Park et al., 2008).

As with other survey and screening instruments, it is important to ensure that CAGE is adapted to a particular setting, population, and/or culture. Overall, CAGE has demonstrated a high level of sensitivity and specificity for detecting severe drinking problems in patients in clinical settings (for review see Dhalla and Kopec, 2007). However, since there is conflicting evidence for the validity of CAGE outside of clinical settings (Bisson et al., 1999; Chan et al., 1994; Cherpitel, 1998; Etter and Gmel, 2011; Messiah et al., 2008), application of this instrument in different populations and settings requires caution. First, ensuring that a translated instrument is linguistically and conceptually equivalent to the original version is a challenging process (for instance, see Guillemin et al., 1993; Wang et al., 2006). Second, cultural differences in perceptions and attitudes towards alcohol use and abstinence may limit the external validity of CAGE and other screening instruments (Bloomfield et al., 2002; Cherpitel, 1998). Finally, cultural specifics not related to the construct of interest (in our case, alcohol), such as social desirability, may also introduce measurement error (Van de Vijver and Poortinga, 1997). To date, only one study exploring the validity of a Mandarin Chinese version of CAGE has been published. The study was conducted among hospitalized patients in Taiwan; it found that in detecting hazardous drinking among males CAGE demonstrates lower sensitivity, specificity, and positive predictive value against the reference standard Schedule for Clinical Assessments in Neuropsychiatry as compared to other screening instruments (e.g., AUDIT; Wu et al., 2008b). To our knowledge, no studies have investigated the validity of CAGE among MSM in mainland China, nor have such studies been published for MSM in other countries. Therefore, the aim of this study was to assess the validity of a Chinese-translated version of the CAGE instrument using self-reported current heavy drinking as a criterion among MSM in China.

## 2. METHODS

### 2.1 Study sample and procedure

The data for the current study were collected from the Shanghai Men's Study, a series of three cross-sectional surveys examining prevalence of HIV and sexually transmitted infections and related sexual risk factors among MSM and money boys (men who sell sex to other men) in Shanghai, China. The study recruited 1,352 participants (721 MSM and 631 money boys) between August, 2008 and April, 2012 via respondent driven sampling (RDS), community popular opinion leaders (CPOLs), and venue-based sampling (VBS). RDS (Heckathorn, 1997, 2002) started with recruiting eight seeds – gay-identified and non-gay identified money boys and non-money boy MSM. Each seed recruited up to three peers, who then completed surveys and received three recruitment coupons to distribute to their peers. More details on this recruitment method can be found elsewhere (Huang et al., 2012). CPOLs recruitment involved selection of 40 community popular opinion leaders (CPOLs)

from money boy and non-money boy segments of MSM population, who were trained to recruit 10–15 money boys or general MSM from their respective networks. Detailed description of CPOL recruitment is available elsewhere (Nehl et al., 2015). VBS entailed recruiting participants via various Internet and smartphone applications (such as “QQ”, JACKD and GRINDR), as well as in bathhouses and bars frequented by MSM by posting fliers with a hotline number and arranging “hangout” time with potential participants at the permission of venue owners. The eligibility criteria for the Shanghai Men’s Study included: (1) at least 18 years old, (2) self-identified as a male, (3) being able to give verbal and written consent, and (4) having had sex with another man during the 12 months prior to the survey (oral, anal, or both).

All participants provided informed consents. A standard and rigorous translation and back-translation were carried out for all protocols, informed consent and other human subject forms, and questionnaires. Interviews were conducted by trained interviewers using a standardized pencil-and-paper questionnaire. The interviews lasted approximately 45 minutes. Each participant was compensated with US\$40 for completing the survey. All consents and human subject forms and procedures had been reviewed and approved by the Institutional Review Boards of Emory University and Fudan University in China.

## 2.2 Measures

**2.2.1 Socio-demographic characteristics**—Participants were asked to report socio-demographic characteristics, including *date of birth*, *Hu-Kuo or hometown*, (Shanghai vs. other), *sexual orientation* (openly gay/bisexual, closeted gay/ bisexual, heterosexual/other), being self-identified as *money boy* or not, *ethnicity* (Han vs. non-Han), *educational attainment* (illiterate/primary school, middle school, high school or equal, college or above), *marital status* (never married, current married/living together, divorced/widowed), and *monthly income* (0–2999, 3000–4999, 5000 Yuan; ~US\$1=6.3 Yuan).

**2.2.2 Alcohol use**—Based on previous literature, we chose self-reported alcohol use as the criterion of validity (Adams et al., 1996; Aithal et al., 1998; Bisson et al., 1999; King, 1986; Skogen et al., 2011). *Past week alcohol use* was assessed by summing responses to a series of questions about the amount of drinks in the week prior to the survey (“in the past week, how many drinks did you consume for each of the following type of alcoholic beverage?”). Alcoholic beverage types included beer, yellow wine or rice wine, Chinese white wine, Western white wine, red wine, and Western hard liquor. Participants were categorized into heavy drinkers if they drank 14 or more drinks in the past week (National Institute on Alcohol Abuse and Alcoholism, 2015).

**2.2.3 The CAGE questionnaire**—We used the Mandarin Chinese version of the standard 4-item CAGE translated from the original English version (Ewing, 1984). Participants were instructed to answer “yes (1)” or “no (0)” to the following four items: (1) “have you ever felt the need to cut down on your drinking?”, (2) “have you ever been annoyed by others criticizing your drinking?”, (3) “have you ever felt guilty about your drinking?”, and (4) “do you ever need an eye-opener in the morning?”. The items were summed with the score ranging from 0 to 4. A total CAGE score of 2 and higher is the

recommended cutoff for screening alcohol abuse and dependence, although some authors used a cutoff of 1 and higher (Dhalla and Kopec, 2007). Cronbach's alpha for the CAGE was 0.55.

### 2.3 Analysis

Participants were not eligible for analyses if they were not current drinkers (i.e., not drinking in the past 3 months prior to the survey,  $n = 313$ ). Furthermore, we excluded participants from the analyses if they skipped any CAGE item ( $n = 22$ ) or missed the past week alcohol use question ( $n = 9$ ), which comprised less than 3% of the sample. This resulted in a final sample of 1,009 participants. Descriptive statistics were used to examine the distribution of the socio-demographic characteristics, number of alcohol drinks in the past week, and the CAGE items and total scores. Standard measures of sensitivity, specificity, and positive predictive value (PPV) were calculated for the criterion of self-reported heavy drinking (i.e., 14 or more alcoholic drinks in the past week) for CAGE cutoff scores of 1 and higher, 2 and higher, and 3 and higher. We selected several cutoff scores to assist the interpretation and assessment of the CAGE based on previous evidence (Bisson et al., 1999). Receiver operating characteristic (ROC) analysis generated the area under curve (AUC) statistic to assess the capacity of CAGE to distinguish participants who self-reported heavy drinking in the past week from those who did not. To evaluate the performance of the CAGE at various cutoff points, the best combination of sensitivity and specificity was estimated calculating the product of sensitivity and specificity values (the higher, the better; Knight et al., 2003). Item-specific criterion validity was calculated for each of the four CAGE items to examine the validity indices of each single item. All analyses were stratified by money boys and general MSM.

## 3. RESULTS

### 3.1 Sample characteristics

Among the 1,009 participants, the mean age was 28.7 ( $SD = 8.8$ ), 78.4% reported Shanghai to be their hometown, 95.1% were of Han ethnicity, 9.1% were openly gay or bisexual, 69.1% had a high school education or less, 14.9% were married or cohabitating, 74.7% had a monthly income lower than 5000 Yuan (Table 1). A majority of the participants were non-heavy drinkers – 823 participants (81.6%) reported less than 7 drinks and 111 (11.0%) reported 7–13 drinks in the past week. A total of 75 participants (7.4%) met the criterion of heavy drinking (14 or more drinks in the past week).

Chi-square analyses indicated several demographic differences between money boys and general MSM. Money boys were younger ( $p < 0.001$ ), more likely to be migrants to Shanghai ( $p < 0.001$ ), less likely to have their sexual orientation closeted ( $p < 0.001$ ), more likely to have a lower level of educational attainment ( $p < 0.001$ ), not been married ( $p < 0.001$ ), and more likely to have a higher monthly income ( $p < 0.001$ ). The past week alcohol use was not significantly different between money boys and general MSM.

### 3.2 CAGE

Overall, 292 (28.9%) reported they had ever felt the need to cut down on their drinking, 123 (12.2%) had ever been annoyed by others' criticisms of their drinking, 115 (11.4%) had ever felt guilty because of their drinking, and 6 (0.6%) reported ever needing an eye-opener in the morning. Overall, 35.1% of the sample responded positively to at least one of the CAGE items and 12.7% to two or more of the items. A higher percentage of money boys responded positively to each of the CAGE items than general MSM; however, this difference was significant for the cut-down item only ( $p = 0.03$ ). There was no significant difference in the total CAGE scores between money boys and general MSM.

### 3.3 Criterion validity

Table 2 presents the sensitivity, specificity, and PPV statistics for the relevant cutoff scores and individual items of CAGE for the criterion of heavy drinking (i.e., reporting 14 or more drinks in the past week).

The AUC of CAGE was 0.70 (95% CI: 0.63–0.77), indicating a 70% probability that someone who drank heavily in the past week had a higher score on CAGE than someone without heavy drinking experience. The AUC for money boys and general MSM were 0.67 (95% CI: 0.58–0.76) and 0.73 (95% CI: 0.63–0.84), respectively.

Overall, the best combination of sensitivity and specificity (i.e., the highest product of sensitivity and specificity) (Knight et al., 2003) was detected for CAGE 1+ cutoff scores as compared to 2+ and 3+ cutoffs. For a cutoff score of 1 or more, the sensitivity, specificity, and the PPV were 66.7% (95% CI: 56.0%–77.3%), 67.5% (95% CI: 64.5%–70.5%), and 14.1% (95% CI: 10.5%–17.8%), respectively. For both money boys and general MSM, the optimal cutoff score for the heavy drinking criterion was also 1. In general, there was no significant difference in the sensitivities, specificities, and PPVs across different cutoff scores between money boys and general MSM.

Regarding the validity of each CAGE item, overall, the item *cut down* had the highest value of sensitivity (56.0%; 95% CI: 44.8%–67.2%) and the item *eye-opener* had the lowest (4.0%; 95% CI: 0.0%–8.4%); the item *eye-opener* had the highest value of PPV (50.0%; 95% CI: 10.0%–90.0%) and the item *cut down* had the lowest (14.4%; 95% CI: 10.4%–18.4%). In general, there was no significant difference in the sensitivities, specificities, and PPVs across CAGE items between money boys and general MSM (i.e., overlapped 95% confident intervals).

## 4. DISCUSSION

The present study investigated the validity of CAGE to screen for current heavy drinking among MSM in China. Validity measures of sensitivities, specificities, and PPVs were examined with respect to different cutoff scores and each individual item of CAGE. We found that CAGE did not demonstrate high sensitivity, specificity or PPV in detecting current heavy drinkers (+14 drinks in the week prior to the survey) among both money boys and general MSM in our sample. Regardless of a cutoff point chosen, CAGE failed to

discriminate between current heavy and non-heavy drinkers. No individual CAGE item performed well on any validity measure either.

Because of the low sensitivities, specificities, and PPVs, we were not able to come to a conclusion about an optimal cutoff score. Similar to a previous study conducted among a general population sample in Canada, CAGE did not demonstrate an acceptable sensitivity, a specificity, and a PPV using self-reported alcohol use as a criterion for validity assessment (Bisson et al., 1999). However, a recent study also conducted among general population reported an adequate ability to detect current and previous excessive drinking also using a self-reported alcohol use criterion (Skogen et al., 2011). Regarding the Chinese translation of CAGE, research in Taiwan also found less than optimal validity of the CAGE compared with other screening instruments (e.g., AUDIT; Wu et al., 2008b).

In our sample, a large proportion (85.9%) of the participants who reported 1 score on CAGE (i.e., were CAGE-positive) did not report a number of drinks exceeding the heavy drinking threshold in the week prior to the survey. Most likely, the main explanation for these findings is that CAGE was developed to screen for *lifetime* alcohol problems and may not be the ideal instrument to detect *current* drinking problems. The alcohol use measure used in the current study was restricted to participants' past week experience, while they might have consumed alcohol at a hazardous level at some earlier point in their lifetime (Bisson et al., 1999). Another explanation for the low validity indices may be stigmatization of alcohol use among the Chinese MSM population. In China, excessive drinking has been associated with increased sexual risky behaviors (Nehl et al., 2012). Due to the rapid expansion of the HIV/AIDS epidemic among MSM population in China, the negative attitudes toward MSM have also been linked with their drinking behaviors (Liao et al., 2014; Lu et al., 2013). It is possible that our participants tended to report lower number of alcoholic drinks than they actually consumed to avoid negative attitudes toward the MSM population.

With respect to each CAGE item, the sensitivities and PPVs were mostly inadequate. For the first three items in CAGE (*cut down*, *annoyed*, and *guilty*), a large proportion of our participants who responded positively on these items were not heavy drinkers. For example, for 85.6% who scored positive for the *cut down* item, 77.2% who scored positive for the *annoyed* item, and 82.6% who scored positive for the *guilty* item, the number of drinks was below the heavy drinking threshold. Similar to the explanation mentioned above, this may be due to the inconsistency between the temporality of the CAGE items and the alcohol use measure. The last item (*eye-opener*) is considered as the item that requires a higher level of alcohol use problems (e.g., withdrawal symptoms and tolerance; Skogen et al., 2011). Because we did not have a high percentage of participants who reported heavy drinking, the low number of positive responses to this item as well as its extremely low sensitivity is not surprising. Previous studies have suggested excluding the last item to improve the validity of CAGE (Malet et al., 2005).

In our sample, the endorsement of the eye-opener item of the CAGE was much lower than that of the other three items. As reported previously, the eye-opener item is often considered as a high-threshold item that requires a higher level of alcohol problem (Skogen et al.,

2011). Such an item may induce a defensive response and result in underreporting the item (Wu et al., 2008b). Additionally, in the current study, we asked drinking patterns before we administered the CAGE. This may have produced a denial reaction among participants and reduced the validity of the CAGE (Etter, 2004). Future studies validating the Chinese CAGE should take into account the survey question order.

There are several limitations to the current study. First, all measures concerning alcohol experiences solely relied on self-report. Although efforts have been made by the trained interviewers to encourage accurate responses, it is possible that these participants might have underreported their current drinking behaviors. Second, we used alcohol consumption quantity as the only criterion to validate CAGE and did not include other important aspects of drinking such as intensity of consumption and related social problems as validity criteria. Nor did we use other screening tools or clinical diagnostic interviews for validation. Thus, our validity findings may not reflect other important aspects of alcohol abuse and drinking problems. Third, the current study was conducted among MSM in Shanghai, so our findings cannot be generalized to other cities in China or other Chinese-speaking countries due to differences in drinking patterns and social environments (Wu et al., 2008a).

Despite these limitations, our study is the first to assess the validity of CAGE among Chinese MSM using a large-scale community-based sample generated by multiple recruitment methods. The current study underscores the need for continued efforts to examine the validity of CAGE in detecting alcohol abuse and dependence among the Chinese MSM population.

Although we did not demonstrate high criterion validity of CAGE, our findings should not be construed as evidence against using this screening tool among the MSM population in China. Rather, our study underscores the need for additional research on CAGE validity using a combination of validation measures including DSM-IV criteria as well as other screening instruments (Dhalla and Kopec, 2007). One of these common screening tools is the 10-item Alcohol Use Disorders Identification Test (AUDIT) developed specifically for international use in screening for harmful and hazardous drinking (Reid et al., 1999; Saunders et al., 1993). In particular, AUDIT has been shown to be suitable for investigating alcohol-related HIV risks among MSM in Beijing, China (Lu et al., 2013). In addition, investigating the influence of social norms over individual's perception of CAGE items with quantitative and qualitative methods may help to understand better the cultural specifics of applicability of CAGE in MSM in China. Addressing drinking problems among MSM population in China is one of public health priorities; therefore, it is important to identify instruments to screen for early drinking problems that are reliable, valid, and easy to administer.

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### Highlights

- We examine the validity of the CAGE as a screening tool for alcohol use problems among a sample of Chinese MSM.
- The CAGE had inadequate sensitivity, specificity, and positive predictive values using past week drinking as the criterion.
- The CAGE was limited in the ability to discriminate between heavy and non-drinkers.
- Findings showed the inadequate validity of CAGE as a screening instrument for current heavy drinking in Chinese MSM population. Further research using a combination of validity criteria and culturally-informed research is needed to determine the applicability of CAGE for this population.

**Table 1**

Sample characteristics and distribution of responses to CAGE items among money boy and general MSM

Variable	Overall (n = 1009)	Money Boy (n = 486)	General MSM (n = 523)	p-value
	Mean (SD) n (%)	Mean (SD) n (%)	Mean (SD) n (%)	
Age	28.70 (8.80)	25.36 (6.06)	31.79 (9.77)	<0.001
Hu-Kuo				
Shanghai	789 (78.35)	13 (2.69)	205 (39.20)	<0.001
Other	218 (21.65)	471 (97.31)	318 (60.80)	
Sexual orientation				
Openly gay/bisexual	92 (9.12)	39 (8.02)	53 (10.13)	<0.001
Closeted gay/bisexual	831 (82.36)	373 (76.75)	458 (87.57)	
Heterosexual/other	86 (8.52)	74 (15.23)	12 (2.29)	
Ethnicity				
Han	956 (95.12)	457 (94.23)	499 (95.96)	0.202
Other ethnicities	49 (4.88)	28 (5.77)	21 (4.04)	
Education				
Illiterate/primary school	38 (3.77)	21 (4.33)	17 (3.25)	<0.001
Middle school	267 (26.49)	166 (34.23)	101 (19.31)	
High school or equal	391 (38.79)	244 (50.31)	147 (28.11)	
College or above	312 (30.95)	54 (11.13)	258 (49.33)	
Marital status				
Never married	783 (77.99)	417 (86.34)	366 (70.25)	<0.001
Currently married/living together	150 (14.94)	42 (8.70)	108 (20.73)	
Divorced/widowed	71 (7.07)	24 (4.97)	47 (9.02)	
Income				
0–2999	399 (39.58)	160 (32.99)	239 (45.70)	<0.001
3000–4999	354 (35.12)	194 (40.00)	160 (30.59)	
5000	255 (25.30)	131 (27.01)	124 (23.71)	
Drinks in the past week				
<7 drinks	823 (81.6)	398 (81.9)	425 (81.3)	0.077
7–13 drinks	111 (11.0)	45 (9.3)	66 (12.6)	
14 drinks	75 (7.4)	43 (8.9)	32 (6.1)	
CAGE item				
Cut down	292 (28.9)	156 (32.1)	136 (26.0)	0.033
Annoyed	123 (12.2)	62 (12.8)	61 (11.7)	0.596
Guilty	115 (11.4)	60 (12.4)	55 (10.5)	0.361
Eye-opener	6 (0.6)	4 (0.8)	2 (0.4)	0.363
CAGE score				
0	655 (64.9)	297 (61.1)	358 (68.5)	0.112
1	226 (22.4)	124 (25.5)	102 (19.5)	

Variable	Overall (n = 1009)	Money Boy (n = 486)	General MSM (n = 523)	p-value
	Mean (SD)	Mean (SD)	Mean (SD)	
2	75 (7.4)	38 (7.8)	37 (7.1)	
3	52 (5.2)	26 (5.4)	26 (5.0)	
4	1 (0.1)	1 (0.2)	0 (0.0)	

<sup>a</sup>N varies based on missing responses

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**Table 2**  
 Criterion validity indices for heavy drinking of CAGE among money boys and general MSM

	Cutoff scores				CAGE item			
	1+	2+	3+	3+	Cut down	Annoyed	Guilty	Eye-opener
<b>Overall</b>	AUC=0.70 (0.63-0.77)							
Sens (95% CI)	66.7 (56.0-77.3)	38.7 (27.7-49.7)	18.7 (9.9-27.5)	56.0 (44.8-67.2)	37.3 (26.4-48.3)	26.7 (16.7-36.7)	4.0 (0.0-8.4)	99.7 (99.3-100.0)
Spec (95% CI)	67.5 (64.5-70.5)	89.4 (87.4-91.4)	95.8 (94.5-97.1)	73.2 (70.4-76.1)	89.8 (87.9-91.8)	89.8 (87.9-91.8)	17.4 (10.5-24.3)	50.0 (10.0-90.0)
PPV (95% CI)	14.1 (10.5-17.8)	22.7 (15.4-29.9)	26.4 (14.6-38.3)	14.4 (10.4-18.4)	22.8 (15.4-30.2)	17.4 (10.5-24.3)	50.0 (10.0-90.0)	
Sens*Spec	45.0	34.6	17.9					
<b>Money Boy</b>	AUC=0.67 (0.58-0.76)							
Sens (95% CI)	65.1 (50.9-79.4)	32.6 (18.6-46.6)	16.3 (5.2-27.3)	58.1 (43.4-72.8)	30.2 (16.5-44.0)	20.9 (8.8-33.1)	4.7 (0.0-11.0)	99.6 (98.9-100.0)
Spec (95% CI)	63.7 (59.2-68.1)	88.5 (85.5-91.5)	95.5 (93.6-97.4)	70.4 (66.2-74.7)	88.9 (86.0-91.9)	88.5 (85.5-91.5)	15.0 (6.0-24.0)	50.0 (1.0-99.0)
PPV (95% CI)	14.8 (9.8-19.9)	21.5 (11.5-31.5)	25.9 (9.4-42.5)	16.0 (10.3-21.8)	21.0 (10.8-31.1)	15.0 (6.0-24.0)	50.0 (1.0-99.0)	
Sens*Spec	41.5	28.9	15.6					
<b>General MSM</b>	AUC=0.73 (0.63-0.84)							
Sens (95% CI)	68.8 (52.7-84.8)	46.9 (29.6-64.2)	21.9 (7.6-36.2)	53.1 (35.8-70.4)	46.9 (29.6-64.2)	34.4 (17.9-50.8)	3.1 (0.0-9.2)	99.8 (99.4-100.0)
Spec (95% CI)	70.9 (29.6-64.2)	90.2 (87.6-92.9)	96.1 (94.4-97.8)	75.8 (72.0-80.0)	90.6 (88.1-93.2)	91.0 (88.5-93.6)	20.0 (9.4-30.6)	50.0 (0.0-100.0)
PPV (95% CI)	13.3 (7.6-36.2)	23.8 (13.3-34.3)	26.9 (9.9-44.0)	12.5 (6.9-18.1)	24.6 (13.8-35.4)	20.0 (9.4-30.6)	50.0 (0.0-100.0)	
Sens*Spec	48.8	42.3	21.0					