



# Anal Sexual Roles and Impacts on HIV Infection and Psychological Distress Among Men Who Have Sex With Men in China: A 14-Year Longitudinal Study

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## Abstract

Previous studies have shown that men who have sex with men (MSM) with different anal sexual roles, namely bottom, versatile, and top, are at different risk of HIV infection and psychological distress. However, the evidence was primarily derived from cross-sectional designs from Western countries, and it remains unclear how anal sexual roles change over a long time and their health impacts among MSM from Eastern countries. We aimed to describe the changes in anal sexual roles among a Chinese sample of MSM over 14 years and explore their effects on HIV infection, depression, anxiety, and suicidal ideation. Between 2009 and 2023, a longitudinal study was conducted on 373 MSM in Changsha, China, to assess their anal sexual roles, HIV infection, and psychological distress, including depression, anxiety, and suicidal ideation. Generalized linear models with a binomial probability was used to analyze the predictive effect of anal sexual roles on HIV infection and psychological distress. At baseline, 30.3% of MSM self-identified as bottom, 32.2% as versatile, and 37.5% as top, and these numbers changed slightly to 35.9%, 33.0%, and 31.1%, respectively, at follow-up ( $p=0.131$ ). From baseline to follow-up, 48 (12.9%) new HIV cases were identified. The prevalence of depression increased from 23.1 to 38.1% ( $p<0.001$ ), anxiety increased from 25.5% to 35.4% ( $p=0.003$ ), and suicidal ideation increased from 30.8 to 38.9% ( $p=0.021$ ). MSM with bottom and versatile roles were more likely to have HIV infection, depression, anxiety, and suicidal ideation than those with top roles. MSM's risk of HIV infection and psychological distress varies according to their anal sexual roles, suggesting that future HIV prevention and mental health improvement programs for MSM may benefit from providing targeted and individualized support based on their anal sexual roles, with a particular focus on those with bottom and versatile roles.

**Keywords** Men who have sex with men · Anal sexual roles · HIV · Psychological distress · Longitudinal study · Sexual orientation

## Introduction

Sexual behavior among MSM is predominantly characterized by anal intercourse, which mainly includes insertive anal intercourse (IAI), receptive anal intercourse (RAI), and a combination of both (Dangerfield et al., 2018). Based on the various sexual positioning practices, MSM developed their self-ascribed identities, generally referred to as sexual roles (Dangerfield et al., 2016). Sociological, psychological, and public health studies have shown that sexual self-labeling is

prevalent among MSM, where individuals commonly identify with specific sexual roles (Moskowitz et al., 2022; Newton et al., 2022; Pereira, 2021). In Western countries, men who prefer IAI self-identify as “top,” men who prefer RAI self-identify as “bottom,” and men who have no preference for either position self-identify as “versatile” (Pereira, 2021). Unlike Western cultures, where sexual roles are described using descriptive terms based on personal identity and behavioral habits (e.g., top, bottom, and versatile), Chinese culture uses a coding system to provide a more qualitative and symbolic description of sexual roles (Zheng & Fu, 2024; Zheng et al., 2015). In China, sexual labels are substituted by the use of numbers, with “1,” “0,” and “0.5” equivalent to the Western sexual labels of “top,” “bottom,” and “versatile,” respectively (Zheng & Fu, 2024; Zheng et al., 2015). In Chinese culture, numbers often carry specific symbolic

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meanings and the coding of sexual roles could increase its identity recognition and popularity in the Chinese gay community. Additionally, these numbers provide a simple labeling system to describe sexual roles concisely and accurately, making it easy to understand and communicate in the Chinese gay community. These classifications extend beyond anal sexual behaviors and reflect various sexual attitudes, with the top indicating an active (insertive) role, the bottom indicating a passive (receptive) role, and versatile indicating flexibility in multiple activities (Xu & Zheng, 2018; Zheng & Fu, 2024).

Increasing evidence has shown that the proportion of MSM who identify in each of the sexual roles varies across studies and countries (Dangerfield et al., 2017). A population study based on social network data of 464,873 MSM user profiles in Germany showed that a majority of profiles indicated a preference for versatile (32.9%). In contrast, tops (19.2%) and bottoms (20.9%) showed somewhat similar proportions (Scholz et al., 2019). Similarly, a study on immigrant MSM living in the USA showed that versatile accounted for the majority (49%), followed by tops (23%) and bottoms (16%) (Parchem et al., 2022). On the other hand, a study in Portugal showed that the majority of MSM self-identified as bottoms (41.4%), followed by tops (30.3%), and versatile (28.3%) (Pereira, 2021). Another multi-center study among 1235 MSM in Western China showed that the majority reported themselves as tops (45.83%), while a similar proportion reported themselves as versatile (27.29%) and bottoms (26.88%) (Zeng et al., 2016). The different rates reported by various studies suggest that MSM's sexual roles may vary by study sample and cultural context (Dangerfield et al., 2017). However, it remains unknown whether MSM's sexual roles change over a long time.

MSM bear a disproportionate burden of HIV, and their sexual roles also affect the risk of HIV infection (Dangerfield et al., 2017). Typically, MSM with bottom roles have a higher risk of HIV infection than MSM with top roles due to the thin lining in the rectum and increased risk of tearing, leading to more HIV access to the bloodstream (Baggaley et al., 2018; Zeng et al., 2016). On the other hand, MSM with top roles transmit HIV mainly through the opening of the penis (Baggaley et al., 2018; Zeng et al., 2016). Modeling studies corroborate that role versatility in anal sex elevates HIV transmission (Beyrer et al., 2012; Goodreau et al., 2005; Lyons et al., 2013).

In addition, MSM are also at high risk of psychological distress, including depression, anxiety, and suicide ideation (Jiang et al., 2016; Wang et al., 2018; Wei et al., 2020). While various factors affecting MSM's mental health have been identified (Batchelder et al., 2017; Sun et al., 2020), the relationship between anal sexual roles and psychological distress has received limited attention. One study involving 1,771 MSM from western China reported the highest incidence of anxiety and depression among those identified as

bottoms, followed by versatile and tops (Liu et al., 2020). The different levels of psychological distress by sexual roles may be explained by the masculinity differences, as studies consistently reveal that "tops" often exhibit more dominant, masculine characteristics, whereas "bottoms" are associated with more submissive, feminine traits (Kim, 2020; Pereira, 2021). Moreover, MSM may switch between different sexual roles, leading to significant role conflicts and subsequent psychological distress, particularly anxiety, depression, and suicidal ideation (Javanbakht et al., 2022; Marcotte et al., 2021; Nugraheni et al., 2020).

Although MSM's sexual roles and health have been receiving increasing research attention, most of the previous studies were conducted in Western countries with more open and acceptable attitudes toward MSM (Dangerfield et al., 2017). As MSM's sexual roles are dependent on cultural context (Dangerfield et al., 2017), it is equally important to investigate the issue in Eastern countries such as China, where MSM are more stigmatized (Sun et al., 2020). In addition, previous evidence on MSM's sexual roles and health was predominantly derived from cross-sectional study designs, which can neither reflect the long-term changes in sexual roles nor establish causal relationships between sexual roles and health outcomes. To address these gaps, we conducted a 14-year longitudinal study among a Chinese sample of MSM to assess the long-term changes in anal sexual roles and their impact on HIV infection and psychological distress, such as depression, anxiety, and suicidal ideation.

## Method

### Participants and Procedure

This longitudinal study was conducted from 2009 to 2023 in Changsha City, China. Participants were recruited online after a pilot survey of 105 gay men attending offline parties in Changsha revealed that the Internet was their primary platform for dating. Inclusion criteria comprised: (1) self-identified MSM with active anal intercourse, (2) HIV-negative, (3) aged 18 or older at the baseline survey (born before June 1, 1991), and (4) possessing official household registration of Changsha city or having resided in Changsha City for at least 3 months. The study excluded individuals who: (1) did not engage in anal intercourse in the recent 1 month, (2) not having a sexual roles self-label, and (3) were unable to complete the survey due to severe physical or mental illness. Our sample size was set at 500, in accordance with recommendations from the WHO and Chinese CDC for sentinel surveillance of high-risk STI groups (typically 250–400) (Yu et al., 2022).

The baseline survey was conducted between March and December 2009; participants were recruited from the five largest Chinese MSM dating websites and nearly 100 QQ

groups for MSM in Changsha, encompassing roughly 18,000 individuals. QQ, an instant messaging software service developed by the Chinese technology company Tencent, is a multi-functional platform that provides online social networks, games, music, shopping, and group and voice chat software (Tai, 2022; Wu & Frantz, 2012). QQ group is a virtual online community where people with similar identities and interests can communicate by sending messages, pictures, and files and making video calls. It is a crucial platform for Chinese people to socialize and exchange information online, and its stability over time also provides an optimal opportunity to retain participants in longitudinal studies (Tai, 2022; Wu & Frantz, 2012). A random sample of 500 MSM were selected from the dating websites and QQ groups. Potential participants were initially approached online by our research team, who explained in detail the study's purpose, procedure, benefits, and risks. Those interested in participation were then invited to complete a questionnaire in our designated office at a scheduled time at their convenience. After providing written informed consent, participants completed a paper-based questionnaire independently in a quiet office to ensure privacy. A research personnel was present to answer any questions the participants may have.

The follow-up survey was conducted from March to April 2023; we reconnected with 418 participants who completed the baseline survey via email, text, QQ, and WeChat. After providing electronic informed consent, participants completed the same online questionnaire as the baseline survey. We then matched participants who completed the follow-up survey with those who completed the baseline survey using the 8-digit birthdate numbers collected at baseline and follow-up. After excluding 45 follow-up responses with no identical birthdate with the baseline, we successfully matched 373 responses, representing 89.2% of the follow-up cohort. There were no significant differences in the baseline characteristics between the 418 participants who completed the follow-up survey and the 127 participants who were lost to follow-up from baseline and between the 373 participants who were matched and the 45 participants who were not matched.

## Measures

**Demographics** We collected participants' demographic information, including age (continuous variable), marital status (unmarried/married), original household registration (cities/rural areas), whether they have children (yes/no), whether being an only child (yes/no), education level (below Bachelor/Bachelor and above), occupation (students/civil servants/enterprise employee/others), monthly income (<4000/≥4000 Yuan), and HIV infection status (yes/no).

**Anal sexual roles** In this study, anal sexual roles in MSM relationships are conceptualized across a continuum of 11 levels, as illustrated in Fig. 1. This spectrum ranges from

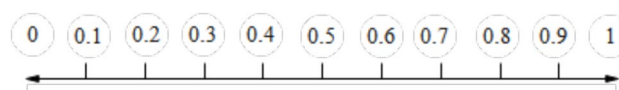


Fig. 1 Anal sexual role in MSM

exclusively receptive (pure 0) to exclusively penetrative (pure 1) roles. Participants categorized their roles according to their sexual activities over the past year. Within this framework, roles from 0 to 0.3 are designated as "bottom," those between 0.4 and 0.6 as "versatile" (or "vers"), and roles from 0.7 to 1 as "top."

**Depression and Anxiety** Depression was evaluated using the 20-item Center for Epidemiological Studies Depression Scale (CES-D) (Liu et al., 2020), where participants rated symptoms on a scale from 0 (rarely or none of the time) to 3 (most or all of the time), based on the previous week's frequency. A threshold score of 20 or higher, out of a maximum of 60, indicated depressive symptoms. The CES-D exhibited a Cronbach's  $\alpha$  of 0.82. Anxiety was assessed using the 20-item Self-Rating Anxiety Scale (SAS) (Zung, 1971), with a scoring range of 1 to 4. The aggregate score was adjusted by multiplying by 1.25 and rounding off, with scores of 50 or above signifying anxiety symptoms. The SAS reported a Cronbach's  $\alpha$  of 0.83 in this research.

**Suicidal ideation** Suicidal ideation was assessed using the Beck Scale for Suicide Ideation-Chinese Version (BSI-CV) (Liu et al., 2023). This scale includes 19 items that evaluate suicidal thoughts and tendencies. It employs a 3-point Likert scale (ranging from 0 to 2) for each item, where higher scores indicate higher suicidal ideation. In our research, the BSI-CV exhibited good internal consistency, as evidenced by Cronbach's alpha coefficient of 0.88. Furthermore, participants who answered "weak" or "moderate to strong" to either question 4 or 5 were identified as having suicidal ideation.

## Data Analysis

Data analysis was performed using SPSS 26.0. Categorical variables were presented as frequencies and percentages, while continuous variables were described as means with standard deviations. We used Pearson chi-square tests to compare baseline and follow-up data, and our data with other published data. Generalized linear models with a binomial probability (Naimi & Whitcomb, 2020) were conducted to assess the impact of the anal sexual role and changes on HIV status, depression, anxiety, and suicidal ideation while controlling for the following factors: age, marital status, only child status, education level, occupation, monthly income, depression, anxiety, and suicide ideation at baseline.  $p < 0.05$  was considered statistically significant.

## Results

### Sample Characteristics and Changes

At baseline, participants' mean age was  $24.2 \pm 4.0$  years (range: 16–44). Most were unmarried (92.0%), without children (95.4%), of urban residence (70.6%), and with a monthly income below 4,000 yuan (80.7%). During follow-up, we observed significant changes in marital status, parenthood, occupation, and monthly income ( $p < 0.001$ ). For details, refer to Table 1.

### Anal Sexual Roles and Changes

At baseline, 30.3% of MSM self-identified as bottom, 32.2% as versatile, and 37.5% as top, and these numbers changed slightly to 35.9%, 33.0%, and 31.1%, respectively, at follow-up, without significant difference in each category ( $p = 0.131$ ). Among the 373 participants, 154 (41.3%) reported no changes in their anal sexual roles from baseline to follow-up, including 55 bottoms (14.7%), 45 versatile (12.1%), and 54 tops (14.5%). In contrast, 219 (58.7%) reported a change, including 41 who changed from versatile to bottom (18.7%), 38 from top to bottom (17.4%), 30 from bottom to versatile (13.7%), 48 from top to versatile (21.9%),

**Table 1** Changes in sample characteristics from baseline to follow-up among MSM ( $n = 373$ ) [ $n(\%)$ / $\bar{x} \pm S$ ]

Variables	Baseline data	Follow-up data	$\chi^2$	$p$ values	Variables	Baseline data	Follow-up data	$\chi^2$	$p$ values
Age	$24.2 \pm 4.0$	$38.2 \pm 4.0$			Anal sexual roles				
Marital status					Bottom	113(30.3)	134(35.9)	4.07	0.131
Unmarried	343(92.0)	230(61.7)	96.09	<0.001	Vers	120(32.2)	123(33.0)		
Married	30(8.0)	143(38.3)			Top	140(37.5)	116(31.1)		
Whether having children					Anal sexual role changes				
No	356(95.4)	232(62.2)	123.47	<0.001	Always bottom	55(14.7)	55(14.7)		
Yes	17(4.6)	141(37.8)			Changed from vers to bottom		41(11.0)		
Only child					Changed from top to bottom		38(10.2)		
Yes	216(57.9)	216(57.9)			Always vers	45(12.1)	45(12.1)		
No	157(42.1)	157(42.1)			Changed from bottom to vers		30(8.0)		
Education level					Changed from top to vers		48(12.9)		
Below bachelor degree	141(37.8)	232(62.2)	0.47	0.494	Changed from bottom to top		28(7.5)		
Bachelor's degree or above	132(35.4)	241(64.6)			Changed from vers to top		34(9.1)		
Occupation					Always top	54(14.5)	54(14.5)		
Students	145(38.9)	0	189.94	<0.001	HIV				
Civil servants & institutions	38(10.2)	101(27.1)			Yes	0	48(12.9)		
Enterprise employee	139(37.3)	214(57.4)			No	373(100.0)	325(87.1)		
Others	51(13.7)	58(15.5)			Depression				
Monthly income (RMB)					Yes	86(23.1)	142(38.1)	19.81	<0.001
<4000	301(80.7)	37(9.9)	377.03	<0.001	No	287(76.9)	231(61.9)		
≥4000	72(19.3)	336(90.1)			Anxiety				
					Yes	95(25.5)	132(35.4)	8.67	0.003
					No	278(74.5)	241(64.6)		
					Suicidal ideation				
					Yes	115(30.8)	145(38.9)	5.31	0.021
					No	258(69.2)	228(61.1)		

28 from bottom to top (12.8%), and 34 from versatile to top (15.5%). For details, refer to Table 1.

Additionally, we compared the anal sexual roles at follow-up within our study to Western samples in other studies. As shown in Table 2, our sample was comparable with Pereira et al.'s (2021) sample ( $\chi^2 = 2.34$ ,  $p = 0.310$ ) but statistically different from Moskowitz and Roloff's (2017) sample ( $\chi^2 = 35.50$ ,  $p < 0.001$ ) in anal sexual roles.

### HIV Infection and Psychological Distress

From 2009 to 2023, 48 participants (12.9%) were diagnosed with HIV, with an average HIV diagnosis duration of  $6.33 \pm 4.11$  years (range: 1–14). The prevalence of depression increased from 23.1% to 38.1% ( $p < 0.001$ ), anxiety increased from 25.5 to 35.4% ( $p = 0.003$ ), and suicidal ideation increased from 30.8 to 38.9% ( $p = 0.021$ ).

### Impact of Anal Sexual Roles on HIV infection and Psychological Distress

Table 3 shows the impact of anal sexual roles on HIV infection and psychological distress by logistic regression analyses. The bottom role significantly predicted higher risk of HIV infection (Risk Ratio [RR]: 2.84, 95% Confidence Interval [CI]: 1.71–4.70), depression (RR: 2.09, 95% CI: 1.48–2.95), anxiety (RR: 2.15, 95% CI: 1.53–3.04), and suicidal ideation (RR: 1.55, 95% CI: 1.10–2.17). Similarly, the versatile role also predicted a higher risk of HIV infection (RR: 2.72, 95% CI: 1.64–4.53), depression (RR: 1.94, 95% CI: 1.38–2.72), anxiety (RR: 1.98, 95% CI: 1.41–2.78), and suicidal ideation (RR: 1.57, 95% CI: 1.13–2.18).

Table 3 also shows the associations between changes in anal sexual role, HIV infection, and psychological distress by logistic regression analysis. Respondents transitioning to or consistently adopting the bottom role exhibit an increased risk of HIV infection (RR: 2.44–2.48, 95% CI: 1.16–5.30), depression (RR: 1.97–1.98, 95% CI: 1.15–3.39), anxiety (RR: 1.87–2.03, 95% CI: 1.14–3.44), and suicidal ideation (RR: 1.71–1.75, 95% CI: 1.04–2.96). In a similar

vein, adopting or transitioning to the versatile role correlates with higher risks of HIV infection (RR: 2.45–2.50, 95% CI: 1.11–5.41), depression (RR: 1.70–1.99, 95% CI: 1.03–3.47), anxiety (RR: 1.77–1.95, 95% CI: 1.08–3.38), and suicidal ideation (RR: 1.72–1.86, 95% CI: 1.07–3.09).

### Discussion

To our knowledge, this is the first longitudinal study to investigate the changes in anal sexual roles and multiple health outcomes among Chinese MSM over a long follow-up period of 14 years. In addition, we comprehensively explored how various sexual roles affected subsequent HIV infection and psychological distress, including depression, anxiety, and suicidal ideation. Our findings showed that MSM's sexual roles were almost equally distributed among tops, bottoms, and versatile and changed slightly over 14 years. Despite this, there were 48 new HIV cases and significant rises in the prevalence of depression, anxiety, and suicidal ideation. The data suggest bottom and vers roles are associated with increased risks of HIV infection and psychological distress, highlighting a predictive link between anal sexual roles and adverse health outcomes.

### Changes in Anal Sexual Roles Over Time

At baseline, a slightly higher portion of MSM self-identified as top (37.5%), while a similar proportion reported bottom (30.3%) and versatile (32.2%). At follow-up, the proportions of top, bottom, and versatile sexual roles tend to be similar. Our results were in contrast with previous studies showing the majority of MSM self-identified as top (Zeng et al., 2016), bottom (Pereira, 2021), or versatile (Parchem et al., 2022; Scholz et al., 2019). These findings further indicate that MSM's sexual roles may be sample-dependent and culture-dependent, and it is essential to take the different sexual roles into consideration in MSM studies. In addition, our study showed changes in MSM's sexual roles over time, suggesting that sexual role is not a stable characteristic but

**Table 2** Comparison of anal sexual roles between our study and Western samples

	Our study n=373	Pereira (2021) n=278	$\chi^2$	p values
Anal sexual roles				
Bottom	134(35.9)	115(41.4)	2.34	0.310
Vers	123(33.0)	79(28.3)		
Top	116(31.1)	84(30.3)		
	Our study n=373	Moskowitz (2017) n=282		
Anal sexual roles				
Bottom	134(35.9)	99(35.0%)	35.50	<0.001
Vers	123(33.0)	42(15.0%)		
Top	116(31.1)	141(50.0%)		

**Table 3** Generalized linear models with HIV status, depression, anxiety, and suicidal ideation as dependent variables in follow-up data<sup>a,b</sup>

Dependent variable	Independent variable			B	SE	Wald $\chi^2$	RR(95%CI)	p values
HIV (Follow-up)	Yes	Anal sexual roles (baseline)	Bottom	1.04	0.26	16.35	2.84(1.71–4.70)	<0.001
			Vers	1.00	0.26	14.90	2.72(1.64–4.53)	<0.001
			Top				1	
Depression (Follow-up)	Yes	Anal sexual roles (baseline)	Bottom	0.74	0.18	17.33	2.09(1.48–2.95)	<0.001
			Vers	0.66	0.17	14.62	1.94(1.38–2.72)	<0.001
			Top				1	
Anxiety (Follow-up)	Yes	Anal sexual roles (baseline)	Bottom	0.77	0.18	18.96	2.15(1.53–3.04)	<0.001
			Vers	0.68	0.17	15.52	1.98(1.41–2.78)	<0.001
			Top				1	
Suicidal ideation (Follow-up)	Yes	Anal sexual roles (baseline)	Bottom	0.44	0.17	6.36	1.55(1.10–2.17)	0.012
			Vers	0.45	0.17	7.08	1.57(1.13–2.18)	0.008
			Top				1	
HIV (Follow-up)	Yes	Anal sexual role and changes	Always bottom	0.91	0.39	5.53	2.48(1.16–5.30)	0.019
			Changed to bottom during follow-up	0.89	0.37	5.72	2.44(1.18–5.08)	0.017
			Always vers	0.90	0.41	4.88	2.45(1.11–5.41)	0.027
			Changed to vers during follow-up	0.92	0.37	6.02	2.50(1.20–5.20)	0.014
			Changed to top during follow-up	0.21	0.43	0.23	1.23(0.53–2.89)	0.631
			Always top				1	
	No	Anal sexual role and changes	Always bottom	0.68	0.28	6.12	1.98(1.15–3.39)	0.013
			Changed to bottom during follow-up	0.67	0.25	7.06	1.97(1.19–3.24)	0.008
			Always vers	0.69	0.28	5.90	1.99(1.14–3.47)	0.015
			Changed to vers during follow-up	0.53	0.25	4.36	1.70(1.03–2.81)	0.037
Depression (Follow-up)	Yes	Anal sexual role and changes	Changed to top during follow-up	0.13	0.28	0.21	1.13(0.66–1.95)	0.651
			Always top				1	
	No	Anal sexual role and changes	Always bottom	0.71	0.27	6.84	2.03(1.19–3.44)	0.009
			Changed to bottom during follow-up	0.63	0.25	6.21	1.87(1.14–3.06)	0.013
			Always vers	0.67	0.28	5.60	1.95(1.12–3.38)	0.018
			Changed to vers during follow-up	0.57	0.25	5.05	1.77(1.08–2.90)	0.025
	No	Anal sexual role and changes	Changed to top during follow-up	0.15	0.27	0.30	1.16(0.68–1.98)	0.586
			Always top				1	
			Always bottom	0.56	0.27	4.37	1.75(1.04–2.96)	0.037
Anxiety (Follow-up)	Yes	Anal sexual role and changes	Changed to bottom during follow-up	0.54	0.24	4.82	1.71(1.06–2.76)	0.028
			Always vers	0.62	0.27	5.11	1.86(1.09–3.19)	0.024
			Changed to vers during follow-up	0.54	0.24	4.96	1.72(1.07–2.76)	0.026
			Changed to top during follow-up	–0.39	0.28	1.87	0.68(0.39–1.18)	0.172
			Always top				1	
	No	Anal sexual role and changes	Always bottom	0.56	0.27	4.37	1.75(1.04–2.96)	0.037
			Changed to bottom during follow-up	0.54	0.24	4.82	1.71(1.06–2.76)	0.028
			Always vers	0.62	0.27	5.11	1.86(1.09–3.19)	0.024
			Changed to vers during follow-up	0.54	0.24	4.96	1.72(1.07–2.76)	0.026
Suicidal ideation (Follow-up)	Yes	Anal sexual role and changes	Changed to top during follow-up	–0.39	0.28	1.87	0.68(0.39–1.18)	0.172
			Always top				1	
	No	Anal sexual role and changes	Always bottom	0.56	0.27	4.37	1.75(1.04–2.96)	0.037
			Changed to bottom during follow-up	0.54	0.24	4.82	1.71(1.06–2.76)	0.028
			Always vers	0.62	0.27	5.11	1.86(1.09–3.19)	0.024
			Changed to vers during follow-up	0.54	0.24	4.96	1.72(1.07–2.76)	0.026
	No	Anal sexual role and changes	Changed to top during follow-up	–0.39	0.28	1.87	0.68(0.39–1.18)	0.172
			Always top				1	
			Always bottom	0.56	0.27	4.37	1.75(1.04–2.96)	0.037

<sup>a</sup>The beta parameters of each regression model were estimated after controlling for the following factors: age, marital status, only child status, education level, occupation, and monthly income

<sup>b</sup>When examining the impact of anal sexual roles and changes on depression, anxiety, and suicidal ideation, we also controlled for baseline levels of depression, anxiety, and suicidal ideation



a dynamic process that needs to be reevaluated from time to time. This finding has significant implications for the future classification of MSM based on their sexual roles to guide targeted interventions and services.

### Anal Sexual Roles and HIV Infection

This study revealed that MSM with bottom and versatile roles in anal sex were at a heightened risk of HIV infection. This finding was consistent with the bulk of previous studies showing higher HIV infection rates among those with bottom and versatile roles than those with top roles (Dangerfield et al., 2017). For instance, a cross-sectional study in Western China showed that the risk of HIV infection was 2.6 times higher among MSM with versatile roles and 3 times higher among those with bottom roles than MSM with top roles (Zeng et al., 2016). Compared to MSM with top roles who transmit HIV mainly through the open penis, MSM with bottom roles are at increased risk of HIV infection due to direct mucosal contact that is more susceptible to micro-cracking and breakage (McNeil et al., 2022). In addition, MSM with versatile roles have a higher risk of HIV infection through RAI and may also spread HIV to others through IAI (Dangerfield et al., 2017).

The different risks of HIV infection by sexual roles may also be explained by the socially constructed gender norms on power dynamics in sexual relationships (Conroy et al., 2020; Ólafsdóttir & Kjaran, 2019). These dynamics often result in some individuals wielding greater decision-making power in sexual encounters while others assume more passive roles. In male-male anal intercourse, MSM with top roles exert greater control over critical decisions like condom usage. Conversely, MSM with bottom roles may adopt a more passive stance, frequently overlooking the significance of using condoms. This dynamic can lead to high-risk sexual practices such as unprotected anal intercourse, which is a notable risk factor for HIV infection (Liu et al., 2020). Similar patterns have been observed in other sexually transmitted diseases (STD), with higher risk in MSM with bottom and versatile roles (Cornelisse et al., 2020; Zeng et al., 2016).

### Anal Sexual Roles and Psychological Distress

Our research illustrated that compared to MSM with top roles, MSM with bottom and versatile roles had a higher risk of psychological distress, including anxiety, depression, and suicidal ideation. This finding was congruent with Liu et al.'s (2020) study reporting the highest incidence of anxiety and depression among MSM with bottom roles. Given the increased vulnerability of anal tissue to damage, MSM who engage in RAI face a heightened risk of various infectious diseases, including HIV that penetrate the body through damaged mucous membranes (McNeil et al., 2022). Compared to

MSM with top roles, MSM with bottom and versatile roles are at an elevated risk of HIV and other STD infections, which may contribute to stress and regret following anal sex, potentially leading to psychological distress (Liu et al., 2020).

Another explanation may be related to the conflict between traditional gender roles and sexual roles among MSM with bottom and versatile roles. Traditional social expectations of gender norms require men to embody independence, strength, dominance, and assertiveness (Moradi & Parent, 2013; Steinberg & Diekmann, 2016). However, men in “bottom” and “vers” roles often display more passive or submissive behaviors, conflicting with these gender norms and potentially leading to feelings of marginalization and difficulty in adhering to expected gender expressions. This conflict may explain why MSM who identify as “bottom” often experience unmet psychological and physical needs, leading to chronic frustration and an increased likelihood of mental health issues.

Additionally, MSM in “bottom” roles tend to be younger (Zeng et al., 2016), have an earlier age of first anal intercourse (De Santis et al., 2008), and are more prone to engage in unprotected anal sex. This could further contribute to their subservient status and diminished self-protection ability, exacerbating psychological distress. Conversely, MSM in the “top” roles often occupy a more dominant position, are more experienced and self-protective, and exhibit fewer psychological issues. The psychosexual conflict in MSM with a “vers” role is notable, possibly due to the variability in their sexual partners and behaviors (Wang et al., 2018).

Furthermore, MSM with bottom and versatile roles often encounter heightened sexual minority discrimination (Feng et al., 2010; Magno et al., 2019). This discrimination primarily stems from their perceived deviation from traditional masculinity norms, making them more identifiable as MSM, even without disclosing their sexual orientations (Zheng et al., 2015). Such discrimination typically takes the form of misconceptions and biases within familial, professional, or social environments, further complicating their social identity. Consequently, this additional strain exacerbates psychological stress and leads to depression, anxiety, and even suicide ideation.

### Limitations

This study had several limitations. First, we used a convenience sample recruited online, which may not represent all MSM. Second, we had a long follow-up period of 14 years but only measured the data at baseline and 14 years later instead of measuring them annually, which may not reflect the fluctuations of participants' depression, anxiety, and suicide ideation over the 14 years. Additionally, the 14-year follow-up period may make it difficult to attribute MSM's health outcomes exclusively to anal sexual roles, considering the

potential influence of external factors such as social, political, and cultural changes. Third, our analysis did not include the 127 participants who were lost to follow-up and 45 follow-up participants who were not matched with baseline, which may lead to potential bias. Fourth, all data were collected based on self-report, which may be subject to recall bias and social desirability bias. Fifth, the categorization of anal sexual roles relied on a self-devised question rather than a validated scale. Finally, the study did not examine the concept of ideal anal sexual roles, acknowledging that some MSM may have discrepancies between their ideal and actual gender roles for various reasons.

## Conclusions

Our study provides fresh insights into the dynamic changes in anal sexual roles over time among MSM in China, which can be used to guide future targeted interventions and services based on sexual roles. In addition, we observed notable increases in the prevalence of HIV infection, depression, anxiety, and suicidal ideation over time, which were higher among MSM with bottom and versatile roles. These findings suggest that anal sexual roles are potential indicators for various health challenges in MSM, including HIV infection and psychological distress. Future HIV prevention and mental health improvement programs for MSM may benefit from providing targeted and individualized support based on their anal sexual roles, with particular focus on those with bottom and versatile roles.

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**Author contributions** All authors contributed to the study conception and design. Material preparation and data collection were performed by Yong Yu, Keke Qin, and Shishi Tang, Yedong Xian. Data analysis was performed by YU Yong, Qin Keke, Shishi Tang, and Yedong Xian contributed to the interpretation of data. The first draft of the article was written by YU Yong, Qin Keke, Shishi Tang, and Yedong Xian commented on previous versions of the article. All authors read and approved the final article.

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**Data availability** The datasets generated and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

## Declarations

**Conflict of interest** The authors have no conflicts of interest to declare that are relevant to the content of this article.

**Consent to participate** Consent was obtained from all individual participants included in the study.

**Ethical approval** This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Guangxi Normal University (No. 20230301002). Informed consent was obtained from all individual participants included in this study.

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