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Commercial sex behaviours among involuntary male bachelors: findings from a survey of migrants in Xi'an, China

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ABSTRACT

Background The highly male-biased sex ratio at birth has produced a severe male 'marriage squeeze' in China. However, with an imbalanced sex ratio, the marriage-squeezed or involuntary bachelors can meet their sexual needs only through ways other than marriage.

Methods To investigate the commercial sex behaviours of involuntary bachelors, we conducted a survey on reproductive health and family living among male migrant bachelors in Xi'an City, the capital of Shaanxi Province, from December 2009 to January 2010.

Results The prevalence of commercial sex use was 37.2% among unmarried men, 30.1% among married but separated men and 17.2% among married and cohabitating men ($\chi^2 = 31.33$; $P = 0.000$; df = 2). Marital status, knowledge about acquired immunodeficiency syndrome (AIDS), age and income were associated with the prevalence and frequency of commercial sex behaviours. Condom use was less frequent among involuntary bachelors and was significantly associated with knowledge about AIDS and other sexually transmitted diseases, the frequency of commercial sex behaviours, marital status and age.

Conclusions The higher prevalence of commercial sex behaviours and the lower frequency of condom use indicate a higher risk of disease from commercial sex among involuntary bachelors, implicating both individual and public health.

Keywords commercial sex behaviours, involuntary bachelors, marriage squeeze, migration, sex imbalance

Introduction

The male-biased sex ratio in China has produced a severe 'marriage squeeze'. Since 2010, there has been a surplus of at least 10% of men on the marriage market, and this percentage is increasing.[1–4] Due to the 'hypergamy' in which women tend to marry men of a higher socio-economic status, the current sex imbalance in the marriage market will exacerbate the existing marriage squeeze in the future.[2,3,5] Many marriage-squeezed bachelors are >30 years, located in rural and remote areas, have economic poverty and are of a lower social status and have few social resources.[6,7]

There may be more unsafe sexual activities among involuntary bachelors, such as buying sex and having unprotected sex, which increases the risks of human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) and sexually transmitted diseases (STDs).[8–10] Although forbidden by law, commercial sex exists in every corner of the society.[11–14] A large amount of research indicates that unprotected commercial sex is one of the main routes of transmission of HIV/AIDS and STDs.[15,16] Therefore, an increase in the prevalence of commercial sex use by involuntary bachelors, especially an increase in the prevalence of unprotected commercial sex, will exert a great impact on public health.

The present study was designed to investigate commercial sex behaviours and to assess the impact of the 'marriage squeeze' among unmarried male migrants.

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Methods

Survey and samples

The data used in this present study were obtained from the 'Survey on Reproductive Health and Family Living of Male Migrant Bachelors in Urban Area' conducted in Xi'an City, the capital of Shaanxi Province, from December 2009 to January 2010. Xi'an has 5 million registered population and 1 million migrants, making it the biggest city with a total population in Shaanxi Province.

The opportunity for marriage is much reduced after 28 and is almost zero after 35 years;[6,7] therefore, involuntary male bachelors in the present study were defined as 'male rural residents >27 years old who migrate from their registered places to Xi'an for work or livelihoods. Moreover, participants were classified into two categories: 28–35 years old and >35 years old.

Cluster sampling was adopted for the survey in three informal labour markets and two construction sites, selected for their high concentration of migrants.

A computer-assisting personal interview method was adopted to ensure the reliability and validity of the survey. We designed a programme for investigators to input an identification number as the unique certified identity of the respondent (to avoid double counting).

All interviews were arranged in a closed and quiet environment. Before starting the process, an interviewer informed each respondent of privacy protection regulations, and that they could withdraw at any time. Then, the interviewers explained to participants how to use the computer. During the survey, an interviewer was present to give technical assistance when necessary; however, the computer screen was not visible to the interviewer. In total, 979 men participated in the survey; 26 withdrew for various reasons, including length of the questionnaire or sensitivity of the issues, and 14 participants were excluded, as they were not migrants. This resulted in 939 questionnaires included in the final data analysis.

Measurements

The question 'have you had sex with prostitutes so far' (answers of '0 = No, 1 = Yes') was used to measure 'commercial sex behaviour'; the question 'how many times have you had commercial sex' (answers '0 = 0 time, 1 = 1 time, 2 = 2 times, 3 = 3 times, 4 = 4–5 times, 5 = 6–9 times, 6 = above 10 times') was used to measure 'frequency of commercial sex'. Five-point scales were adopted to measure variables on 'attitudes toward commercial sex', 'frequency of condom use in general sex' and 'frequency of condom use in commercial sex'; the higher the scores, the higher the approval of commercial sex and the higher the frequency of condom use. 'General sex' was defined to include all instances of sex, whether commercial or not.

Commercial sex and condom use behaviours have been shown to be associated with knowledge of HIV/AIDS and STDs.[17,18] In this study, we adopted items measuring knowledge about HIV/AIDS and STDs, such as the transmission pathway for HIV/AIDS and the symptoms of STDs. Higher scores indicated greater knowledge of HIV/AIDS and STDs.

Three important control variables were included to integrate perspectives of sex imbalance and population migration: age (28–35 and ≥35 years), marital status (unmarried, married but separated and married and cohabitating) and migration duration.[19] There were a few unmarried but cohabitating men who had similar characteristics in sexual behaviours to married men, they were included with the married and cohabitating group.

Socio-economic status variables, including education and income, were also included into this study.

Statistical methods

To describe the characteristics of commercial sex among unmarried migrants, we used crosstabs and one-way analysis of variance to compare the prevalence of commercial sex, attitudes toward commercial sex and relevant knowledge among the three marital groups.

To further determine the impacts of relevant attitudes and knowledge on the prevalence and frequency of commercial sex, we employed binary logistic regression analysis and constructed three models with 'if have had the commercial sex' as the dependent variable. Model A1 included 'attitudes toward commercial sex', 'knowledge of HIV/AIDS' and 'knowledge of STDs' as the independent variables; Model A2 added 'marital status' as the control variable to A1 and Model A3 added 'migration duration', 'age', 'educational level' and 'monthly income' as control variables to A2. We also employed ordinal regression and constructed three models with the 'frequency of commercial sex' as the dependent variable; Models B1, B2 and B3 included the same independent control variables as Models A1, A2 and A3, respectively.

Only ~15% of the total sample reported that they used condom in commercial sex, which makes data regarding condom use in commercial sexual intercourses were absent for ~85% of the questionnaires. Therefore, the variable 'frequency of condom use while having commercial sex' could not be included in the regression analysis as a dependent variable, and then we employed ordinal regression with 'frequency of condom use while having sex' as the dependent variable, and constructed three models: Model C1 included 'knowledge of HIV/AIDS' and 'knowledge of STDs' as

independent variables; Model C2 added 'marital status' as the control variable to C1 and Model C3 added 'migration duration', 'age', 'educational level' and 'monthly income' as control variables to C2.

Results

Table 1 presents the commercial sex and condom use behaviours of migrants with different marital statuses. The prevalence of commercial sex was 37.2% among unmarried migrants, 30.1% among married but separated migrants and 17.2% among married and cohabitating migrants ($\chi^2 = 31.33$; $P = 0.000$; df = 2). There was no significant difference in the frequency of commercial sex use between married and unmarried but separated migrants; however, attitudes toward commercial sex among unmarried migrants (2.61) were more positive than those among married but separated (2.20) and married and cohabitating migrants (2.45) ($F = 4.67$; $P = 0.01$).

Table 1 Comparison of unmarried and married male migrants

	Unmarried (frequency + percentage/ mean + SD)	*Married but separated (frequency + percentage/ mean + SD)*	*Married and cohabitating (frequency + percentage/ mean + SD)*
If have had commercial sex			
No	98 (62.8)	72 (69.9)	453 (82.8)
Yes	58 (37.2)	31 (30.1)	94 (17.2)
χ^2 test (unmarried and married)		$\chi^2 = 31.33$***($P = 0.000$, df = 2)	
The frequency of commercial sex	4.22 (2.02)	3.92 (1.67)	4.23 (2.02)
F test χ^2 (unmarried and married)		$F = 0.25$ ($P = 0.78$)	
The attitudes toward commercial sex	2.61 (1.21)	2.20 (1.06)	2.45 (1.19)
F test (unmarried and married)		$F = 4.67$**($P = 0.01$)	
The condom use frequency while having sex	2.80 (1.37)	2.48 (1.26)	2.25 (1.12)
F test (unmarried and married)		$F = 13.18$***($P = 0.000$)	
The condom use frequency while having commercial sex	3.51 (1.46)	3.79 (1.44)	3.67 (1.61)
F test (unmarried and married)		$F = 0.29$ ($P = 0.75$)	
Knowledge of HIV/AIDS	3.80 (2.74)	4.08 (2.73)	4.05 (2.76)
F test (unmarried and married)		$F = 0.73$ ($P = 0.48$)	
Knowledge of STDs	1.00 (0.82)	1.24 (0.87)	1.20 (0.86)
F test (unmarried and married)		$F = 4.45$* ($P = 0.012$)	
Migration duration	15.29 (7.29)	16.70 (8.70)	18.14 (8.35)
F test (unmarried and married)		$F = 9.91$* ($P = 0.000$)	
Age			
28–35	110 (50.7)	38 (31.9)	171 (27.9)
>35	107 (49.3)	81 (68.1)	441 (72.1)
χ^2 test (unmarried and married)		$\chi^2 = 37.32$*** ($P = 0.000$, df = 2)	
Education			
Primary school and under	51 (23.5)	18 (15.1)	103 (16.8)
Junior high school	121 (55.8)	73 (61.3)	363 (59.3)
Senior high school	45 (20.7)	28 (23.5)	146 (23.9
χ^2 test (unmarried and married)		$\chi^2 = 5.80$ ($P = 0.22$, df = 4)	
Monthly income			
<1000	108 (49.8)	48 (40.3)	194 (31.7)
1000–1500	68 (31.3)	34 (28.6)	197 (32.2)
>1500	41 (18.9)	37 (31.1)	221 (36.1)
χ^2 test (unmarried and married)		$\chi^2 = 30.08$*** ($P = 0.000$, df = 4)	

Data source: Survey on Reproductive Health and Family Living of Male Migrant Bachelors in Urban Area in Xi'an City from December 2009 to January 2010.
+$P < 0.1$, *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

The frequency of unmarried migrants' condom use was reported as 2.8 (between '2 = seldom' and '3 = occasionally'), higher than the 2.48 for married but separated migrants and 2.25 for married and cohabitating migrants ($F = 13.18$; $P = 0.000$); the frequency of condom use by all samples while having commercial sex was above 3 (between '3 = occasionally' and '4 = often'), though there was no significant difference between the three groups.

There was no significant difference in knowledge of HIV/AIDS between unmarried and married migrants, while the average score for knowledge of STDs in this group was 1, significantly lower than the scores among married but separated migrants (1.24) and among married and cohabitating migrants (1.20) ($F = 4.45$; $P = 0.012$).

The average migration duration was 15.29 years for unmarried migrants, 16.70 years for unmarried but separated migrants and 18.14 years for married and cohabitating migrants ($F = 4.45$; $P = 0.012$).

Unmarried migrants were much younger than married migrants. Participants aged 28–35 years comprised 50.7% of unmarried migrants, 31.9% of married but separated migrants and 27.0% of married and cohabitating migrants ($\chi^2 = 37.32$; $P = 0.000$; df = 2).

There was no significant difference in educational level between unmarried and married migrants, while the monthly income of the unmarried migrant was lower than that of the married migrant. Approximately 49.8% of unmarried migrants had a monthly income lower than RMB 1000 compared with 40.3% among married but separated migrants and 31.7% among married and cohabitating migrants ($\chi^2 = 30.08$; $P = 0.000$; df = 4).

Table 2 presents the regression results associated with commercial sex use. In Model A1, only 'knowledge of HIV/AIDS' had a significantly positive impact on 'if have had commercial sex' (1.12, $P < 0.01$), meaning that migrants with a higher score on knowledge about HIV/AIDS were more likely to have commercial sex. In Model A2, when 'marital status' was included as a control variable, the impact of 'knowledge of HIV/AIDS' on the dependent variable was almost unchanged (1.13, $P < 0.01$), while 'marital status' had a significantly negative impact on 'if have had commercial sex' (0.35, $P < 0.001$). In Model A3, the impact of 'knowledge of HIV/AIDS' on the dependent variable was almost unchanged, while the regression coefficient of marital status increased from 0.35 to 0.42. Among the newly included variables, age had a significantly negative effect on the dependent variable, meaning that migrants aged 28–35 were more likely to have commercial sex than older migrants (0.52, $P < 0.01$). Monthly income (<¥1000 versus ≥¥1000) also had a significantly negative effect on the dependent variable (0.57, $P < 0.05$; 0.69, $P < 0.1$).

In Model B1, only knowledge about HIV/AIDS had a significantly positive impact on the frequency of commercial sex (0.11, $P < 0.01$). In Model B2, the impact of knowledge about HIV/AIDS on the dependent variable was almost unchanged (0.12, $P < 0.01$). Marital status has a significantly negative impact on the frequency of commercial sex use (−1.10, $P < 0.001$). In Model B3, the impact of 'knowledge about HIV/AIDS' on the dependent variable was almost unchanged, while the regression coefficient of marital status on dependent variable changed from −1.10 to −0.90. Among the other control variables, age and monthly income had significantly negative impacts on the dependent variable, meaning that migrants aged 28–35 used commercial sex more frequently than those aged >35 (−0.64, $P < 0.01$), and those with a monthly income under 1000 used commercial sex more frequently than those with a monthly income of ¥1000–1500 (−0.70, $P < 0.01$).

With the control variables included stepwise into the model, the explanatory power increased but stayed relatively low. The Cox and Snell R^2 and Nagelkerke R^2 in Model A1 were 0.016 and 0.024, respectively, and increased to 0.051 and 0.078 in Model A2 and to 0.072 and 0.110 in Model A3, respectively. The Cox and Snell R^2 and Nagelkerke R^2 in Model B1 were 0.012 and 0.015, respectively, and increased to 0.046 and 0.058 in Model B2 and to 0.066 and 0.085 in Model B3, respectively.

Table 3 presents the regression results for factors associated with condom use. In Model C1, knowledge about HIV/AIDS and knowledge about STDs had significantly positive impacts on frequency of condom use (0.11, $P < 0.001$; 0.23, $P < 0.01$). In Model C1, when the frequency of commercial sex and marital status were included in the model as control variables, the effects of knowledge about HIV/AIDS and STDs on the dependent variable were almost unchanged, while including the frequency of commercial sex had a significantly positive impact (0.12, $P < 0.01$) on the frequency of condom use during commercial sex. Marital status had a significantly negative impact on the dependent variable (−0.71, $P < 0.001$). In Model C3, the effects of knowledge about HIV/AIDS and STDs and the frequency of commercial sex and marital status on the dependent variables were almost unchanged, while only age had a significantly negative impact on the dependent variable (−0.63, $P < 0.001$).

With the control variables included stepwise into the model, the explanatory power increased but stayed at a relatively low level. The Cox and Snell R^2 and Nagelkerke R^2 in Model C1 were 0.049 and 0.052, respectively, and increased to 0.083 and 0.089 in Model C2 and to 0.107 and 0.113 in Model C3, respectively.

Table 2 Factors associated with commercial sex use

Dependent variable: if have had commercial sex (reference: no)	*Model A1*	*Model A2*	*Model A3*
The attitudes toward commercial sex	1.02	1.04	1.03
Knowledge of HIV/AIDS	1.12**	1.13**	1.15***
Knowledge of STDs	0.94	0.97	0.96
Marital status (reference: unmarried)			
Married but separated		0.73	0.85
Married and cohabitating		0.35***	0.42***
Migration duration			1.00
Age (reference: 28–35)			
35 and above			0.52**
Education (reference: primary school and under)			
Junior high school			0.81
Senior high school			0.95
Monthly income (reference: <1000)			
1000–1500			0.57*
>1500			0.69+
2 Log likelihood	850.93	820.91	773.23
Cox and Snell R^2	0.016	0.051	0.072
Nagelkerke R^2	0.024	0.078	0.110
Dependent variable: the frequency of commercial sex	Model B1	Model B2	Model B3
The attitudes toward commercial sex	0.03	0.02	0.01
Knowledge of HIV/AIDS	0.11**	0.12**	0.14**
Knowledge of STDs	−0.07	−0.05	−0.05
Marital status (reference: unmarried)			
Married but separated		−0.37	−0.22
Married and cohabitating		−1.10***	−0.90***
Migration duration			−0.01
Age (reference: 28–35)			
35 and above			−0.64**
Education (reference: primary school and under)			
Junior high school			−0.36
Senior high school			−0.37
Monthly income (reference: <1000)			
1000–1500			−0.70**
>1500			−0.32
2 Log Likelihood	1015.73	1091.38	1092.77
Cox and Snell R^2	0.012	0.046	0.066
Nagelkerke R^2	0.015	0.058	0.085

Data source: Survey on Reproductive Health and Family Living of Male Migrant Bachelors in Urban Area in Xi'an City from December 2009 to January 2010
$+P<0.1$, $*P<0.05$, $**P<0.01$, $***P<0.001$.

Discussion

Main finding of this study

The prevalence of commercial sex was the highest (37.2%) in our unmarried sample and was the lowest among the married and cohabitating migrants (17.2%), much higher than that previously reported for rural residents.[10] A possible explanation is that rural residents have less access to sex workers than rural–urban migrants, and the income of rural residents is much lower than rural–urban migrants.[20–22]

There were no significant differences in the frequency of commercial sex use among the three marital groups in this study. In addition, there were no significant differences in knowledge about HIV/AIDS among the three groups, likely because the Chinese government has conducted educational programmes quite broadly among migrants.[23,24]

Table 3 Factors associated with condom use

Independent variable: condom use frequency	*Model C1*	*Model C2*	*Model C3*
Knowledge of HIV/AIDS	0.11***	0.09***	0.11***
Knowledge of STDs	0.23**	0.26**	0.24**
Frequency of commercial sex		0.12**	0.10**
Marital status (reference: unmarried)			
Married but separated		−0.38	−0.34
Married and cohabitating		−0.71***	−0.68***
Migration duration			0.02+
Age (reference: 28–35)			
35 and above			−0.63***
Education (reference: primary school and under)			
Junior high school			−0.07
Senior high school			−0.12
Monthly income (reference: <1000)			
1000–1500			−0.27
>1500			−0.10
2 Log Likelihood	1367.09	1698.84	2939.02
Cox and Snell R^2	0.049	0.083	0.107
Nagelkerke R^2	0.052	0.089	0.113

Data source: Survey on Reproductive Health and Family Living of Male Migrant Bachelors in Urban Area in Xi'an City from December 2009 to January 2010.
$+P < 0.1$, $*P < 0.05$, $**P < 0.01$, $***P < 0.001$.

From the regression analysis, knowledge of HIV/AIDS, marital status, age and monthly income were significantly associated with prevalence and frequency of commercial sex use. Male migrants with a greater knowledge of HIV/AIDS and unmarried migrants were more likely to use commercial sex and used commercial sex more frequently, consistent with results from previous studies.[6,7]

The frequency of condom use was relatively low and varied greatly among migrants with different marital statuses. The highest level was among the unmarried, and the lowest level was among the married and cohabitating, in agreement with previous findings among rural residents.[10] However, there was no significant difference in condom use frequency among the three groups.

Our regression analysis indicates that knowledge about HIV/AIDS and STDs had a significant positive effect on the frequency of condom use, in accord with the findings from previous research.[11,25,26] Marital status has a significantly positive impact on condom use frequency and age had a significantly negative impact on condom use frequency.

What is already known on this topic

In a survey conducted among migrants (including women) in Shenzhen in 2005, ~6% of respondents admitted using commercial sex.[27] Approximately 4.6% of respondents reported having commercial sex in a survey conducted at Baotou City in Inner Mongolia,[13] and another Shenzhen survey found that 7.9% of male migrants admitted to having commercial sex.[14]

Existing research suggests that attitudes, knowledge of AIDS, marital status and living arrangements, income, education, areas and age are associated with the prevalence of commercial sex use. A study among migrants in Shenzhen found that the average score obtained in a test of knowledge about AIDS was slightly higher among those who have had commercial sex than in those who have not.[14] Another study reported that married men are less likely to use commercial sex than unmarried men, and men who are living with their spouses are less likely to use commercial sex than those who are separated from their spouses.[20,22] A study of Hispanic Americans found that the frequency of commercial sex use decreases with increasing educational level and increases with increasing income level; surveys in Cheing Mai, Thailand and Jiangxi, China found similar results.[12,20,28]

With regard to condom use, a study in Inner Mongolia suggested that only about 36% of the sample (including women) frequently used condoms.[13] A survey conducted among patients with STDs in Jiangxi, China indicated that only 27.8% of men used condoms voluntarily.[12] Another survey

conducted in Shenzhen reported that among 133 men who reported having commercial sex, only 10 used a condom every time (about 7.5%); 38 persons used a condom occasionally (about 29%) and 44 persons never used a condom (about 33%).[14]

Knowledge about STDs and HIV/AIDS, income and educational level have been found to be associated with condom use in commercial sex. A study in Shenzhen found that knowledge of STDs and AIDS was associated with condom use among men having commercial sex.[11] A similar phenomenon was also found in Hong Kong.[26] Another survey conducted in Jiangxi of China found that men with higher educational level and income are more likely to use condoms while having commercial sex.[12]

What this study adds

While there have been previous studies on commercial sex use in China, many of these studies included both ordinary men and women in the study population. This study firstly focuses on the commercial sex behaviours in a population of 'marriage-squeezed' male migrants in a context of sex imbalance. Due to the male-biased sex ratio and resulting marriage squeeze, many male migrants (including unmarried and married but separated) lack a stable sexual relationship, and commercial sex becomes a compensatory measure. At the same time, with less knowledge about HIV/AIDS and STDs, the prevalence of unprotected commercial sex among unmarried male migrants is high. There are nearly 30 million marriage-squeezed bachelors in China; when such a large number of marriage-squeezed bachelors are connected with other similar groups of the same or different gender through unprotected commercial sex as the bridge, the risks of HIV/AIDS and STD transmission will be multiplied.[8,9,29] This study reveals the possible impact of the sex ratio imbalance and resulting marriage squeeze on public health.

Limitations of this study

First, the sample used in this study is from a city in western China; therefore, our study results may not reflect the trends in eastern and southern cities. In addition, the sensitivity of the sexual issues involved in this survey led to a high rate of missing data, which may have contributed to bias. In a previous study, we conducted a similar survey among rural residents in rural areas that are not directly connected to the migrants in this study. Thus, the samples in the two surveys are not comparable.

Secondly, certain variables in this study were measured using relatively simple measurements, which might lead to a bias in reliability and validity of measurements. For example, as suggested by Majra,[30] condom use should be measured by 'correct and consistent use' in order to assess the risk of HIV and STD transmission. However, in our study, we adopted the 'frequency of use' for measuring condom use, which precludes a precise measurement of correct use.

Thirdly, the data and measurements used in this study were all from a survey, which was not specifically designed to focus on questions relevant to commercial sex among involuntary bachelors. Therefore, this study excluded many relevant questions.

Future studies can be improved as follows: revise and modify the present questionnaires and measurements, select more representative cities where migrants are concentrated to conduct new surveys and improve the reliability and validity of the measurements through better survey technology.

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References

1 Attané I, Zhang QL, Li SZ *et al.* Bachelorhood and sexuality in a context of female shortage: evidence from a survey in rural Anhui, China. *China Q* 2013;**215**:703–26.

2 Li SZ, Zhang QL, Yang XY *et al.* Male singlehood, poverty and sexuality in rural China: an exploratory survey. *Population-E* 2010;**65(4)**:679–94.

3 Chen YH, Ullrich M. Chinese male overpopulation-scale, structure, influence factors and development trends analysis. *Market Popul Anal (in Chinese)* 2001;**3**:1–11.

4 Li SZ, Jiang QB, Feldman WM. *Gender Preference and Social Development (in Chinese)*. Beijing: China Social Sciences Literature Press, 2006.

5 Li Z, Wei SZ. Gradient marriage problem. *Contemp Youth Stud (in Chinese)* 1986;**23(9)**:21–8.

6 Yang XY, Attané I, Li SZ *et al.* Masturbation as a compensation for partnered-sex among enforced male bachelors in rural China—findings from a survey conducted in a context of a deficit of females. *J Mens Health* 2012a;**9(4)**:220–9.

7 Yang XY, Attané I, Li SZ *et al.* On same-sex sexual behaviors among male bachelors in rural China: evidence from a female shortage context. *Am J Mens Health* 2012b;**6(2)**:108–19.

8 Merli MG, Hertog S, Wang B *et al.* Modeling the spread of HIV/AIDS in China: the role of sexual transmission. *Popul Stud* 2006; **60(1)**:1–22. doi:10.1080/00324720500436060.

9 Giovanna Merli M, Sara Hertog. Masculine sex ratios, population age structure and the potential spread of HIV in China. *Demogr Res* 2010;**(22)**:63–94.

10 Yang XY, Attane I, Li SZ. Commercial sex and condom use among involuntary bachelors: An exploratory survey in rural China. *Am J Mens Health* 2014;**8(3)**:205–16.

11 Zuo Q, Shan GL, He B *et al*. Analysis on the correlation between men' commercial sex behavior patterns and their personality. *Health Psychol J* 2003;**11(5)**:328–30.

12 Liu B, Lv YP, Wan LS *et al*. Analysis on influential factors of extramarital, commercial sexual behaviors and condom use of STD patients in Jiangxi Province. *Contemp Prev Med* 2007;**34(14)**:2606–8.

13 Li B, Wang Y, Zhang F *et al*. A Study on extramarital sexual intercourse and condom use related factors among floating population. *Chin J Public Health* 2008;**24(7)**:791–2.

14 Wen B, Li YY, Zhou Y *et al*. Commercial sexual behavior among migrants in Shenzhen city. *Chin J Public Health* 2012;**28(3)**:391–2.

15 Morison L, Weiss HA, Buvé A *et al*. Commercial sex and the spread of HIV in four cities in sub-Saharan Africa. *AIDS* 2001;**15(4)**:61–9.

16 Mills S, Saidel T, Bennett A *et al*. HIV risk behavioral surveillance: a methodology for monitoring behavioral trends. *AIDS* 1998;**12**:153–9.

17 Wit De J, Storebe W, Voorme De E *et al*. Understanding AIDS preventive behaviour with casual and primary partners in homosexual men: the theory of planned behaviour and the information-motivation-behavioural-skill model [J]. *Psychol Health* 2000; **15**:325–40.

18 Matteson DR. Bisexual and homosexual behaviour and HIV risk among Chinese-, Filipino- and Korean-American men [J]. *J Sex Res* 1997;**34(1)**:93–104.

19 Wu HX, Li SZ. Attitudes of childbearing among rural–urban migrants influenced by social network: a study in Shenzhen. *Popul Dev* 2008;**14(6)**:11–20.

20 Parrado EA, Flippen CA, McQuiston C. Use of commercial sex workers among Hispanic migrants in North Carolina: implications for the spread of HIV. *Perspect Sex Reprod Health* 2004;**36(4)**:150–6.

21 Carael M, Slaymaker E, Lyerla R *et al*. Clients of sex workers in different regions of the world: hard to count. *Sex Transm Infect* 2006;**82(3)**:26–33.

22 Leclerc PM, Garenne M. Clients of commercial sex workers in Zambia: prevalence, frequency, and risk factors. *Open Demogr J* 2008;**1**:1–10.

23 Kaufman J, Jing J. China and AIDS—the time to act is now. *Science* 2002;**296(5577)**:2339–40.

24 Wang ST. Special Edition: Prevention AIDS, China taking action, 2004. http://www.people.com.cn/GB/14739/22109/2447929.html (date last accessed 14 April 2004–9 August 2011).

25 Ford K, Wirawan DN, Fajans P *et al*. Behavioral interventions for reduction of sexually transmitted disease/HIV transmission among female commercial sex workers and clients in Bali, Indonesia. *AIDS* 1996;**10(2)**:213–22.

26 Lau JTF, Tang ASY, Tsui HY. The relationship between condom use, sexually transmitted diseases, and location of commercial sex transaction among male Hong Kong clients. *AIDS* 2003;**17(1)**:105.

27 Cai WD, Tan GJ, Luo XR. A survey on knowledge and behaviors of AIDS among migrants in Shenzhen city. *J Public Health Prev Med* 2006;**17(6)**:103–4.

28 Celentano DD, Nelson KE, Suprasert S *et al*. Behavioral and sociodemographic risks for frequent visits to commercial sex workers among northern Thai men. *AIDS* 1993;**7(12)**:1647.

29 Wang B, Li X, Stanton B *et al*. HIV-related risk behaviors and history of sexually transmitted diseases among male migrants who patronize commercial sex in China. *Sex Transm Dis* 2007;**34(1)**:1.

30 Majra J. Correct and consistent use of condoms. *Indian J Sex Transm Dis* 2009;**30(1)**:53.