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## Characteristics of low-tier female sex workers who engaged in commercial sex with old male clients in Zhejiang Province, China: a cross-sectional study

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4 **Characteristics of low-tier female sex workers who engaged in commercial**  
5 **sex with old male clients in Zhejiang Province, China: a cross-sectional study**  
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## Abstract

**Objectives:** To characterise low-tier female sex workers (FSWs) who engaged in commercial sex with old male clients (OMCs).

**Design:** Cross-sectional study.

**Setting:** 21 counties of Zhejiang Province, China.

**Participants:** 2647 low-tier FSWs who participated in the survey from September to November 2013, and responded to the question regarding whether they engaged in commercial sex with OMCs during the previous month.

**Main outcome measures** Sociodemographic characteristics, factors related to sexual behavior, HIV/STI risk perception, ever exposure to HIV prevention, and degree of self-efficacy regarding condom use were collected by a face-to-face questionnaire administered by trained interviewers.

**Results:** Of the 2647 participants, 1165 (44.0%) had engaged in commercial sex with OMCs over the previous month. Low-tier FSWs from roadside shops, those who had a longer duration of sex work, those with a larger number of clients, those who had engaged in anal or oral sex during the previous month, those who presently used contraception measures, those who had STI-related symptoms and those who had exposure to HIV prevention services during the previous half year were more likely to engage in commercial sex with OMCs; those who had received a higher level of education, those from small venues other than streets, hair salons and roadside shops, those who had higher trade fees for commercial sex, those who had sex with young clients during the previous month, and those who had seen a doctor during the previous half year were less likely to engage in commercial sex with OMCs.

**Conclusions:** Low-tier FSWs who engaged in commercial sex with OMCs were more vulnerable to HIV infection/STIs than those who didn't engage in this behaviour. Special attention should be given to this group of FSWs, and their characteristics should be carefully taken into account in future intervention programs targeting low-tier FSWs.

**Keywords:** Low-tier; Female sex worker; Old male client; Commercial sex.

### Strength and limitation of this study

- The first study examining the characteristics of low-tier FSWs who engaged in commercial sex with old male clients in China.
- A large study implemented in 21 counties.
- Possible information biases, particularly those related to sexual behavior questions, due to the sensitivity of the sexual behavior and the illegality and stigma of sex work in China.
- A cross-sectional design with a short time frame may limit the generalisation of our finding to other regions or whole low-tier FSWs in China.

### INTRODUCTION

Female sex workers (FSWs) are at much higher risk for HIV infection than the general female population, and a systematic review and meta-analysis indicated that FSWs were 13.5 times more likely to be living with HIV than the general female population in low- and middle-income countries [1]. A meta-analysis estimated global HIV prevalence among FSWs at 10.4% and an increased HIV burden among FSWs compared to that among adult women in all regions, although there is great variability in HIV prevalence among FSWs across regions [2]. FSWs are considered an important bridge population in the transmission of HIV and sexually transmitted infections (STIs) between high-risk clients and noncommercial partners such as husbands or regular boyfriends [3, 4].

FSWs in China are classified as high-, middle-, and low-tier according to the price of sex transactions, and work venue; low-tier FSWs charge low fees for each sexual service, usually work on the street, or in small or hidden venues such as hair salons, rental rooms, small hotels and so on [5-9]. Previous studies show that low-tier FSWs usually have lower living standards and are older, less educated, married, separated or divorced [9, 10]. These sociodemographic characteristics may be related to a higher rate of condomless sex [9, 10] and lower use of HIV prevention services [11]. Low-tier FSWs always have less understanding of HIV and STI information and do not use condoms consciously and regularly [6, 12, 13]. Low-tier FSWs who use

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4 condoms infrequently could attract more clients and earn extra money, economic  
5 pressure limits their power to negotiate safer sex [14], and consistent condom use  
6 would decrease while having sex with regular clients [15]. These factors result in  
7 higher rates of HIV and STIs among low-tier FSWs than among high- and middle-tier  
8 FSWs[6, 8]. Two cross-sectional studies revealed that the HIV and syphilis  
9 prevalence among low-tier FSWs were 2-5% and 11-15%, respectively [8, 16]. A  
10 similar conclusion was reached that the HIV prevalence among low-tier FSWs was  
11 1.37%, while that among middle- and high-tier FSWs was only 0.28% and 0.07%,  
12 respectively, in a meta-analysis [17].

21 On the other hand, the number and proportion of elderly people with HIV have  
22 increased rapidly in recent years, internationally and domestically. According to a  
23 UNAIDS report, the number of HIV-infected people who are over 50 years of age  
24 was reported to be approximately 5.8 million in 2015, which accounted for 15.8% of  
25 36.7 million HIV infections[18]. In Canada, over 20% of all newly diagnosed HIV  
26 cases are now in people 50 years of age and older, and the proportion of newly  
27 diagnosed HIV cases among those  $\geq 50$  years increased from 15.1% to 22.8%  
28 between 2008 and 2017, with a higher proportion of newly diagnosed HIV cases  
29 being male in the older group (81.2%) than in the younger group (74.6%)[19].

38 In China, the number of diagnosed older HIV cases has also increased, and the  
39 number of newly diagnosed patients greater than or equal to 65 years of age in 2016  
40 represented 10.4% of the total number of newly diagnosed cases for that year[20].  
41 The majority of newly diagnosed persons aged 65 and over 65 years are male, and the  
42 male-to-female ratio is 5 to 1. The main infection mode among elderly infected  
43 persons is heterosexual sex[21], and 46% of HIV cases were men over 50 years of age  
44 in one southern province of China[22]. Commercial sex is the key transmission route  
45 for elderly male HIV cases, and 70-90% of older male people living with HIV admit  
46 to having commercial sex[23]. The proportion of commercial sex infections among  
47 male cases increases with age (approximately 30.0% in the 15-19 age group and  
48 65.0% to 67.0% in the  $\geq 60$  age group)[21]. In Zhejiang Province, newly diagnosed  
49 HIV cases aged 60 or over 60 years increased rapidly, with an annual average  
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4 increase of 15.6% from 2015 to 2018; 80.6% of newly diagnosed cases during this  
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6 period of time were male, and two-thirds of them reported experiencing heterosexual  
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8 commercial sex[24].

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10 Previous research in China has documented the characteristics of men who had  
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12 sex with low-tier SWs. Male clients who visit low-tier FSWs are more likely to  
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14 practice unprotected sex than those who visit high-tier FSWs, have low risk  
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16 awareness and have low knowledge of HIV/STIs[25]. Older male clients (OMCs) had  
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18 high HIV and syphilis infection rates, and most of them visited low-tier venues and  
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20 used condoms at a very low rate while having sex with low-tier FSWs[26, 27]. The  
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22 older the client, the lower the tier of the sex venues at which the sex transaction is  
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24 engaged[27]. Older males who were infected with HIV through commercial sex  
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26 reported that sex transactions were usually conducted at small venues, such as a rental  
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28 room or a small hotel, with the payment per sex act being less than 50 Yuan  
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30 (approximately 7 US dollars) in Zhejiang Province [24].

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32 Increasing evidence has shown that low-tier FSWs and elderly clients not only  
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34 have a large degree of intersection in commercial relationships but also influence each  
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36 other in terms of HIV/STI infection. However, to date, there is no literature that  
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38 documents the characteristics of low-tier FSWs who have sex with OMCs in China.  
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40 This study aimed to explore the correlates related to low-tier FSWs who engaged in  
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42 this specific behavior, to provide in-depth insight into this group of FSWs and to  
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44 develop comprehensive and appropriate HIV prevention programs targeting low-tier  
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46 FSWs.

## 47 **METHODS**

### 48 **Location and participant**

49  
50 The data in this manuscript was derived from a large-scale cross-sectional study  
51  
52 on low-tier FSWs carried out in 21 counties that implemented the AIDS Care project  
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54 in Zhejiang Province, from September to November 2013. Zhejiang is a province with  
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56 balanced regional development and a relatively developed economy in China. The  
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58 study location and method, introduction to Zhejiang province and AIDS Care project,  
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60 were already documented elsewhere [28].



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4 FSWs were eligible for participation in the study if they were currently engaging  
5 in commercial sex on the street and/or at small venues, including hair salons, roadside  
6 shops, and other venues with fewer than nine FSWs. A pilot survey to confirm the  
7 location of low-tier FSWs in these 21 counties was conducted, and then a plan to  
8 conduct the field survey was developed.  
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13 The trained staff from local centers for disease control and prevention(CDC)  
14 reached out to recruit and face-to-face interview participants using a structured  
15 questionnaire anonymously. The study's purpose, method, and confidentiality policy  
16 was explained verbally. The participants were recruited voluntarily. All participating  
17 FSWs gave their informed oral consent to participate in the study. For each FSW  
18 participated, their consent to participate in the study was recorded on the respective  
19 questionnaire. The study was formally reviewed and approved by the ethical committee  
20 of Zhejiang provincial CDC.  
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29 In total, 2648 low-tier FSWs participated in the study. Of these, 2647 FSWs who  
30 responded to the question regarding whether they engaged in commercial sex with  
31 OMCs during the previous month were included in the analysis of this study. Our  
32 participants were divided into two groups, those who engaged in commercial sex with  
33 OMCs and those who didn't engage in this behaviour. In this study, OMCs was defined  
34 as those who are over 50 years old, and were based on the report of the low-tier FSWs.  
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#### 40 **Questionnaire development and measures**

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42 The questionnaire used in this study was developed based on the instruments used  
43 for HIV sentinel surveillance among FSWs in Zhejiang and comprehensive reviews  
44 of foreign and domestic literatures on low-tier FSWs. The questionnaire was finalised  
45 by repeated discussions within the research team, consultations with the local CDCs  
46 staff who conducted outreach interventions among FSWs in the counties studied, and  
47 two pilot surveys with low-tier FSWs in two counties.  
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54 Self-reported commercial sex with OMCs in the previous month was used as a  
55 dependent variable in the analysis. The independent variables included  
56 sociodemographic characteristics, factors related to sexual behavior, HIV/STI risk  
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4 perception, ever exposure to HIV prevention, and degree of self-efficacy regarding  
5 condom use.  
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8 The scale measuring self-efficacy regarding condom use consisted of three  
9 questions related to whether a FSW could persuade a client to use a condom when a  
10 client refused to do so, whether she could refuse sex when a client refused to use a  
11 condom, and whether she could insist on using a condom with clients every time. The  
12 possible responses were “I can,” “I can’t,” and “I’m not sure.” Cronbach’s alpha  
13 coefficients for the internal consistency of this scale and the range of scores were  
14 computed; FSWs were categorized into three groups with different levels of scores  
15 based on the frequency distribution of each scale. The scores for this scale ranged from  
16 0 to 3, with 3 reflecting a high level of self-efficacy, 1–2 reflecting a middle level of  
17 self-efficacy, and 0 reflecting a low level of self-efficacy. The Cronbach’s alpha  
18 coefficient for this scale was 0.913.  
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### 29 **Patient and public involvement**

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31 Patients were not involved in the questionnaire survey. The questionnaire survey  
32 was face-to-face interviewed by trained staff of 21 local CDCs in the study field.  
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### 35 **Statistical analysis**

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37 Data were analyzed using SPSS for Windows (Version 17.0; SPSS Inc.,  
38 Chicago, IL, USA). Univariate analysis was first used to determine the possible  
39 association with self-reported commercial sex with OMCs for each independent  
40 variable. The significant variables resulting from univariate analysis were then  
41 introduced into a multivariate logistic regression model in order to adjust for possible  
42 confounding. The strength of statistical associations between the dependent variable  
43 and each independent variable was measured by crude and adjusted Odds ratios (OR),  
44 their corresponding 95% confidence intervals(95% CI) and a *P*-value based on a chi-  
45 square test of proportions. *P* < 0.05 was considered as statistically significant for these  
46 univariate and multivariable analyses.  
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## 56 **RESULTS**

### 57 **Sociodemographic characteristics**

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4 Of the 2647 participants, 1165 (44.0%) had commercial sex with OMCs during  
5 the previous month, and 1482 (56.0%) did not. Of all participants, 31.8% were aged 25  
6 years or younger, and 27.4% were older than 35 years of age (Table 1). Overall, 78.2%  
7 came from provinces other than Zhejiang. In terms of education, 36.8% had received,  
8 at most, primary school education, and 9.9% had received at least high school education.  
9 28.8% were not married, and 62.4% were married or had cohabited with someone. A  
10 total of 28.2% earned an income of less than 3000 Yuan (one Yuan≈0.143 US dollars)  
11 per month, and 40.3% earned an income of 3000-4000 Yuan. The sources of the  
12 participants were 15.6%, 63.5%, 10.5%, and 10.2% for the street, hair salons, roadside  
13 shops and other, respectively.  
14

### 23 **Sociodemographic correlates of commercial sex with OMCs among low-tier FSWs**

24  
25 Univariate analysis indicated that participant residence and income per month  
26 were not associated with self-reported commercial sex with OMCs (Table 1). FSWs  
27 who had junior high school education (OR=0.63, 95% CI=0.54-0.75) or who had at  
28 least a high school education (OR=0.43, 95% CI=0.32-0.57) versus those who had  
29 primary school education at most and FSWs who were from hair salons (OR=0.62, 95%  
30 CI=0.50-0.77) and locations other than streets, hair salons, and roadside shops  
31 (OR=0.26, 95% CI=0.19-0.37) versus those from streets were less likely to engage in  
32 commercial sex with OMCs. FSWs who were aged 25-35 years (OR=1.23, 95%  
33 CI=1.02-1.48) and those who were over 35 years (OR=2.67, 95% CI=2.17-3.26) versus  
34 those who were 25 or less than 25 years old and FSWs who were married or had  
35 cohabited with someone (OR=1.34, 95% CI=1.13-1.60) and those who were widowed  
36 or divorced (OR=1.80, 95% CI=1.34-2.43) versus those who were unmarried were  
37 more likely to engage in commercial sex with OMCs.  
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### 50 **Behavioral and psychological correlates of commercial sex with OMCs among** 51 **low-tier FSWs**

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53 Univariate analysis indicated that those FSWs who had commercial sex with  
54 young men (OR=0.64, 95% CI=0.55-0.76), those who earned an average price of 51-  
55 100 Yuan (OR=0.53, 95% CI=0.42-0.67) and over 100 Yuan (OR=0.24, 95% CI=0.19-  
56 0.31) per commercial sex act versus those who earned 50 or less than 50 Yuan, those  
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4 who always/often used condoms versus those who never/rarely used them (OR=0.70,  
5 95% CI=0.55-0.88), and those who had seen a doctor during the previous 6 months  
6 versus those who had not (OR = 0.74, 95% CI=0.62-0.87) were less likely to engage in  
7 commercial sex with OMCs during the previous one month (Table 2).  
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11 Those FSWs who had engaged in commercial sex for 13-24 months (OR=1.89,  
12 95% CI=1.50-2.38) or more than 24 months (OR=3.67, 95% CI=3.07-4.38) versus  
13 those who had worked 1–12 months, those who had experienced commercial sex with  
14 16-30 clients (OR=2.66, 95% CI =2.19-3.13) or more than 30 clients (OR =3.37, 95%  
15 CI=2.77-4.11) versus those who had fewer clients, those who had experienced anal sex  
16 with clients versus those who had not (OR=4.30, 95% CI=2.86-6.44), those who had  
17 experienced oral sex versus those who had not (OR=3.12, 95% CI=2.57-3.78), those  
18 who used contraception at present versus those who did not (OR=2.46, 95% CI=2.10-  
19 2.88)(those FSWs who used intrauterine devices, had undergone tubal ligation, or used  
20 the Norplant method were considered to be using contraception), those who had shown  
21 STI-related symptoms during the previous 6 months versus those who had not  
22 (OR=2.81, 95% CI=1.93-4.10), those who were diagnosed with an STI versus those  
23 who were not (OR=1.67, 95% CI=1.32-2.12), those who were exposed to an HIV  
24 prevention service (any intervention involving distribution of education material,  
25 distribution of condoms, face-to-face education by medical staff, peer education, and  
26 others) during the previous half year versus those who were not (OR=1.24, 95%  
27 CI=1.03-1.49), those who perceived that it was likely that they might contract HIV  
28 versus those who perceived it was impossible or were unsure (OR=1.24, 95% CI=1.30-  
29 1.49), and those who perceived that they were likely to contract STIs versus those who  
30 perceived it was unlikely or were unsure (OR=1.52, 95% CI=1.29-1.80) were more  
31 likely to engage in commercial sex with OMCs during the previous one month.  
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52 Experiences with middle-aged clients during the previous month and self-efficacy  
53 for condom use were not associated with commercial sex with OMCs.  
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### 55 **Multivariate analysis**

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57 After controlling for possible confounding variables, multivariate analysis  
58 revealed that those FSWs who received education through junior high school (OR=0.78,  
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4 95% CI= 0.63-0.95) and at least high school (OR=0.61, 95% CI=0.44-0.86) versus  
5 those who received primary school education at most, those from locations other than  
6 streets, hair salons, and roadside shops versus those from streets (OR=0.53, 95% CI=  
7 0.35-0.80), those who earned an average price of 51-100 Yuan (OR=0.58, 95% CI  
8 =0.44-0.76) or over 100 Yuan (OR =0.33, 95% CI=0.25-0.45) per commercial sex act  
9 versus those who earned 50 or less than 50 Yuan, those who had engaged in commercial  
10 sex with young clients versus those who did not (OR=0.72, 95% CI= 0.59-0.89) and  
11 those who had seen a doctor versus those who had not (OR=0.61, 95% CI=0.49-0.76)  
12 were all less likely to engage in commercial sex with OMCs (Table 3).  
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21 Those from roadside shops versus those from streets (OR=1.49, 95% CI= 1.03-  
22 2.15), those who had engaged in commercial sex for 13-24 months (OR=1.33, 95%  
23 CI=1.02-1.74) or for over 24 months (OR=2.22, 95% CI=1.79-2.76) versus those who  
24 had worked 1–12 months, those who had 16-30 sexual clients (OR=1.99, 95% CI  
25 =1.59-2.50) and those who had over 30 sexual clients (OR=2.14, 95% CI= 1.69-2.70)  
26 versus those with fewer than 16 clients, those who performed anal sex versus those who  
27 did not (OR=3.02, 95% CI=1.88-4.87), those who performed oral sex versus those who  
28 did not (OR=2.64, 95% CI=2.08–3.35), those who used contraception versus those who  
29 did not (OR=1.95, 95% CI=1.58-2.39), those who reported STI-related symptoms  
30 versus those who did not (OR=1.36, 95% CI=1.02-1.82) and those who were ever  
31 exposed to HIV prevention service versus those who were not (OR=2.00, 95% CI=1.51-  
32 2.64) were more likely to engage in commercial sex with OMCs.  
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## 44 **DISCUSSION**

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46 As we know, this study is the first to examine the characteristics of low-tier FSWs  
47 who engaged in commercial sex with OMCs in China. Chinese studies have revealed  
48 that low-tier FSWs had high rate of unprotected sex[9,10,12,13], and high prevalence  
49 of HIV/STI infection[6,8,16,17]. We found that 44% of our low-tier FSWs had  
50 commercial sex with OMCs during the previous month, and that they engaged in more  
51 risky behaviours related to HIV/STI infectin than other low-tier FSWs who did't have  
52 this behaviour. Our study enrich the litearure on low-tier FSWs in China, and makes  
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4 us understand that there are different levels of risks for HIV infections/STI even among  
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6 low-tier FSWs.

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8 Low-tier FSWs had low sociodemographic level[9,10]. The low-tier FSWs who  
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10 had commercial sex with OMCs in this study were more likely to be less educated. A  
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12 previous study showed that low-tier FSWs with lower education are associated with  
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14 lower HIV-related knowledge[12], lower rates of condom use and lower participation  
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16 in HIV testing[9, 29], which would lead this group of low-tier FSWs to have a greater  
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18 risk of HIV/STI infections.

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20 Our study indicated that a long duration of commercial sex is indicative of low-  
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22 tier FSWs having commercial sex with OMCs. A trend was exhibited that the longer  
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24 they engaged in commercial sex, the more likely they were to have had sex with OMCs.  
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26 This might be because with the prolonged duration of sex work, the possibility of  
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28 conducting sex with older clients increased. In addition, the competitiveness of FSWs  
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30 with longer histories of participation in sex work might be getting lower and lower,  
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32 motivating them to have sex with OMCs. One Chinese study reported that older FSWs  
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34 had fewer clients and made less money than younger women working in the same  
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36 venue[30]. A longer duration of participation in commercial sex is a risk factor for  
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38 STIs[31] and HIV infection[26, 32]. The relationship between a long duration of sex  
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40 work and engaging in sex with OMCs should be noticed when carrying out HIV-related  
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42 propaganda and interventions among low-tier FSWs.

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44 Low-tier FSWs entered into sex work mainly because of economic burden; and  
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46 compared with high- and middle-tier FSWs, low-tier FSWs earn less money per sex  
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48 act[30, 33, 34]. Our study revealed that the higher the trade fee per sex act, the less  
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50 likely low-tier FSWs were to engage in commercial sex with OMCs, and we also found  
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52 that low-tier FSWs who had commercial sex with OMCs had more sex clients during  
53  
54 the previous month than those who did not have this behavior, implying that this group  
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56 of low-tier FSWs have less competition for sex service than other low-tier FSWs; thus,  
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58 they had to have sex with more clients to earn more money. As a risky sexual behavior,  
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60 multiple sexual partners was a high-risk factor for HIV infection for low-tier FSWs;

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4 however, condom use did not increase for this group of FSWs in our multivariate  
5 analysis, which makes them vulnerable to HIV and STI infection.  
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8 In our study, low-tier FSWs who had commercial sex with OMCs were less likely  
9 to have sex with young clients, indicating that they are less attractive to young clients,  
10 so they turned to elderly individuals for sex transactions. This group of FSWs was  
11 tended to work on streets and in roadside shops; in addition, they had lower levels of  
12 education, implying that they have a lower socioeconomic status. Our findings could  
13 be applied to other results in China. OMCs usually search for low-tier FSWs for  
14 commercial sex[35], and street-based FSWs have lower education levels and charge  
15 less for their services than venue-based FSWs[36]. OMCs were found to have higher  
16 rates of HIV and syphilis infection than other general male populations in China<sup>[35]</sup>,  
17 street-based FSWs use condoms at a very low rate, the prevalence of STIs among them  
18 is high[36], and the majority of older male HIV cases contracted HIV by commercial  
19 sex with FSWs at small venues[24]. Precautionary measures should be taken because  
20 the HIV and STI transmission network might already be interwoven between lower-tier  
21 FSWs and OMCs, and the spouse or regular partners of OMCs are at greater risk for  
22 STI/HIV infection. In China, the majority of older HIV-positive women are infected  
23 via sexual transmission from their male spouse[23].  
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39 Studies have reported that the risks of HIV acquisition and transmission for  
40 receptive anal sex are dramatically higher than those for vaginal sex[37-39]. In our  
41 study, 8.7% of those who had sex with OMCs practiced anal sex. FSWs who had sex  
42 with OMCs were more likely to have anal sex. Foreign literature reported that most  
43 low-tier FSWs did not understand the risk of anal sex in HIV and STI transmission [40].  
44 Similarly, we found that this group of FSWs were more likely to have oral sex.  
45 Although oral sex involves a low risk of STI/HIV infection, oral sex practitioners have  
46 a profile of risky behaviors relevant to STIs/HIV infection, such as multiple  
47 partnerships and less use of condoms in Chinese studies[41, 42]. Thus, the roles of anal  
48 intercourse and oral intercourse in HIV/STI transmission should not be ignored  
49 considering that high rates of the two sex behaviors were reported in FSWs having sex  
50 with OMCs.  
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4 Our low-tier FSWs who had commercial sex with OMCs were more likely to use  
5 contraception measures such as intrauterine devices, tubal ligation, and the Norplant  
6 method. Low-tier FSWs adopt contraception measures with long-term effects to avoid  
7 unwanted pregnancies[43] and losing clients[6, 44]. Thus, it is critical to address the  
8 defects of contraception measures for preventing HIV and STI infection in this group  
9 of low-tier FSWs.  
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15 We found that around 40% of our participants who had commercial sex with  
16 OMCs received a zero score for condom-use self-efficacy, and consistent use plus  
17 oftent use of condom is less than 70%. Other studies revealed that low-tier FSWs had  
18 a high rate of unprotected sex, and HIV knowledge, risk perception, and venue types  
19 were associated with unprotected sex among low-tier FSWs[5, 30, 36]. Economic  
20 pressures limit low-tier FSWs' power to negotiate safer sex, sex workers' self-efficacy  
21 is a strong indicator of self-reported consistent condom use[14,28], and old males had  
22 a higher prevalence of erectile dysfunction, making condom use particularly  
23 difficult[45]. Evidence has shown that consistent condom use during commercial sex  
24 among FSWs is the most effective way to prevent the transmission of HIV and STIs  
25 [46]. Thus, it is necessary to inform low-tier FSWs about HIV/STIs and HIV/STIs  
26 infection risks; the effectiveness of condom use for preventing unwanted pregnancy  
27 and HIV infection/STIs, skills for negotiation of condom use with clients, and skills for  
28 helping older clients to use condoms needs to be provided for lower-tier FSWs, and  
29 education on condom use self-efficacy among FSWs should be promoted to empower  
30 them to take effective protection during commercial intercourse. More accurately,  
31 intensive condom promotion interventions should be tailored and provided to those  
32 low-tier FSWs engaged in sex with OMCs since they had a larger number of clients and  
33 a higher prevalence of STI or STI-related symptoms but not an increased condom use  
34 rate or condom-use self-efficacy compared with those who did not engage in sex with  
35 OMCs, even though they were more likely to be exposed to HIV prevention services.  
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56 The low-tier FSWs who had commercial sex with OMCs was more susceptible  
57 to STI infection than other lower-tier FSWs. We found that they had more STI-related  
58 symptoms during the previous half year, and were also more likely to be diagnosed with  
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4 an STI among those who had seen a doctor. However, they were less likely to see a  
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6 doctor during the previous half year in our study. The univariate analysis shows that  
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8 this group of FSWs was more likely to have higher risk awareness for HIV and STI  
9  
10 infection, but this association did not remain in the multivariate analysis. Education on  
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12 risk awareness, the consequences of STI infections, and provision or referral of STI  
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14 diagnosis and treatment should be promoted among this group of low-tier FSWs, as  
15  
16 15.1% of them reported STI-related symptoms during the previous half year, and 27.5%  
17  
18 reported having been diagnosed with an STI among those who had seen a doctor.

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20 Our study suffered from several limitations. This study was conducted using a  
21  
22 cross-sectional design, which limits our ability to make causal inferences regarding  
23  
24 the relationship between the independent variables and outcome variables.  
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26 Information biases, particularly those related to sexual behavior questions, may exist  
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28 in this study due to the sensitivity of the sexual behavior, the illegality and stigma of  
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30 sex work in China, and social desirability. Our study was conducted in a period of  
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32 three months. These factors would limit the generalisation of our finding to other  
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34 regions or whole low-tier FSWs in China. However, our study still has strengths. This  
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36 study was conducted in 21 counties of all 11 municipalities of Zhejiang province, and  
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38 the research subjects were all low-tier FSWs in various venues of these areas.

## 39 **CONCLUSIONS**

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41 Our study first provides insight into the characteristics of low-tier FSWs who had  
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43 commercial sex with OMCs. This group of FSWs are more likely to be associated with  
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45 a series of risks for HIV infection/STIs compared to other low-tier FSWs, including  
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47 being more likely to be less educated, to have a longer duration of sex work, to have  
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49 sex with more commercial clients, to sell sex at lower trade fees, to have anal sex or  
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51 oral sex, to use contraception at present, and to have STI-related symptoms, and being  
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53 less likely to conduct sex with young clients and to have seen a doctor during the  
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55 previous half year than those who did not have sex with OMCs. Future HIV/STI  
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57 intervention programs should take their characteristics into account and specific  
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59 attention should be given to this group of FSWs, and free medical examinations and  
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61 treatment should be included in such programs given their low economic background,

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4 low likelihood of seeing doctors and high prevalence of STIs. Interventions for OMCs  
5 of low-tier FSWs should also be considered in these programs, as the OMCs are also at  
6 high risk of HIV infection/STIs.  
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24  
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26 manuscript. XP and JJ coordinated the study in field; LC, HW, X Z, and WC played a  
27 major role in the field survey. All authors contributed to the design of this research,  
28 read and approved the contents of the manuscript.  
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35 bureau of health to fund and promote HIV prevention policy-making, HIV-related  
36 education, behavioural interventions, counselling and testing, antiretroviral treatments,  
37 and so on,were implemented. This study was one of these series of activities.  
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43 **Competing interests** None declared.  
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48 **Ethics approval** This study was reviewed and approved by the ethics committee of  
49 Zhejiang provincial cener for disease prevention and control, China. All potential  
50 participants were informed of the study's purpose and assured that their privacy and  
51 confidentiality would be firmly protected. Every participant was invited to voluntarily  
52 participate in the study. Verbal consent were obtained from them.  
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Table 1 Sociodemographic characteristics and correlates of commercial sex with old male clients among low-tier FSWs (n=2647)

Variable	Total (%)	OMCs (%)	Crude OR (95%CI) <sup>a</sup>	P value
<b>Age</b>				
≤25	843(31.8)	300(35.6)	1	
26-35	1071(40.5)	433(40.4)	1.23(1.02-1.48)	0.031
≥36	726(27.4)	432(59.5)	2.67(2.17-3.26)	0.000
<b>Residence</b>				
Local area	270(10.2)	126(46.7)	1	
Other area in this province	307(11.6)	134(43.6)	0.89(0.64-1.23)	0.467
Other province	2070(78.2)	905(43.7)	0.89(0.69-1.15)	0.359
<b>Education</b>				
Primary school and below	974(36.8)	507(52.1)	1	
Junior high school	1405(53.1)	573(40.8)	0.63(0.54-0.75)	0.000
High school and above	262(9.9)	83(31.7)	0.43(0.32-0.57)	0.000
<b>Marital status</b>				
Unmarried	762(28.8)	292(38.3)	1	
Married/Cohabit	1652(62.4)	751(45.5)	1.34(1.13-1.60)	0.001
Widowed/divorced	229(8.7)	121(52.8)	1.80(1.34-2.43)	0.000
<b>Income per month</b>				
< 3000	746(28.2)	333(44.6)	1	
3000-4000	1068(40.3)	479(44.9)	1.01(0.84-1.22)	0.929
> 4000	748(28.3)	326(43.6)	0.96(0.78-1.18)	0.681
<b>Location of sampling</b>				
Street	413(15.6)	224(54.2)	1	
Hair salon	1682(63.5)	714(42.4)	0.62(0.50-0.77)	0.000
Roadside shop	276(10.4)	163(59.1)	1.22(0.89-1.66)	0.212
Other	271(10.2)	64(23.6)	0.26(0.19-0.37)	0.000

\* The percentage may not add up to 100% due to missing data.

Table 2 Behavioural and psychological characteristics and correlates of commercial sex with old male clients among low-tier FSWs (n=2647)

Variable	OMCs (%)	Non-OMCs (%)	Crude OR (95%CI) <sup>a</sup>	P
<b>Duration of commercial</b>				
1-12 months	303(26.0)	766(51.7)	1	
13-24 months	183(15.7)	245(16.5)	1.89(1.50-2.38)	0.000
>24 months	679(58.3)	468(31.6)	3.67(3.07-4.38)	0.000
<b>Number of clients during the previous one month</b>				
<16	273(23.4)	701(47.3)	1	
16-30	435(37.3)	420(28.3)	2.66(2.19-3.13)	0.000
>30	454(39.0)	346(23.3)	3.37(2.77-4.11)	0.000
<b>Anal sex during the previous one month</b>				
No	1063(91.2)	1447(97.6)	1	
Yes	101(8.7)	32(2.2)	4.30(2.86-6.44)	0.000
<b>Oral sex during the previous one month</b>				
No	784(67.3)	1280(86.4)	1	
Yes	380(32.6)	199(13.4)	3.12(2.57-3.78)	0.000
<b>Young client during the previous one month</b>				
No	834(71.6)	917(61.9)	1	
Yes	331(28.4)	565(38.1)	0.64(0.55-0.76)	0.000
<b>Middleaged client during the previous month</b>				
No	64(5.5)	59(4.0)	1	
Yes	1101(94.5)	1423(96.0)	0.71(0.50-1.03)	0.068
<b>Average trade fee for sex service per act</b>				
≤50	285(24.5)	158(10.7)	1	
51-100	549(47.1)	573(38.7)	0.53(0.42-0.67)	0.000
>100	329(28.2)	747(50.4)	0.24(0.19-0.31)	0.000
<b>Condom use during the previous one month</b>				
Never/rarely	170(14.6)	168(11.3)	1	

Sometimes	201(17.3)	188(12.7)	1.06(0.79-1.41)	0.711
Always/often	793(68.1)	1126(76.0)	0.70(0.55-0.88)	0.002
Contraception measures at present				
No	431(37.0)	874(59.0)	1	
Yes	734(63.0)	605(40.8)	2.46(2.10-2.88)	0.000
STI related symptoms during the previous half year				
No	987(84.7)	1333(89.9)	1	
Yes	176(15.1)	142(9.6)	1.67(1.32-2.12)	0.000
Having seen a doctor during the previous half year				
No	867(74.4)	1009(68.14)	1	
Yes	298(25.6)	472(31.8)	0.74(0.62-0.87)	0.000
STI diagnosed during the previous half year(n=770) <sup>b</sup>				
No	216(72.5)	415(87.9)	1	
Yes	82(27.5)	56(11.9)	2.81(1.93-4.10)	0.000
Ever exposure to HIV prevention service during the previous half year				
No	126(10.8)	273(18.4)	1	
Yes	1039(89.2)	1209(81.6)	1.86(1.48-2.34)	0.000
HIV risk perception				
Impossible/unsure	880(75.5)	1174(79.2)	1	
Possible	285(24.5)	306(20.6)	1.24(1.03-1.49)	0.020
STI risk perception				
Impossible/unsure	726(62.3)	1061(71.6)	1	
Possible	439(37.3)	421(28.4)	1.52(1.29-1.80)	0.000
Scale for self-efficacy for condom use				
0	463(39.7)	565(38.1)	1	
1--2	144(12.4)	214(14.4)	0.82(0.64-1.05)	0.114
3	558(47.9)	703(47.4)	0.97(0.82-1.14)	0.706

<sup>a</sup> OR, odds ratio; CI, confidence interval.

<sup>b</sup> This variable was not included into the multivariable analysis.

Table3 Multivariate analysis of commercial sex with old male clients among low-tier FSWs

Variable	Adjusted OR(95%CI) <sup>a</sup>	P value
Education		
Primary school and below	1	
Junior high school	0.78(0.63-0.95)	0.015
High school and above	0.61(0.44-0.86)	0.005



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4	Location of sampling		
5	Street	1	
6	Hair salon	1.07(0.81-1.41)	0.635
7	Roadside shop	1.49(1.03-2.15)	0.034
8	Other	0.53(0.35-0.80)	0.003
9			
10	Duration of commercial sex		
11	1-12 months	1	
12	13-24 months	1.33(1.02-1.74)	0.036
13	>24 months	2.22(1.79-2.76)	0.000
14			
15	Number of clients during the previous one month		
16	<16	1	
17	16-30	1.99(1.59-2.50)	0.000
18	>30	2.14(1.69-2.70)	0.000
19			
20	Average trade fee per act during the previous one month		
21	≤50	1	
22	51-100	0.58(0.44-0.76)	0.000
23	>100	0.33 (0.25-0.45)	0.000
24			
25	Anal sex during the previous one month		
26	No	1	
27	Yes	3.02(1.88-4.87)	0.000
28			
29	Oral sex during the previous one month		
30	No	1	
31	Yes	2.64(2.08-3.35)	0.000
32			
33	Young client during the previous one month		
34	No	1	
35	Yes	0.72(0.59-0.89)	0.002
36			
37	Contraception measures at present		
38	No	1	
39	Yes	1.95(1.58-2.39)	0.000
40			
41	STI related symptoms during the previous half year		
42	No	1	
43	Yes	1.36(1.01-1.82)	0.043
44			
45	Having seen a doctor during the previous half year		
46	No	1	
47	Yes	0.61(0.49-0.76)	0.000
48			
49	Ever exposure to HIV prevention service during the previous half year		
50	No	1	
51	Yes	2.00(1.51-2.64)	0.000
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<sup>a</sup> OR, odds ratio; CI, confidence interval.

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60STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed  (b) Give reasons for non-participation at each stage  (c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders  (b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included  (b) Report category boundaries when continuous variables were categorized  (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9,10, 11
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	11,1 2
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12,1 3,14, 15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

\*Give information separately for exposed and unexposed groups.

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2 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and  
3 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely  
4 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at  
5 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is  
6 available at [www.strobe-statement.org](http://www.strobe-statement.org).  
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# BMJ Open

## Characteristics of Low-tier Female Sex Workers Who Engage in Commercial Sex with Old Male Clients in Zhejiang Province, China: A Cross-sectional Study

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4 **Characteristics of Low-tier Female Sex Workers Who Engage in Commercial Sex with Old**  
5 **Male Clients in Zhejiang Province, China: A Cross-sectional Study**  
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## Abstract

**Objectives:** To characterize low-tier female sex workers (FSWs) who engage in commercial sex with old male clients (OMCs).

**Design:** Cross-sectional study.

**Setting:** Twenty-one counties in Zhejiang Province, China.

**Participants:** A total of 2,647 low-tier FSWs who participated in our survey from September to November 2013, and responded to the question regarding whether they engaged in commercial sex with OMCs during the previous month.

**Main outcome measures:** Data on sociodemographic characteristics, sexual behaviors, risk perception of HIV/sexually transmitted infection (STI), ever exposure to an HIV prevention service, and degree of self-efficacy regarding condom use were collected via a face-to-face questionnaire administered by trained interviewers.

**Results:** Of the 2,647 participants, 1,165 (44.0%) had engaged in commercial sex with OMCs in the previous month. Low-tier FSWs working out of roadside shops, those who had engaged in sex work for longer, those with a larger number of clients, those who had engaged in anal or oral sex during the previous month, those currently using contraception measures, those who had STI symptoms, and those who had been exposed to HIV prevention services during the previous 6 months were more likely to engage in commercial sex with OMCs. FSWs with a high level of education; those working out of small venues other than streets, hair salons and roadside shops; those who charged more for commercial sex; those who had sex with young clients during the previous month, and those who had seen a doctor during the previous 6 months were less likely to engage in commercial sex with OMCs.

**Conclusions:** Low-tier FSWs who engaged in commercial sex with OMCs reported more risky behaviors than those who did not engage in this behavior. Attention should be paid to these behaviors in future interventions targeting low-tier FSWs.

**Keywords:** Low-tier; female sex worker; old male client; commercial sex

### Strengths and limitations of this study

- This is the first study of the characteristics of low-tier FSWs who engaged in commercial sex with OMCs in China.

- This large study targeted all low-tier FSWs in 21 counties of Zhejiang Province.
- Information bias, particularly related to the sexual behavior questions, may have been present due to the sensitivity of such behavior and the illegality and stigma of sex work in China.
- The short-term, cross-sectional design and non-random sampling method may limit the generalizability of our findings to low-tier FSWs in other regions of China.

## INTRODUCTION

Female sex workers (FSWs) are at higher risk of HIV infection than the general female population, and a systematic review and meta-analysis indicated that FSWs were 13.5-fold more likely to be living with HIV than the general female population in low- and middle-income countries [1].

Another meta-analysis reported a global HIV prevalence among FSWs of 10.4%, and an increased HIV burden among FSWs compared to adult women in all regions, although there is large variability in HIV prevalence among FSWs across regions [2]. FSWs are considered an important bridge population for the transmission of HIV and sexually transmitted infections (STIs) between high-risk clients and noncommercial partners, such as husbands and regular boyfriends [3, 4].

FSWs in China are classified as high-, middle-, or low-tier according to the venues they work in. Low-tier FSWs are defined as those who work in smaller and hidden venues, such as hair salons, rental accommodations, small hotels and so on, or on the street [5-9]. Low-tier FSWs typically have lower living standards and are older, less educated, and married, separated, or divorced [9, 10]. These sociodemographic characteristics may be related to a higher rate of condomless sex [9, 10] and lower use of HIV prevention services [11]. Low-tier FSWs have less understanding of HIV and STI than middle- and high-tier FSWs, and do not tend to use condoms regularly [6, 12, 13]. Low-tier FSWs who use condoms infrequently can attract more clients and earn extra money, and this economic incentive limits the likelihood of engaging in safer sex [14]. These factors result in higher rates of HIV and STIs among low- than high- and middle-tier FSWs [6, 8]. Two cross-sectional studies revealed HIV and syphilis prevalences among low-tier FSWs of 2–5% and 11–15%, respectively [8, 15]. In a meta-analysis, the HIV prevalence among low-tier FSWs was 1.37%, whereas that among middle- and high-tier FSWs was 0.28% and 0.07%, respectively [16].

The number and proportion of older people with HIV have increased rapidly in recent years, both internationally and domestically. According to a UNAIDS report, the number of HIV-infected

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4 people over 50 years of age was approximately 5.8 million in 2015, which accounted for 15.8% of  
5 the total of 36.7 million HIV infections [17]. In Canada, the proportion of newly diagnosed HIV  
6 cases among those  $\geq 50$  years of age increased from 15.1% to 22.8% between 2008 and 2017 [18].  
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10 In China, the number of older people diagnosed with HIV cases has also increased, and the  
11 number of newly diagnosed patients aged  $\geq 65$  years in 2016 accounted for 10.4% of the newly  
12 diagnosed cases in that year [19]. Most newly diagnosed persons aged  $\geq 65$  years are male; the  
13 male-to-female ratio in that group is 5 to 1. Commercial sex is the key transmission route for HIV in  
14 older males, and 70–90% of older males living with HIV admit to participating in commercial sex  
15 [20]. In Zhejiang Province, the number of newly diagnosed HIV cases aged  $\geq 60$  years has increased  
16 rapidly, with an annual average increase of 15.6% from 2015 to 2018; 80.6% of newly diagnosed  
17 cases during this period were male, and two-thirds of them reported experiencing heterosexual  
18 commercial sex [21].  
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27 Previous research in China has documented the characteristics of men who had sex with  
28 low-tier FSWs. Male clients who visit low-tier FSWs are more likely to practice unprotected sex than  
29 those who visit high-tier FSWs, and have low risk awareness and knowledge of HIV/STIs [22].  
30 Older male clients (OMCs) were reported to have high HIV and syphilis infection rates, and most of  
31 them visited low-tier venues and used condoms very infrequently while having sex with low-tier  
32 FSWs [23, 24]. Older clients tend to use lower-tier sex venues [24]. Older males infected with HIV  
33 through commercial sex reported that the sex transactions usually occurred in small venues, such as  
34 rental accommodations or small hotels, with the price per sex act being less than 50 Yuan  
35 (approximately 7 US dollars) in Zhejiang Province [21].  
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44 Low-tier FSWs and older clients have a mutual influence on each other in terms of HIV/STI  
45 infection. However, there has been no report of the characteristics of low-tier FSWs who have sex  
46 with OMCs in China. We explored the characteristics of low-tier FSWs who engage in this behavior,  
47 to promote the development of comprehensive HIV prevention programs targeting low-tier FSWs.  
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## 52 **METHODS**

### 53 **Study design**

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55 This was a cross-sectional study of low-tier FSWs who engaged in commercial sex with OMCs in  
56 Zhejiang Province, China.  
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## Study area

The study area covered 21 counties in Zhejiang Province. Zhejiang, which has a relatively developed economy, is located on the east coast of China and has a population of 55.4 million people; it includes 90 counties in 11 prefectures [25]. Of them, 22 counties implemented the AIDS Care Project in 2013. The AIDS Care Project was a pilot program initiated by the National Ministry of Health and Provincial Bureau of Health, to support and promote HIV prevention practices and policies. Of the 22 counties, 1 did not participate in the study because no low-tier FSWs were identified therein; the remaining 21 counties were distributed across all 11 prefectures of the province.

## Study period

September to November, 2013.

## Study participants

FSWs were eligible to participate if they were currently engaging in commercial sex on the street and/or at small venues, including hair salons, roadside shops, and other venues with fewer than nine FSWs. In total, 2,648 low-tier FSWs participated in the study. Of them, 2,647 FSWs who responded to the question regarding whether they engaged in commercial sex with OMCs during the previous month were included in the analysis.

## Study process

The questionnaire was developed based on instruments used for HIV sentinel surveillance of FSWs in Zhejiang, and on comprehensive reviews of international and Chinese studies on low-tier FSWs. The questionnaire was finalized based on discussions within the research team, consultations with the staff of local Centers for Disease Control and Prevention (CDCs) who conducted outreach interventions among FSWs in the counties studied, and two pilot surveys of low-tier FSWs in two counties.

A pilot survey to determine the location of low-tier FSWs in the 21 counties was conducted, and a plan for the field survey was developed. The staff of local CDCs who conducted behavioral interventions for FSWs, and were familiar with the FSW communities in the study areas, were trained by the research team and then reached out to recruit participants from low-tier venues. Face-to-face interviews were then conducted using a structured questionnaire. All data were anonymized. The interview was conducted in a private and quiet space within the venues. The

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4 study's purpose, method, and confidentiality policy were explained verbally. All participating FSWs  
5 provided informed oral consent. Consent to participate in the study was indicated by ticking the box  
6 following the Chinese word 'agree' at the beginning of each questionnaire.  
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### 9 **Ethical considerations**

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11 The participants voluntarily participated in this study, were informed of the study requirements, and  
12 assured that their privacy and confidentiality would be protected. This study received approval from  
13 the Ethics Committee of the National Center for STD/AIDS Control and Prevention, China CDC  
14 (X120331209; March 31, 2012).  
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### 18 **Measures**

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20 Self-reported commercial sex with OMCs during the previous month was the dependent variable in  
21 the analysis. The participants were divided into those who did and those who did not engage in  
22 commercial sex with OMCs.  
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26  
27 The independent variables included sociodemographic characteristics (age, current residence,  
28 educational level, marital status, income per month, and location of sampling), and behavioral and  
29 psychological characteristics (duration of practicing commercial sex, number of clients, having anal  
30 and oral sex with clients, having young and middle-aged clients, average fee per sex act, condom use  
31 during the previous month, current use of contraception, presence of STI symptoms, seen by a doctor  
32 [and diagnosed with an STI among those who had seen a doctor], exposure to an HIV prevention  
33 service during the previous 6 months, risk perception of HIV and STI infection, and degree of  
34 self-efficacy regarding condom use).  
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43 The participants estimated the ages of their clients during the previous month. Current use of  
44 contraception refers to the use of intrauterine devices, tubal ligation, or the Norplant method. STI  
45 symptoms include painful urination or a burning sensation, abnormal genital secretions, genital skin  
46 damage or hyperplasia, and anal ulcers. HIV prevention service refers to any intervention involving  
47 the distribution of educational material and/or condoms, face-to-face education delivered by medical  
48 staff, peer education, etc.  
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55 The scale measuring self-efficacy regarding condom use consisted of three questions pertaining  
56 to whether a FSW could persuade a reluctant client to use a condom, whether she could refuse sex  
57 when a client refused to use a condom, and whether she could insist on using a condom with every  
58 client. The response options were "I can," "I can't," and "I'm not sure." "I can" responses were  
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4 assigned 1 point, and “I can’t” and “I’m not sure” responses were assigned 0 points. Cronbach’s  
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6 alpha was computed to determine the internal consistency of the scale; the value was 0.913. The  
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8 FSWs were categorized into three self-efficacy groups score of 3, high level of self-efficacy; score of  
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10 1–2, intermediate level of self-efficacy; and score of 0, low level of self-efficacy.

### 11 **Patient and public involvement**

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13 No patients were involved in the questionnaire survey. The questionnaire survey involved  
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15 face-to-face interviews conducted by trained staff of the 21 local CDCs in the study area.

### 16 **Statistical analysis**

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18 Data were analyzed using SPSS™ for Windows™ software (version 17.0; SPSS Inc., Chicago, IL,  
19  
20 USA). Factors associated with engagement by low-tier FSWs in commercial sex with OMCs were  
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22 identified by univariate analysis. Variables significant in univariate analyses were included in a  
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24 multivariate logistic regression model. Odds ratios (OR) and 95% confidence intervals (95% CI)  
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26 were used to quantify the association between the dependent variable and independent variables.  $P <$   
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28 0.05 was considered indicative of statistical significance in the univariate and multivariate analyses.  
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## 31 **RESULTS**

### 32 **Sociodemographic characteristics**

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34 Of the 2,647 FSWs, 1,165 (44.0%) had commercial sex with OMCs during the previous month, and  
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36 1,482 (56.0%) did not. Of the FSWs, 40.5% were aged 26–35 years (Table 1). Overall, 78.2% were  
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38 from provinces other than Zhejiang. In terms of education, 53.1% of the FSWs had received a junior  
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40 high school education; 62.4% were married or had cohabited with someone. In total, 40.3% of the  
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42 FSWs had an income of 3,000–4,000 Yuan (1 Yuan = 0.143 US dollars) per month. Most of the  
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44 FSWs worked in hair salons (63.5%).  
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### 47 **Sociodemographic correlates of commercial sex with OMCs among low-tier FSWs**

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49 Univariate analyses indicated that residence and income per month were not associated with  
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51 self-reported commercial sex with OMCs (Table 1). FSWs who had a junior high or at least high  
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53 school education, and those who worked in hair salons and at locations other than the streets, hair  
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55 salons, or roadside shops, were less likely to engage in commercial sex with OMCs. FSWs aged 25–  
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57 35 years or > 35 years, those who were married or had cohabited with someone, and those who were  
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59 widowed or divorced were more likely to engage in commercial sex with OMCs.  
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### **Behavioral and psychological correlates of commercial sex with OMCs among low-tier FSWs**

Univariate analyses indicated that FSWs who had commercial sex with young men, those who charged an average price of 51–100 Yuan or > 100 Yuan per sex act, those who always/often used condoms, and those who had seen a doctor during the previous 6 months were less likely to engage in commercial sex with OMCs during the previous month (Table 2).

FSWs who had engaged in commercial sex for 13–24 or > 24 months, those who had experienced commercial sex with 16–30 or > 30 clients, those who had experienced anal sex with clients, those who had experienced oral sex, those who used contraception at present, those who had shown STI symptoms during the previous 6 months, those who were diagnosed with an STI, those who were exposed to an HIV prevention service during the previous half year, those who believed that they were likely to contract HIV, and those who believed that they were likely to contract STIs were more likely to engage in commercial sex with OMCs during the previous month (Table 2).

Middle-aged clients during the previous month and self-efficacy for condom use were not associated with commercial sex with OMCs.

### **Multivariate analysis**

After controlling for possible confounding variables, the multivariate analysis revealed that FSWs with at least a junior high school education (OR = 0.78, 95% CI = 0.63–0.95) or at least a high school education (OR = 0.61, 95% CI = 0.44–0.86); those who worked at locations other than the streets, hair salons, and roadside shops (OR = 0.53, 95% CI = 0.35–0.80); those who charged an average of 51–100 Yuan (OR = 0.58, 95% CI = 0.44–0.76) or > 100 Yuan (OR = 0.33, 95% CI = 0.25–0.45) per sex act; those who had engaged in commercial sex with young clients (OR = 0.72, 95% CI = 0.59–0.89); and those who had seen a doctor (OR = 0.61, 95% CI = 0.49–0.76) were less likely to engage in commercial sex with OMCs (Table 3).

FSWs at roadside shops (OR = 1.49, 95% CI = 1.03–2.15), those who had engaged in commercial sex for 13–24 months (OR = 1.33, 95% CI = 1.02–1.74) or > 24 months (OR = 2.22, 95% CI = 1.79–2.76), those who had 16–30 sexual clients (OR = 1.99, 95% CI = 1.59–2.50) and > 30 sexual clients (OR = 2.14, 95% CI = 1.69–2.70), those who performed anal sex (OR = 3.02, 95% CI = 1.88–4.87), those who performed oral sex (OR = 2.64, 95% CI = 2.08–3.35), those who used contraception (OR = 1.95, 95% CI = 1.58–2.39), those who reported STI symptoms (OR = 1.36, 95%

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4 CI = 1.02–1.82) and those ever exposed to HIV prevention services (OR = 2.00, 95% CI = 1.51–  
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6 2.64) were more likely to engage in commercial sex with OMCs (Table 3).  
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## 8 **DISCUSSION**

### 9

10 This study is the first to examine the characteristics of low-tier FSWs who engaged in commercial  
11 sex with OMCs in China. Chinese studies have revealed that low-tier FSWs have a high rate of  
12 unprotected sex [9,10,12,13] and high prevalence of HIV/STI infection [6,8,15,16]. We found that  
13 44% of our low-tier FSWs had commercial sex with OMCs during the previous month, and that they  
14 engaged in more risky behaviors related to HIV/STI infection than other low-tier FSWs who did not  
15 engage in sex with OMCs. These findings enhance our knowledge of low-tier FSWs in China, and  
16 indicate that the risk of HIV infection/STI varies among low-tier FSWs.  
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24 Low-tier FSWs have a low socioeconomic status [9,10]. The low-tier FSWs who had  
25 commercial sex with OMCs in this study tended to have a low level of education; such FSWs also  
26 tend to have lower HIV-related knowledge [12], and lower rates of condom use and participation in  
27 HIV testing [9, 26], which increases their risk of HIV infection/STIs.  
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32 A long duration of practicing commercial sex by the low-tier FSWs was associated with a  
33 higher likelihood of having sex with OMCs specifically. In addition, the competitiveness of FSWs  
34 with longer careers as sex workers might be lower, motivating them to have sex with OMCs. In a  
35 Chinese study, older FSWs had fewer clients and made less money than younger FSWs working in  
36 the same venue [27]. A longer duration of participation in commercial sex is a risk factor for STIs  
37 [28] and HIV infection [23, 29]. The relationship between a long duration of practicing sex work and  
38 engaging in sex with OMCs should be considered when implement HIV-related interventions for  
39 low-tier FSWs.  
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47 Low-tier FSWs became sex workers mainly because of economic reasons, and earn less money  
48 per sex act than middle- and high-tier FSWs [27, 30, 31]. Our study revealed that the higher the fee  
49 per sex act, the less likely low-tier FSWs were to engage in commercial sex with OMCs. Also, the  
50 low-tier FSWs who had commercial sex with OMCs had more clients during the previous month  
51 than those who did not, implying that the former group of low-tier FSWs have less competition for  
52 sex services than other low-tier FSWs. Having multiple sexual partners is a risk factor for HIV  
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4 infection for low-tier FSWs; however, condom use prevalence was not higher in this group in the  
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6 multivariate analysis, so they are vulnerable to HIV infection and STIs.

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8 In this study, the low-tier FSWs who had commercial sex with OMCs were less likely to have  
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10 sex with young clients, suggesting that they are less attractive to young clients and so rely on elderly  
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12 individuals for sex transactions. This group of FSWs tended to work on the streets and in roadside  
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14 shops; in addition, they had a low level of education, implying a low socioeconomic status. OMCs  
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16 usually seek out low-tier FSWs for commercial sex [32], and street-based FSWs have lower  
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18 educational levels and charge less than venue-based FSWs [33]. OMCs reportedly have higher rates  
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20 of HIV and syphilis infections than the general male population of China [32]. Street-based FSWs  
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22 use condoms at a very low rate and have a high prevalence of STIs [33]; moreover, most older male  
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24 HIV cases contracted the disease via commercial sex with FSWs at small venues [21]. Precautionary  
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26 measures should be taken because lower-tier FSWs and OMCs can transmit HIV and STIs to each  
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28 other, and the spouses and regular partners of OMCs are thus at risk for STI/HIV infection. In China,  
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30 most older HIV-positive women were infected by their male spouse [20].

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32 The risk of HIV acquisition and transmission is markedly higher via receptive anal than  
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34 vaginal sex [34-36]. In this study, 8.7% of the respondents who had sex with OMCs practiced anal  
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36 sex. FSWs who had sex with OMCs were more likely to have anal sex. Most low-tier FSWs do not  
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38 understand the risk of HIV and STI transmission posed by anal sex [37]. Similarly, this group of  
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40 FSWs are more likely to have oral sex. Although oral sex carries a low risk of STI/HIV infection,  
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42 those engaging in it show risky behaviors associated with STIs/HIV infection, such as multiple  
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44 partners and low levels of condom use, according to Chinese studies [38, 39]. Therefore, the roles of  
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46 anal and oral intercourse in HIV/STI transmission should not be ignored, because these behaviors  
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48 were reported at high rates by FSWs having sex with OMCs.

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50 The low-tier FSWs in this study who had commercial sex with OMCs were more likely to use  
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52 contraception. Low-tier FSWs use contraception with long-lasting effects to avoid unwanted  
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54 pregnancies [40] and loss of clients [6, 41]. Therefore, it is critical to address shortcomings in  
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56 contraceptive measures to prevent HIV infection and STIs in low-tier FSWs.

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58 Around 40% of the FSWs in this study who had commercial sex with OMCs had a score of  
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60 zero for condom-use self-efficacy, and the rate of consistent and frequent use of condoms was <  
70%. Other studies revealed that low-tier FSWs had high rates of unprotected sex, and that HIV

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4 knowledge, risk perception, and venue type were associated with unprotected sex among low-tier  
5 FSWs [5, 27, 33]. Economic pressures limit the likelihood of low-tier FSWs engaging in safer sex,  
6 and self-efficacy is a strong indicator of self-reported consistent condom use by sex workers [14, 25].  
7 Moreover, older males were reported to have a higher prevalence of erectile dysfunction, hampering  
8 condom use [42]. Consistent condom use during commercial sex is the most effective way to prevent  
9 transmission of HIV and STIs among FSWs [43]. Therefore, it is necessary to inform low-tier FSWs  
10 of the risk of HIV/STIs, and the effectiveness of condoms for preventing unwanted pregnancy and  
11 HIV infection/STIs. Skills for negotiating condom use with clients, and for helping OMCs to use  
12 condoms, should also be promoted, to empower FSWs to use effective protection during commercial  
13 intercourse. Based on the results of this study, such interventions should be tailored specifically for  
14 low-tier FSWs engaged in sex with OMCs, because they see more clients with STIs or symptoms  
15 thereof, but show no increase in condom use or self-efficacy compared with those who do not  
16 engage in sex with OMCs, even though they are more likely to be exposed to HIV prevention  
17 services.

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31 The low-tier FSWs in this study who had commercial sex with OMCs were more susceptible to  
32 STIs than other low-tier FSWs. Also, they had more STI symptoms during the previous 6 months  
33 and were more likely to be diagnosed with an STI (among those who had seen a doctor). However,  
34 they were overall less likely to see a doctor during the previous 6 months. The univariate analyses  
35 showed that this group of FSWs was more likely to have higher awareness of the risk of HIV  
36 infection and STIs, but this association disappeared in the multivariate analysis. Education promoting  
37 risk awareness and knowledge of the consequences of STIs, along with the provision of treatment  
38 and referrals for STIs, should be promoted among low-tier FSWs, because 15.1% of those in our  
39 study reported STI symptoms during the previous half year and 27.5% reported having been  
40 diagnosed with an STI (among those who had seen a doctor).

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51 Our study had several limitations. First, it used a cross-sectional design, limiting the ability to  
52 make causal inferences regarding the relationships between the outcome and independent variables.  
53 Second, information biases, particularly those related to the sexual behavior questions, may exist due  
54 to the sensitivity of sexual behavior, the illegality and stigma of sex work in China, and social  
55 desirability. Third, the study was conducted over 3 months and used a non-random sampling method.  
56 These factors limit the generalizability of our findings to low-tier FSWs in other regions of China.  
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4 Nevertheless, we believe that our sample is reasonably representative. This study was conducted in  
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6 21 counties among all 11 prefectures of Zhejiang Province, and the participants were all low-tier  
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8 FSWs working in various venues in these areas. The investigators were familiar both with local  
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10 FSWs and their community; moreover, a pilot survey to confirm the locations of the low-tier FSWs  
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12 was conducted, to ensure that all of the low-tier venues located by our investigators could be  
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14 approached. Furthermore, the sample size was large. Finally, client ages were estimated by the  
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16 participants, potentially reducing the reliability of this measure. However, considering the large  
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18 number of clients and experience of the FSWs, their judgments of client age are generally considered  
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20 credible. This also applies to the middle-aged and young clients seen during the previous month.  
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## 22 **CONCLUSIONS**

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24 Our findings provide insight into the characteristics of low-tier FSWs engaging in commercial sex  
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26 with OMCs. This group of FSWs are more likely to have risk factors for HIV infection/STIs  
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28 compared to other low-tier FSWs, including a low educational level, a long duration of practicing  
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30 sex work, sex with more commercial clients, lower fees per sex act, anal or oral sex, current use of  
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32 contraception, STI symptoms, and less likely to conduct sex with young clients and to have seen a  
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34 doctor during the previous half year than those who did not have sex with OMCs. Future HIV/STI  
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36 intervention programs should take these characteristics into account, and special attention should be  
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38 paid to low-tier FSWs. Also, free medical examinations and treatment should be included in such  
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40 programs given the low socioeconomic status of FSWs, and their low likelihood of seeing doctors  
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42 and high prevalence of STIs. Interventions for the OMCs of low-tier FSWs should also be considered  
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44 in these programs, because they are also at high risk of HIV infection/STIs.  
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57  
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59

## 60 **Contributors**

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4 QM, JJ, TJ, and XP analyzed and interpreted the data, and drafted the manuscript. XP and JJ  
5 coordinated the study in the field; LC, HW, XZ, and WC played a major role in the field survey. All  
6 authors contributed to the design of this study and read and approved the manuscript.  
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14 and testing, and antiretroviral treatments, was implemented. Our study formed part of this program.  
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### 19 20 **Competing interests**

21 None declared.  
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### 24 25 **Ethics approval**

26 This study received approval from the Ethics Committee of the National Center for STD/AIDS  
27 Control and Prevention, China Center for Disease Control and Prevention (X120331209; March 31,  
28 2012). This study was also ratified by the Ethics Committee of Zhejiang Provincial Center for  
29 Disease Control and Prevention. All potential participants were informed of the study's purpose and  
30 assured that their privacy and confidentiality would be protected. Participation in the study was  
31 voluntary, and verbal consent was obtained from all participants.  
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### 38 39 **Provenance and peer review**

40 Not commissioned; the study was externally peer reviewed.  
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### 43 44 **Data availability statement**

45 Data are available upon reasonable request by email: qqma@cdc.zj.cn.  
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Table 1. Correlations of sociodemographic characteristics with commercial sex with old male clients among low-tier FSWs (N = 2,647).

Variable	Total (%)	OMCs (%)	Crude OR (95%CI) <sup>a</sup>	P value
Age (years)				
≤ 25	843 (31.8)	300 (35.6)	1	
26–35	1071 (40.5)	433 (40.4)	1.23 (1.02-1.48)	0.031
≥ 36	726 (27.4)	432 (59.5)	2.67 (2.17-3.26)	0.000
Residence				
Local area	270 (10.2)	126 (46.7)	1	
Other area in this province	307 (11.6)	134 (43.6)	0.89 (0.64-1.23)	0.467
Other province	2070 (78.2)	905 (43.7)	0.89 (0.69-1.15)	0.359
Education				
Primary school or below	974 (36.8)	507 (52.1)	1	
Junior high school	1405 (53.1)	573 (40.8)	0.63 (0.54-0.75)	0.000
High school or above	262 (9.9)	83 (31.7)	0.43 (0.32-0.57)	0.000
Marital status				
Unmarried	762 (28.8)	292 (38.3)	1	
Married/cohabit	1652 (62.4)	751 (45.5)	1.34 (1.13-1.60)	0.001
Widowed/divorced	229 (8.7)	121 (52.8)	1.80 (1.34-2.43)	0.000
Income per month (Yuan)				
< 3,000	746 (28.2)	333 (44.6)	1	
3,000–4,000	1068 (40.3)	479 (44.9)	1.01 (0.84-1.22)	0.929
> 4,000	748 (28.3)	326 (43.6)	0.96 (0.78-1.18)	0.681
Location of sampling				
Street	413 (15.6)	224 (54.2)	1	
Hair salon	1682 (63.5)	714 (42.4)	0.62 (0.50-0.77)	0.000
Roadside shop	276 (10.4)	163 (59.1)	1.22 (0.89-1.66)	0.212
Other	271 (10.2)	64 (23.6)	0.26 (0.19-0.37)	0.000

\* The percentages may not sum to 100% because of missing data.



Table 2. Behavioral and psychological correlates of commercial sex with old male clients among low-tier FSWs (N = 2,647).

Variable	OMCs (%)	Non-OMCs (%)	Crude OR (95%CI) <sup>a</sup>	P-value
Duration of practicing commercial sex (months)				
1-12	303 (26.0)	766 (51.7)	1	
13-24	183 (15.7)	245 (16.5)	1.89 (1.50-2.38)	0.000
> 24	679 (58.3)	468 (31.6)	3.67 (3.07-4.38)	0.000
Number of clients during the previous month				
< 16	273 (23.4)	701 (47.3)	1	
16-30	435 (37.3)	420 (28.3)	2.66 (2.19-3.13)	0.000
> 30	454 (39.0)	346 (23.3)	3.37 (2.77-4.11)	0.000
Anal sex during the previous month				
No	1063 (91.2)	1447 (97.6)	1	
Yes	101 (8.7)	32 (2.2)	4.30 (2.86-6.44)	0.000
Oral sex during the previous month				
No	784 (67.3)	1280 (86.4)	1	
Yes	380 (32.6)	199 (13.4)	3.12 (2.57-3.78)	0.000
Young client during the previous month				
No	834 (71.6)	917 (61.9)	1	
Yes	331 (28.4)	565 (38.1)	0.64 (0.55-0.76)	0.000
Middle-aged client during the previous month				
No	64 (5.5)	59 (4.0)	1	
Yes	1101 (94.5)	1423 (96.0)	0.71 (0.50-1.03)	0.068
Average fee per sex act (Yuan)				
≤ 50	285 (24.5)	158 (10.7)	1	
51-100	549 (47.1)	573 (38.7)	0.53 (0.42-0.67)	0.000
> 100	329 (28.2)	747 (50.4)	0.24 (0.19-0.31)	0.000
Condom use during the previous month				
Never/rarely	170 (14.6)	168 (11.3)	1	
Sometimes	201 (17.3)	188 (12.7)	1.06 (0.79-1.41)	0.711
Always/often	793 (68.1)	1126 (76.0)	0.70 (0.55-0.88)	0.002
Currently using contraception				
No	431 (37.0)	874 (59.0)	1	
Yes	734 (63.0)	605 (40.8)	2.46 (2.10-2.88)	0.000
STI symptoms during the previous 6 months				
No	987 (84.7)	1333 (89.9)	1	
Yes	176 (15.1)	142 (9.6)	1.67 (1.32-2.12)	0.000
Seen a doctor during the previous 6 months				
No	867 (74.4)	1009 (68.14)	1	
Yes	298 (25.6)	472 (31.8)	0.74 (0.62-0.87)	0.000

Variable	OMCs (%)	Non-OMCs (%)	Crude OR (95%CI) <sup>a</sup>	P-value
STI diagnosed during the previous half year (n = 770) <sup>b</sup>				
No	216 (72.5)	415 (87.9)	1	
Yes	82 (27.5)	56 (11.9)	2.81 (1.93-4.10)	0.000
Exposure to HIV prevention service during the previous 6 months				
No	126 (10.8)	273 (18.4)	1	
Yes	1039 (89.2)	1209 (81.6)	1.86 (1.48-2.34)	0.000
Risk perception of HIV infection				
Impossible/unsure	880 (75.5)	1174 (79.2)	1	
Possible	285 (24.5)	306 (20.6)	1.24 (1.03-1.49)	0.020
Risk perception of STI infection				
Risk perception of HIV infection				
Impossible/unsure	726 (62.3)	1061 (71.6)	1	
Possible	439 (37.3)	421 (28.4)	1.52 (1.29-1.80)	0.000
Self-efficacy for condom use score				
0	463 (39.7)	565 (38.1)	1	
1-2	144 (12.4)	214 (14.4)	0.82 (0.64-1.05)	0.114
3	558 (47.9)	703 (47.4)	0.97 (0.82-1.14)	0.706

<sup>a</sup> OR, odds ratio; CI, confidence interval

<sup>b</sup> This variable was not included in the multivariate analysis.

Table 3. Multivariate analysis of commercial sex with old male clients among low-tier FSWs.

Variable	Adjusted OR (95%CI) <sup>a</sup>	P-value
Education		
Primary school and below	1	
Junior high school	0.78 (0.63-0.95)	0.015
High school and above	0.61 (0.44-0.86)	0.005
Location of sampling		
Street	1	
Hair salon	1.07 (0.81-1.41)	0.635
Roadside shop	1.49 (1.03-2.15)	0.034
Other	0.53 (0.35-0.80)	0.003
Duration of practicing commercial sex		
1-12 months	1	
13-24 months	1.33 (1.02-1.74)	0.036
> 24 months	2.22 (1.79-2.76)	0.000
Number of clients during the previous month		
< 16	1	
16-30	1.99 (1.59-2.50)	0.000
> 30	2.14 (1.69-2.70)	0.000
Average fee per sex act during the previous month (Yuan)		

Variable	Adjusted OR (95%CI) <sup>a</sup>	P-value
≤ 50	1	
51-100	0.58 (0.44-0.76)	0.000
> 100	0.33 (0.25-0.45)	0.000
Anal sex during the previous month		
No	1	
Yes	3.02 (1.88-4.87)	0.000
Oral sex during the previous month		
No	1	
Yes	2.64 (2.08-3.35)	0.000
Young client during the previous month		
No	1	
Yes	0.72 (0.59-0.89)	0.002
Currently using contraception		
No	1	
Yes	1.95 (1.58-2.39)	0.000
STI symptoms during the 6 previous 6 months		
No	1	
Yes	1.36 (1.01-1.82)	0.043
Seen a doctor during the previous 6 months		
No	1	
Yes	0.61 (0.49-0.76)	0.000
Exposure to HIV prevention service during the previous 6 months		
No	1	
Yes	2.00 (1.51-2.64)	0.000

<sup>a</sup> OR, odds ratio; CI, confidence interval

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
<b>Title and abstract</b>	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
<b>Introduction</b>			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4,5,6
Objectives	3	State specific objectives, including any prespecified hypotheses	6
<b>Methods</b>			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6,7
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7,8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	
		(c) Explain how missing data were addressed	
		(d) If applicable, describe analytical methods taking account of sampling strategy	
		(e) Describe any sensitivity analyses	

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed  (b) Give reasons for non-participation at each stage  (c) Consider use of a flow diagram	7
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders  (b) Indicate number of participants with missing data for each variable of interest	9
Outcome data	15*	Report numbers of outcome events or summary measures	
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included  (b) Report category boundaries when continuous variables were categorized  (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	9,10, 11
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	11,1 2
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12,1 3,14, 15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

\*Give information separately for exposed and unexposed groups.

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2 **Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and  
3 published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely  
4 available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at  
5 <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is  
6 available at [www.strobe-statement.org](http://www.strobe-statement.org).  
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