Original Article

Cervical Cancer Screening Rate and Willingness among Female Migrants in Shenzhen, China: Three-Year Changes in Citywide Surveys

Wei Lin[1,2], **Bin Chen**[1,2], **Bo Wu**[1,2], **Shixin Yuan**[2], **Chuyan Zhong**[2], **Weikang Huang**[2], **Haiyan Hu**[2,3], **Zhihua Liu**[2,3], **Yueyun Wang**[1,2]

[1]*Department of Healthcare, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, Shenzhen,* [2]*Research Team of Cervical Cancer Prevention Project in Shenzhen, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, Shenzhen,* [3]*Department of Gynecology, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, Shenzhen, China*

Purpose This study attempted to detect the changes of cervical cancer screening rate and willingness among female migrants, and the associated socio-demographic factors in Shenzhen city.

Materials and Methods Two citywide surveys were conducted using a multistage random cluster sampling method in 2011 and 2014, respectively. Data on demographic characteristics, screening participation, and willingness to screen were collected. Logistic regression models were applied to detect possible associated socio-demographic characteristics, and their variations with survey years.

Results In total, 12,017 female migrants were enrolled, with a mean age (standard deviation) of 36.73 (6.55) years. From 2011 to 2014, the screening rate increased (25.8% vs. 35.1%, p < 0.001), while the willingness to screen remained stable (82.2% vs. 82.8%, p=0.46). Overall, socio-demographic characteristics of female migrants, including age, marital status, education, monthly income, employment, and medical insurance, were found to be positively associated with screening participation. Similar impacts in relation to willingness were observed except for age. However, these associations varied with survey years, mainly in the contributions of education and monthly income to screening participation, as well as age, monthly income, and medical insurance to willingness of being screened.

Conclusion Identifying changes of associated socio-demographic factors precisely is warranted of necessity, which provides novel clues to adjust targeted actions regularly in promoting cervical cancer screening participation among female migrants in Shenzhen.

Key words Cervical neoplasms, Screening, Participation, Willingness, Migrant

Introduction

Cervical cancer remains to be a global public health concern, as there were 569,847 new cases and 311,365 deaths worldwide, ranking the fourth most common cancer in women [1]. The annual incident and death cases of cervical cancer estimated in China were 98,900 and 30,500 [2]. Routine screening for cervical cancer was a major prevention strategy to attain dramatic reductions in incidence and mortality, of which cytology, human papillomavirus (HPV) DNA-based testing, and visual inspection with acetic acid (VIA) or Lugol's iodine (VILI) were recommended methods [3,4]. The Chinese government had launched the National Cervical Cancer Screening Program (NCCSP) to provide free screening services since 2009; however, it only targeted on women

in rural areas [5]. Past epidemiologic studies suggested that only one-fifth of adult women in China announced having ever been screened [6,7]. Thus, it is deeply in need to discover vulnerable individuals who had never receive screening, to ensure suitable screening related services delivery and achieve high participation rate.

Shenzhen is one of the economically prosperous cities in China, with a majority of internal migrants lacking the local household registration but seeking jobs to settle down here every year. It was estimated of more than 7,860,000 migrants living in this city by the end of 2010 [8]. Migrants were thought to be a disadvantaged group for their shortage in socioeconomic characteristics when compared with local residents. Moreover, they might not have equality to share public resources and health services depending on house-

Correspondence: Yueyun Wang
Department of Healthcare, Research Team of Cervical Cancer Prevention Project in Shenzhen, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, No. 3012 Fuqiang Road, Futian District, Shenzhen 518048, China
Tel: 86-075582882999 Fax: 86-075582889999 E-mail: wangyueyun@126.com

Co-correspondence: Zhihua Liu
Department of Gynecology, Research Team of Cervical Cancer Prevention Project in Shenzhen, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, No. 2004 Hongli Road, Futian District, Shenzhen 518028, China
Tel: 86-075582882999 Fax: 86-075582889999 E-mail: drzhliu@163.com

hold registration status to great extent. It was reported that migrants were provided with less satisfied quality of the primary health care than their local counterparts [9]. Migrants might also own poorer health literacy in cervical cancer prevention. For example, significant inequalities existed in understanding the role of HPV in cervical cancer and attitudes towards HPV vaccination between female migrants and natives in Shenzhen [10]. Nevertheless, whether migrants performed as well as local residents in the participation and willingness to have cervical cancer screening was still unclear and of great urgency to be explored.

In 2009, cervical cancer prevention has been included in a public welfare project of maternity and child healthcare by the local government in Shenzhen, and was implemented with financial support in all administrative districts [11]. Cervical cancer prevention-related work were carried out every year, including health education to the public, technical training to medical professionals on screening, diagnosis and treatment, and free organized screening services. In order to explore the positive influence on female migrants by this prevention project, we conducted two citywide surveys on cervical cancer screening participation and willingness to screen in 2011 and 2014, respectively. This study attempted to detect 3-year changes of screening rate and willingness to screen among female migrants, as well as associated demographic factors, and finally to help differentially target priority groups to improve screening compliance.

Materials and Methods

1. Study design and sampling

This study included two citywide cross-sectional epidemiologic surveys. The first survey was conducted from March to August 2011. A multistage random cluster sampling method was applied. All administrative districts in Shenzhen were divided into two groups according to economic development and population density: well-developing versus general developing districts. Then two representative streets from each well-developing district were selected by simple random sampling. Simultaneously, only one representative street was chosen in every general developing district. At last, two community health service centers in selected streets were randomly picked out as the survey sites. Female migrants, aged from 21 to 60 years old, would be assigned with a card randomly with the help of health professionals if they came to receive health services in the survey sites. This card was written in "Invite" or "Not Invite." Those who got "Invite" cards would be invited to join in our survey. Here, migrants were defined as people who lived in Shenzhen area but without a household registration of this city. The second

survey employed the same sampling survey sites and the same process of subjects' recruitment used in the first survey, with a shorter survey time period between September and October in 2014. Totally 9,338 and 3,113 eligible women were enrolled in the 2011 and 2014 surveys, and the response rates were 90.81% and 91.29% severally.

2. Measurements

All participants were provided with explanation about the objectives, contents, associated benefits, and risks of the survey. Then they were asked to finish a self-administered questionnaire that was consisted of questions about demographic information, participation and willingness to have cervical cancer screening. General demographic characteristics included age, ethnicity, marital status, education level, employment status, monthly income, and medical insurance status. Cervical cancer screening participation was assessed by asking "Have you ever participate in cervical cancer screening?" with a response of "yes" or "no." If a woman had ever attended cervical screening, detailed information about screening methods, testing results, and the time of the latest screening were further collected. Willingness to have cervical screening was measured using the question "Are you willing to receive cervical cancer screening at present?" with three possible options (yes/no/on the fence). Here the option "on the fence" was considered as lack of willingness. Women were required to choose a prioritized screening method if they were ready to be screened. Otherwise, women needed to write down the main reason for the unwillingness to participate in screening. In light of screening costs, we further evaluated their willingness of self-paying screening. For those who accept self-paying services, the price for screening they could afford was also illustrated. Survey data were all double-checked and input in an electronic database developed by using EpiData software (EpiData Association, Odense, Denmark).

3. Data analysis

Data were managed and analyzed using SPSS ver. 21.0 (IBM Corp., Armonk, NY). Means and standard deviations were calculated for the age of all participants. Categorical variables were presented with numbers and percentages, and distributed differences were tested using chi-square tests. We estimated age-standardized proportions and 95% confidence intervals (CI) of screening rate, willingness to screen, and self-paying willingness to screen using the direct method of standardization with the data from the 2010 Shenzhen population census. Logistic regression analyses were applied to assess the associations of demographic characteristics with cervical cancer screening participation and willingness to screen. All demographic variables were

Table 1. Demographic characteristics of female migrants in the 2011 and 2014 surveys

Variable	Survey year		p-value[a]	Pooled data
	2011 (n=9,155)	2014 (n=2,862)		
Age (yr)				
Mean±SD	36.62±6.40	37.10±7.01		36.73±6.55
21-30	1,348 (14.7)	449 (15.7)	< 0.001	1,797 (15.0)
31-40	5,689 (62.1)	1,632 (57.0)		7,321 (60.9)
41-60	2,118 (23.1)	781 (27.3)		2,899 (24.1)
Ethnicity				
Han	8,768 (95.8)	2,632 (92.0)	< 0.001	11,400 (94.9)
Other	357 (3.9)	196 (6.8)		553 (4.6)
Unknown	30 (0.3)	34 (1.2)		64 (0.5)
Marital status				
Single/Divorced/Widowed	712 (7.8)	393 (13.7)	< 0.001	1,105 (9.2)
Married	8,402 (91.8)	2,458 (85.9)		10,860 (90.4)
Unknown	41 (0.4)	11 (0.4)		52 (0.4)
Education level				
≤ 9 Schooling years	4,985 (54.5)	1,462 (51.1)	0.001	6,447 (53.6)
10-12 Schooling years	2,534 (27.7)	813 (28.4)		3,347 (27.9)
≥ 13 Schooling years	1,577 (17.2)	568 (19.8)		2,145 (17.8)
Unknown	59 (0.6)	19 (0.7)		78 (0.6)
Employment				
Unemployed	1,944 (21.2)	576 (20.1)	0.26	2,520 (21.0)
Employed	7,006 (76.5)	2,205 (77.0)		9,211 (76.6)
Unknown	205 (2.2)	81 (2.8)		286 (2.4)
Monthly income (RMB)				
< 3,000 (low)	3,377 (36.9)	317 (11.1)	< 0.001	3,694 (30.7)
3,000-4,999 (relatively low)	2,549 (27.8)	696 (24.3)		3,245 (27.0)
5,000-9,999 (middle)	1,642 (17.9)	919 (32.1)		2,561 (21.3)
≥ 10,000 (high)	535 (5.8)	334 (11.7)		869 (7.2)
Unknown	1,052 (11.5)	596 (20.8)		1,648 (13.7)
Medical insurance				
No	4,094 (44.7)	1,265 (44.2)	0.61	5,359 (44.6)
Yes	5,005 (54.7)	1,581 (55.2)		6,586 (54.8)
Unknown	56 (0.6)	16 (0.6)		72 (0.6)

Values are presented as number (%) unless otherwise indicated. [a]Chi-square tests were applied to detect distributed differences, in which the category of "unknown" was not calculated in analysis.

entered into the logistic regression model to calculate odds ratios (OR) and 95% CI. Furthermore, stratified analysis was used to detect whether above-mentioned associations with screening participation or willingness to screen varied with survey years. Therefore, multiplicative interactions between the survey year and all demographic characteristics were calculated by including the product term in logistic regression models. Statistical significance was set at less than 0.05 using a two-sided test.

Results

1. Demographic characteristics of all respondents

We excluded 434 cases due to missing data of screening participation or willingness to screen. In total, 12,017 female migrants were analyzed, including 9,155 (76.18%) and 2,862 (23.82%) women recruited in 2011 and 2014 respectively (Table 1). The mean age (standard deviation) for all respondents was 36.73 (6.55) years old. The majorities of them were Han ethnic (94.9%) and married (90.4%). Over half of them (53.6%) only attended school for 9 years or below, and approximately three-quarters (76.6%) of the women were

Table 2. Screening participation and willingness to screen of cervical cancer among female migrants

Variable	Survey year		p-value[a]	Pooled data
	2011	2014		
Screening participation				
No	6,791 (74.2)	1,858 (64.9)	< 0.001	8,649 (72.0)
Yes	2,364 (25.8)	1,004 (35.1)		3,368 (28.0)
Screening method for the latest screening[b]				
Cytology	1,205 (51.0)	452 (45.0)	< 0.001	1,657 (49.2)
HPV testing	857 (36.3)	475 (47.3)		1,332 (39.5)
Other methods	302 (12.8)	77 (7.7)		379 (11.3)
Ever been diagnosed as cervical diseases in the latest screening[b]				
No	2,034 (86.0)	865 (86.2)	0.069	2,899 (86.1)
CIN1	140 (5.9)	39 (3.9)		179 (5.3)
CIN2+	82 (3.5)	36 (3.6)		118 (3.5)
Unknown	108 (4.6)	64 (6.4)		172 (5.1)
The time of the latest screening[b]				
Within 3 yr	2,144 (90.7)	918 (91.4)	0.098	3,062 (90.9)
Over 3 yr	178 (7.5)	59 (5.9)		237 (7.0)
Unknown	42 (1.8)	27 (2.7)		69 (2.0)
Willingness to screen				
No/On the fence	1,629 (17.8)	492 (17.2)	0.46	2,121 (17.6)
Yes	7,526 (82.2)	2,370 (82.8)		9,896 (82.4)
Prioritized screening methods in the future[c]				
Cytology	2,326 (30.9)	567 (23.9)	0.079	2,893 (29.2)
HPV testing	1,099 (14.6)	286 (12.1)		1,385 (14.0)
Co-testing	3,944 (52.4)	878 (37.0)		4,822 (48.7)
Unknown	157 (2.1)	639 (27.0)		796 (8.0)
The main reason for unwillingness to participate in screening[d]				
Thought it to be expensive or unaffordable	712 (43.7)	202 (41.1)	0.032	914 (43.1)
Thought it to be unnecessary	315 (19.3)	92 (18.7)		407 (19.2)
Without enough spare time	325 (20.0)	117 (23.8)		442 (20.8)
Worried about diagnosis of incident cervical diseases	101 (6.2)	17 (3.5)		118 (5.6)
Distrusted medical professionals	29 (1.8)	6 (1.2)		35 (1.7)
Other reasons	147 (9.0)	58 (11.8)		205 (9.7)
Self-paying willingness to screen				
No/On the fence	3,647 (39.8)	1,021 (35.7)	< 0.001	4,668 (38.8)
Yes	5,508 (60.2)	1,841 (64.3)		7,349 (61.2)
Affordable price for self-paying screening (RMB)[e]				
≤ 100	2,612 (47.4)	672 (36.5)	< 0.001	3,284 (44.7)
101-300	2,200 (39.9)	830 (45.1)		3,030 (41.2)
301-500	562 (10.2)	248 (13.5)		810 (11.0)
≥ 500	110 (2.0)	72 (3.9)		182 (2.5)
Unknown	24 (0.4)	19 (1.0)		43 (0.6)

Values are presented as number (%). CIN, cervical intraepithelial neoplasia; HPV, human papillomavirus. [a]Chi-square tests were applied to detect distributed differences, in which the category of "unknown" was not calculated in analysis, [b]Only who had ever participated in cervical cancer screening answered this question, [c]Only who were willing to participate in cervical cancer screening without consideration of its cost answered this question, [d]Only who were not willing or on the fence to participate in cervical cancer screening answered this question, [e]Only who were willing to participate in self-paying cervical cancer screening answered this question.

employed. The proportions of low and relatively low monthly income were 30.7% and 27.0%, respectively. More than half (54.8%) of the women had medical insurance. Table 1 also showed the differences of demographic characteristics for all respondents in these two surveys. Women in the 2014 survey were more appealed to be older, non-Han ethnic, unmarried, high educated, and having higher income when compared to those in the 2011 survey.

2. Cervical cancer screening participation and willingness among female migrants

Nearly one-third (28.0%) of all respondents had ever participated in cervical cancer screening. Women surveyed in 2014 had a higher screening rate than those in 2011 (35.1% vs. 25.8%, p < 0.001). Among women with screening participation, approximately half of them were screened by a cytology method, 86.1% of them reported no cervical disease, and 90.9% of them were screened within recent 3 years (Table 2).

Totally 82.4% of all respondents were willing to participate in cervical cancer screening, which was not differently distributed in the 2011 and 2014 surveys (82.2% vs. 82.8%, p=0.46). Co-testing of cytology and HPV testing was the prioritized screening method (48.7%) in the future among women with screening willingness. The three main reasons mentioned by female migrants with unwillingness to participate in screening were as follows: (1) they thought screening was expensive or unaffordable (43.1%); (2) they declared they did not have enough spare time (20.8%), and (3) they thought screening to be unnecessary (19.2%) (Table 2). If the screening service was self-paying, the willingness to screen was declined to be 61.2%. Women surveyed in 2014 had a higher self-paying willingness than those in 2011 (64.3% vs. 60.2%, p < 0.001). Affordable prices for self-paying screening were mainly accepted in less than 100 RMB (44.7%) and 101 to 300 RMB (41.2%) (Table 2).

In order to figure out the changes of screening participation and willingness to screen from 2011 to 2014 intuitively, age-standardized proportions and 95% CIs were calculated (Fig. 1).

3. Associated demographic factors of screening participation and willingness

Demographic factors associated with screening participation and willingness to screen are presented in Table 3. Through multivariate regression analyses, we found that women who were age ≥ 41 years old (OR, 1.23; 95% CI, 1.06 to 1.44), married (OR, 1.77; 95% CI, 1.49 to 2.11), high-educated (OR, 1.57; 95% CI, 1.41 to 1.75 for 10-12 schooling years; OR, 2.19; 95% CI, 1.93 to 2.49 for more than 13 schooling years), employed (OR, 1.19; 95% CI, 1.06 to 1.35), having higher income (OR, 1.38; 95% CI, 1.23 to 1.56 for middle level; OR,
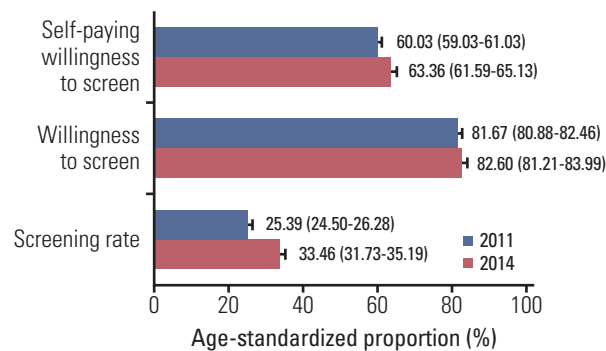

Fig. 1. Age-standardized proportions for screening rate and willingness to screen cervical cancer: changes from 2011 to 2014.

1.49; 95% CI, 1.26 to 1.77 for high level), and having medical insurance (OR, 1.58; 95% CI, 1.44 to 1.74) were more likely to engage in screening participation. Similarly, demographic factors associated with willingness to screen were detected: being married (OR, 2.22; 95% CI, 1.89 to 2.60), high-educated (OR, 1.22; 95% CI, 1.08 to 1.39 for 10-12 schooling years; OR, 1.57; 95% CI, 1.32 to 1.86 for more than 13 schooling years), employed (OR, 1.21; 95% CI, 1.06 to 1.38), having higher income (OR, 1.22; 95% CI, 1.07 to 1.39 for 3,000-4,999 RMB; OR, 1.27; 95% CI, 1.10 to 1.46 for 5,000-9,999 RMB; OR, 1.31; 95% CI, 1.04 to 1.65 for ≥ 10,000 RMB), and having medical insurance (OR, 1.33; 95% CI, 1.19 to 1.49).

4. Changed impacts of demographic factors on screening participation and willingness over time

Three years later, changed impacts of demographic factors to screening participation and willingness to screen were observed from 2011 to 2014. Education and monthly income contributed differently to screening participation in these two surveys (p for interaction, 0.006 and 0.029) (Table 4). Regarding screening participation, high-educated level greater influenced women surveyed in 2011, whereas the impact of higher income was more apparent to those in 2014. In addition, women's willingness to screen that attributed to age, monthly income, and medical insurance also varied in 2011 and 2014 (p for interaction, 0.006, 0.049, and 0.001) (Table 5). Although we found that age was not a predictor of willingness to screen overall, women with an older age (≥ 41 years old) was less ready to being screened in 2014 but not in 2011. Higher income level only facilitated women's willingness in 2011; however, the influence of medical insurance was more obvious among women in 2014.

Table 3. Associated demographic factors of screening participation and willingness to screen among female migrants

Variable	Screening participation		Willingness to screen	
	Crude OR (95% CI)	Multivariate OR (95% CI)	Crude OR (95% CI)	Multivariate OR (95% CI)
Age (yr)				
21-30	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
31-40	1.10 (0.98-1.24)	1.13 (0.99-1.29)	1.10 (0.96-1.26)	1.06 (0.91-1.24)
41-60	1.04 (0.91-1.19)	1.23 (1.06-1.44)	1.01 (0.86-1.17)	1.05 (0.88-1.25)
Ethnicity				
Han	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Other	1.00 (0.83-1.22)	1.05 (0.84-1.31)	0.89 (0.72-1.11)	0.97 (0.76-1.24)
Marital status				
Single/Divorced/Widowed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Married	1.62 (1.39-1.89)	1.77 (1.49-2.11)	1.99 (1.73-2.29)	2.22 (1.89-2.60)
Education level				
≤ 9 Schooling years	1.00 (reference)	1.000 (reference)	1.000 (reference)	1.000 (reference)
10-12 Schooling years	1.68 (1.53-1.85)	1.57 (1.41-1.75)	1.19 (1.07-1.33)	1.22 (1.08-1.39)
≥ 13 Schooling years	2.70 (2.44-3.00)	2.19 (1.93-2.49)	1.79 (1.55-2.06)	1.57 (1.32-1.86)
Employment				
Unemployed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Employed	1.38 (1.24-1.53)	1.19 (1.06-1.35)	1.26 (1.13-1.41)	1.21 (1.06-1.38)
Monthly income (RMB)				
< 3,000 (low)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.000 (reference)
3,000-4,999 (relatively low)	1.13 (1.01-1.26)	1.02 (0.91-1.14)	1.26 (1.12-1.43)	1.22 (1.07-1.39)
5,000-9,999 (middle)	1.70 (1.52-1.90)	1.38 (1.23-1.56)	1.40 (1.22-1.60)	1.27 (1.10-1.46)
≥ 10,000 (high)	2.24 (1.92-2.62)	1.49 (1.26-1.77)	1.65 (1.33-2.05)	1.31 (1.04-1.65)
Medical insurance				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.72 (1.58-1.87)	1.58 (1.44-1.74)	1.37 (1.25-1.50)	1.33 (1.19-1.49)

CI, confidence interval; OR, odds ratio.

Discussion

Our study demonstrated increased screening rates of cervical cancer among female migrants from 2011 (25.8%) to 2014 (35.1%) in Shenzhen, which was relatively higher than the rate (21.4%) from a nationwide survey conducted in 31 provinces of mainland China [7]. These above-mentioned rates were still much lower than those in Hong Kong Chinese women (80.8%) [12,13], suggesting that women's screening participation might be affected by distinct socioeconomic levels across developed and undeveloped regions. We then observed that the willingness to screen of female migrants remained stable in last 3 years, but tended to be in a relatively high level when compared to previous surveys targeted different female groups in other cities (ranged from 63.3% to 85.0%) [14-17]. Hence, identifying barriers to get female migrants screened is urgently in need to be involved in cervical cancer prevention network of Shenzhen city, and the target of health education work should be placed on translating

attitude or belief into practice according to the health belief model [18].

For the majority of whom were unwilling to participate in screening, we found their main concerns focused on the screening cost, lack of spare time, and ignorance on screening necessity. These barriers towards screening in Shenzhen (a first-tier city) were quite different from those in rural areas, for example, most women in Wufeng (a typical low-income county located in central China) worried about anxious feeling of disease diagnosis and did not receive screening because of not symptoms/discomfort [15]. In addition, age and in-school status might also influence on women's consciousness about screening services. A population-based survey in Hong Kong reported that for both school girls and young out-school females, the most common reason for no intention to participation was having a limited knowledge of cervical screening, including "Never heard about it" and "Do not know its function", moreover, out-school females were more likely to concern about the screening cost than

Table 4. Stratified analyses on the associated demographic factors of screening participation among female migrants by survey year

Variable	Screening participation			
	Crude OR (95% CI)		Multivariate OR (95% CI)	
	2011	2014	2011	2014
Age (yr)				
21-30	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
31-40	1.06 (0.93-1.22)	1.28 (1.02-1.60)	1.10 (0.94-1.28)	1.24 (0.95-1.62)
41-60	1.04 (0.89-1.22)	1.01 (0.79-1.30)	1.23 (1.02-1.46)	1.19 (0.88-1.63)
p for interaction		0.11		0.35
Ethnicity				
Han	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Other	1.18 (0.93-1.49)	0.65 (0.47-0.91)	1.16 (0.90-1.51)	0.76 (0.51-1.13)
p for interaction		0.004		0.051
Marital status				
Single/Divorced/Widowed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Married	1.47 (1.22-1.78)	2.25 (1.74-2.91)	1.74 (1.41-2.15)	2.19 (1.62-2.96)
p for interaction		0.009		0.11
Education level				
≤ 9 Schooling years	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
10-12 Schooling years	1.62 (1.45-1.81)	1.83 (1.52-2.19)	1.57 (1.39-1.77)	1.65 (1.33-2.05)
≥ 13 Schooling years	2.81 (2.49-3.18)	2.36 (1.93-2.88)	2.50 (2.16-2.89)	1.65 (1.28-2.13)
p for interaction		0.074		0.006
Employment				
Unemployed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Employed	1.31 (1.16-1.48)	1.57 (1.28-1.93)	1.18 (1.02-1.35)	1.20 (0.93-1.56)
p for interaction		0.13		0.84
Monthly income (RMB)				
< 3,000 (low)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
3,000-4,999 (relatively low)	0.99 (0.88-1.12)	1.60 (1.19-2.15)	0.89 (0.78-1.01)	1.42 (1.03-1.94)
5,000-9,999 (middle)	1.54 (1.35-1.75)	1.86 (1.40-2.47)	1.20 (1.04-1.38)	1.53 (1.12-2.07)
≥ 10,000 (high)	2.00 (1.66-2.43)	2.45 (1.76-3.41)	1.29 (1.04-1.59)	1.60 (1.11-2.32)
p for interaction		0.019		0.029
Medical insurance				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.60 (1.45-1.76)	2.13 (1.82-2.51)	1.48 (1.33-1.66)	1.91 (1.56-2.32)
p for interaction		0.002		0.064

CI, confidence interval; OR, odds ratio.

school girls [19]. We further found that self-paying willingness to screen did increase over time in our study. The potential reason lied that the income levels of migrants have been improved from 2011 to 2014. The expected price of self-paying screening did also elevate, as we observed a greater proportion of women selecting higher screening price in 2014. Nevertheless, establishing a nationwide or regional cervical cancer screening program for free or low-priced is in demand, since financial concerns to screening remained to be a barrier among nearly two-fifths of migrant women in our study.

Socio-demographic factors that were considered to infl-

uence women on their practice in cervical cancer prevention in past studies, were also identified in our study, such as age, marital status, education, income, employment, and medical insurance [7,13,20,21]. We found that women aged 41 or older had a higher odds of receiving screening when referred to 30 years or younger. An older age might associate with a higher possibility of gynecologic problems, subsequently visiting related clinics and receiving screening services incidentally. This association could be reversed when women were out of the recommended age range for cervical screening, as the screening participation would be inhibited with aging process [13]. We also found that married women

Table 5. Stratified analyses on the associated demographic factors of willingness to screen among female migrants by survey year

Variable	Willingness to screen			
	Crude OR (95% CI)		Multivariate OR (95% CI)	
	2011	2014	2011	2014
Age (yr)				
21-30	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
31-40	1.10 (0.95-1.28)	0.42 (0.85-1.49)	1.10 (0.93-1.31)	0.92 (0.65-1.32)
41-60	1.09 (0.92-1.30)	0.80 (0.59-1.08)	1.21 (0.99-1.48)	0.67 (0.45-0.98)
p for interaction		0.030		0.006
Ethnicity				
Han	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Other	0.85 (0.66-1.11)	0.96 (0.66-1.40)	0.87 (0.66-1.16)	1.31 (0.81-2.11)
p for interaction		0.62		0.19
Marital status				
Single / Divorced / Widowed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Married	1.87 (1.57-2.22)	2.33 (1.83-2.98)	2.02 (1.67-2.46)	2.76 (2.04-3.74)
p for interaction		0.14		0.30
Education level				
≤ 9 Schooling years	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
10-12 Schooling years	1.17 (1.04-1.33)	1.24 (0.99-1.55)	1.18 (1.02-1.36)	1.37 (1.04-1.80)
≥ 13 Schooling years	1.79 (1.52-2.12)	1.77 (1.33-2.34)	1.47 (1.20-1.78)	1.80 (1.26-2.59)
p for interaction		0.90		0.33
Employment				
Unemployed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Employed	1.28 (1.13-1.45)	1.20 (0.95-1.52)	1.24 (1.07-1.44)	1.18 (0.87-1.59)
p for interaction		0.63		0.42
Monthly income (RMB)				
< 3,000 (low)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
3,000-4,999 (relatively low)	1.35 (1.17-1.54)	0.93 (0.66-1.32)	1.30 (1.13-1.50)	0.83 (0.58-1.19)
5,000-9,999 (middle)	1.51 (1.29-1.78)	1.09 (0.78-1.53)	1.39 (1.17-1.65)	0.88 (0.61-1.26)
≥ 10,000 (high)	1.76 (1.34-2.31)	1.34 (0.88-2.05)	1.53 (1.14-2.05)	0.76 (0.48-1.22)
p for interaction		0.054		0.049
Medical insurance				
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Yes	1.27 (1.14-1.41)	1.77 (1.45-2.15)	1.21 (1.07-1.37)	1.93 (1.51-2.45)
p for interaction		0.004		0.001

CI, confidence interval; OR, odds ratio.

participated in screening practices more actively than single individuals. On one side, it perhaps resulted from more frequent sexual behaviors and fertility needs engaged in marriage. Sexual behaviors have been shown to influence women's attitudes towards screening substantially [19], to some extent, it might waken women to involve in routine gynecologic related examinations. On the other side, single but sexual active women might underestimate their risk of cervical cancer and present low screening attendance [13]. Furthermore, our study suggested that well-educated, employed, wealthy, and insured women were more readily to undergo or accept screening. As implied in previous inves-

tigations, a good socio-demographic status could promote women to obtain more knowledge of cervical cancer prevention and making accurate decisions, to be well-resourced in affording screening costs, and to increase the probability of opportunistic screening owing to higher reimbursement [7]. These findings suggested that the accessibility of cervical screening should be improved among women with poor socio-demographic status. Developing an outreach, low-cost, and easily accessible screening and treatment method could be helpful to screening promotion, as Zhao et al. [22] did in rural China.

Although we did not detect variation of willingness to

screen in the present study, the screening rate did increase from 2011 to 2014, more interestingly, the associated demographic factors with screening participation and willingness also changed. As mentioned previously, women in Shenzhen could get access to screening services with two choices: free organized screening services provided by the government from 2009, and opportunistic self-paying screening services available in local gynecology clinics [23]. Women who met the following conditions were available to receive free organized screening services: aged from 30 to 59 years old, sexually active, with a household registration of Shenzhen city or stayed in Shenzhen for more than six months, and did not receive free screening services within recent three years. There were two candidate screening methods [3] (cytology alone every 3 years, or HPV and cytology "Co-testing" every 5 years) for free, varied by the difference of financial support across districts. There were some possible reasons why female migrants participate in screening more actively by years. For one thing, women might own more deposits with the increased income [24], which might facilitate them to engage in opportunistic screening. For another thing, the local government enlarged the financial support on organized screening with the growth of gross domestic product in these years [24], so that women could gain more free quotas to being screened. Moreover, we observed that the impact of education level on screening participation was weakened in 2014 than that in 2011, while the association between education and screening willingness did not change significantly. These findings possibly suggested limited effects of education on screening practice promotion over time. Regard to screening willingness, even if it did not increase significantly, the self-paying willingness was improved in three years, suggesting that women might concern less about the cost in opportunistic screening due to the increased income. Therefore, women's screening willingness was shown to be weakly affected by income level in 2014 than in 2011. A reverse finding was shown in the impact of medical insurance on screening willingness, which was more apparent in 2014 rather than in 2011, probably because of increasing reimbursement in accessing screening services. In addition, we noticed that women with an advanced age exhibited less screening willingness. One potential explanation raised by other researchers was that women might feel no necessity to participate in screening after the menopause, which further impaired their risk perception and willingness [13]. Nonetheless, future studies should consider varied predictors of screening practices among elderly women who were still at risk of the disease.

Some limitations should be clarified. First, for self-reported surveys rather than medical records, response or recall bias could not be excluded. Second, we did not collect informa-tion on sexual behaviors and HPV vaccinated status, leaving restriction to draw any conclusion about the impact of these important factors on screening uptake. We also did not distinguish between organized and opportunistic screening, in which distinct participations probably existed. Prospective studies with long follow-up periods are clearly needed to verify vital predictors of screening uptake. Third, as there were no nationwide screening programs for urban areas, findings from Shenzhen city might not be generalized to represent the screening situation of female migrants across the whole country, but to provide novel insights in cervical cancer prevention work in other developed cities. Furthermore, due to the huge difference in sample size of two surveys, it is hard to tell if the observed differences come from the effect of policy or just because of difference population. However, the sampling survey sites and the recruitment of study subjects in 2014 were the same as those in 2011. The investigation processes of these two surveys were consistent with each other. It would be acceptable to clarify the study objectives by adopting a multistage random cluster sampling method. Even though the different sample sizes restricted us to draw confirmed conclusions, some associated clues were detected from this study. Researches that enroll the same study subjects with the longitudinal follow-up design will be ideally appropriate in further verification explorations.

In summary, we investigated the three-year changes of cervical cancer screening rate and willingness among female migrants in Shenzhen city through two citywide surveys. Despite of health resources devoted in cervical cancer prevention by the government in recent years, there were at least three-quarters of female migrants who had never been screened. We also identified changes of associated sociodemographic characteristics that influence women's engagement in screening practices. Proper and targeted actions should be taken and adjusted regularly with a priority in promoting cervical cancer screening participation.

Ethical Statement
An informed consent was obtained from each woman before enrollment. This study got approval from the Institutional Review Board of Shenzhen Maternity and Child Healthcare Hospital (No. SFYLS2011008).

Author Contributions
Conceived and designed the analysis: Lin W, Wang Y, Liu Z.
Collected the data: Chen B, Yuan S, Wang Y.
Contributed data or analysis tools: Yuan S, Zhong C, Huang W, Hu H.
Performed the analysis: Lin W, Wu B.
Wrote the paper: Lin W.

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