RESEARCH ARTICLE

Knowledge of Cervical Cancer Screening among Health Care Workers Providing Services Across Different Socio-economic Regions of China

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Abstract

Background: China carries a heavy burden of cervical cancer (CC) and substantial disparities exist across regions within the country. In order to reduce regional disparities in CC, the government of China launched the National Cervical Cancer Screening Program in Rural Areas (NCCSPRA) in 2009. Critical to the success of the program are the health care workers who play a pivotal role in preventing and managing CC by encouraging and motivating women to use screening services and by providing identification and treatment services. This study aimed to assess cervical cancer knowledge among these health care workers at the county level in maternal and child health (MCH) hospitals across different socio-economic regions of China. Materials and Methods: A cross-sectional survey was conducted and self-administered questionnaires were sent to all health care workers (a total of 66) providing cervical cancer screening services in 6 county level MCH hospitals in Liaoning, Hubei and Shaanxi provinces, representing eastern, central and western regions of China; 64 (97.0%, 64/66) of the workers responded. ANOVA and Chi-square test were used to compare the knowledge rate and scores in subgroups. Results: The knowledge level of the respondents was generally low. The overall combined knowledge rate was 46.9%. The knowledge rates for risk factors, prevention, clinical symptoms, screening and diagnostic tests and understanding of positive results were 31.3%, 37.5%, 18.1%, 56.3% and 84.4%, respectively. Statistically significant differences in scores or rates of CC knowledge were seen across the different regions. The total and sectional scores in the less developed regions were statistically significantly lower than in the other regions. Conclusions: The majority of the health care workers who provide CC screening service in NCCSPRA at county level MCH hospitals do not have adequately equipped with knowledge about CC. Given the importance of knowledge to the program's success in reducing CC burden in rural women in China, efforts are needed to improve the knowledge of health care workers, especially in less developed regions.

Keywords: Cervical cancer - knowledge - health workers - socio-economic regions - China

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Introduction

Worldwide, cervical cancer (CC) is the fourth most common female cancer, with around 528,000 new cases estimated in 2012, accounting for almost 12% of all female cancers (IARC, 2012). CC was responsible for 226,000 deaths, accounting for 7.5% of all female cancer deaths in 2012. CC has become the leading cause of cancer death among women and around 87% of CC deaths occur in developing countries (IARC, 2012).

Because of its large population, China's CC burden has a substantial effect on global estimates of the current and future burden of the disease. In 2012, it was estimated that there were 61,691 new CC cases in China (IARC, 2012), accounting for 12% of new cases in the world. The most recent survey suggests that the number of new cases is projected to rise to 93,500 in 2030 and reach 186,600 in 2050 (Shi et al., 2012). Furthermore, 29,526 women died of the disease in 2012 in China, accounting for 11% of all CC deaths worldwide (IARC, 2012). China is geographically the third largest country in the world with significant regional and socioeconomic disparities, substantial inequity in financial resources, infrastructure, health care staff capacity, and access to health care (MOH, 2013). These factors have led to differences in CC burden across regions of China (NCC et al., 2013). Although the incidence of CC is low in rural areas, mortality is higher than in urban areas. Mortality-to-incidence ratios are 0.3 for rural areas, compared with 0.25 in urban areas (NCC et al., 2013).

Because the 10- to 20-year lag between pre-cancer and cancer offers abounded opportunity to screen, detect and

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treat pre-cancer and avoid its progression to cancer, CC is a largely preventable disease (WHO, 2014). Experience from many countries has shown that a comprehensive CC prevention and control program is an effective measure to prevent and reduce morbidity and mortality from CC (by catching pre-cancerous lesions for treatment) (IARC, 2005; WHO, 2006). In 2009, in order to reduce regional disparities in CC burden, China's government launched the National CC Screening Program in Rural Areas (NCCSPRA). It was the first time that the Chinese government had proposed to widen access in rural areas to CC screening services (from cytology tests for screening to colposcopy and biopsy for diagnostic and confirmatory services) and it represented a important step towards provision of CC screening nationwide (Lancet, 2009). The maternal child health (MCH) hospitals at the county level are responsible for implementation of the program, providing technical service for the health education, consultation, and screening and diagnosis service (MOH, 2009a).

Women obtain information on cervical cancer from a variety of sources, among which health care workers are one of the most obvious. In China, gynaecologists and colposcopists play a pivotal role in the provision of this information, because the personal and continuing relationship with clients of health care workers puts them in a privileged position for supplying women with relevant and specific information (Arbyn et al., 2010). Women's knowledge about CC screening can not only help them to understand and reduce their personal risk of illness, but reduce their anxiety when attending the screening (WHO, 2014). These health care workers are usually trusted by the clients, and overall their involvement in the decision-making process is accepted by women. Some research has indicated that involvement of health care workers is an important factor to increase the screening coverage (Clover et al., 1996; Giorgi et al., 1999; Rossi et al., 2012). Furthermore, many studies have confirmed that the participation rate is one of the most important factors in determining the success of a screening program (Anttila, 2009; IARC, 2005).

Hence given that health care workers' involvement in communicating about cervical cancer screening is important, they should be provided comprehensive and accurate knowledge, in order to give women adequate and accurate information about prevention, screening and treatment. Unfortunately, there have been few studies of the knowledge of cervical cancer among health professionals in China and a lack of research relating specifically to knowledge assessment of the health care workers who provide the CC screening service in NCCSPRA at county level MCH hospitals across China.

Materials and Methods

Design and sample

The study was as a cross-sectional survey of Liaoning, Hubei and Shaanxi provinces, representing the three geographical regions of China: Eastern, Central and Western China. Eastern China, the most economically advanced of the three regions has an average GDP of US$5464. Central China has an average GDP of US$2630. Western China is the least developed region, with an average GDP of US$2354 (Goss et al., 2014; Jian et al., 2010). Based on the GDP 2013 figures for Liaoning, Hubei and Shaanxi (US$4410, US$4018 and US$2613, respectively)(NBS, 2014), these three provinces represent the most economically developed, developed, and less developed regions respectively. Within each province, two counties from the NCCSPRA were selected randomly. They were Xunyang and Hanbin in Shaanxi province, Xiangzhou and Zaoyang in Hubei province, Zhuanghe and Wafang Dian in Liaoning province. All health care workers (including gynecologists and colposcopy providers) who provide CC screening services at county level MCH hospitals were invited to participant in this study.

A structured questionnaire was used to collect data between September and November, 2013 for this study. A total of 66 health care workers who provided CC screening services in NCCPSA in the six county level MCH hospitals in the three provinces were invited to participate in the study. Two health care workers declined to complete the survey, hence total sample of 64 health care workers were surveyed. Before answering the questionnaire, the purpose of the investigation was explained to the participants and all participants were given verbal instructions on completing it. Then, the questionnaire was sent to participants and answered by themselves under supervision of researchers. All participants provided their written consent to participate in this study and all were informed about confidentially measures and rights to withdraw. This study was approved by the Ethics Committee of Griffith University, Queensland, Australia (GU Ref No: ENV/33/13/HREC).

Measures

A questionnaire on knowledge about CC screening was designed through expert consultation and a review of the literature from relevant studies in China and elsewhere (Powe and Finnie, 2003; Nganwai et al., 2007; Ertem, 2009; Ali et al., 2010; Awodele et al., 2011; Urasa et al., 2011; Rani et al., 2012; Jia et al., 2013). It consisted of two sections. The first focused on socio-demographic characteristics, including region, age, and education. The second section assessed knowledge about CC screening and included 5 subsections: risk factors for CC (7 questions), prevention of CC (7 questions), clinical symptoms of CC (9 questions), screening and diagnosis methods (8 questions), and meaning of positive results (9 questions). Most of the questions had only two response options (yes/no or true/false) while some had three response options (yes, no or unclear). This section included 47 questions equal weight. The components of this section were: risk factors for CC, CC prevention, clinical symptoms of CC, screening methods and diagnostic tests for CC, and understanding of positive results. Total scores for each section were summed to determine an overall score (max=47). According to the results of the literature review (Huang et al., 2011), participants with scores of 60% or higher were considered to be knowledgeable. The number of workers who achieved this for any one score is defined as the knowledge rate.

Statistical analysis

Data were entered into EpiData 3.2 with dual entry verification, consistency, and logic error checking. Statistical analyses were performed by SPSS 22.0, with *p*-value<0.05 determined as the threshold of statistical significance. Descriptive analyses were generated for all variables. The ANOVA test was used to estimate statistical differences in overall and sectional knowledge scores within the different regions. The Chi-square test was conducted to compare differences in levels of different types of knowledge and differences in the total and sectional knowledge rates between the different regions.

Logistic regression was performed to examine factors associated with total and sectional knowledge rate, with non- knowledgeable (0) and knowledgeable (1) used as the dependent variable, and the statistical difference factors analyzed by Chi-square test as the independent variables.

Results

Demographic characteristics

A total of 64 (100.0%) valid questionnaires were collected. The average age of the participants was 43.5±6.9 years (range from 28 to 58 years). All of respondents were female. Twenty (31.3%) health care workers were from less developed regions, 26 (40.6%) from developed regions and 18 (28.1%) from most developed regions. Thirty four health care workers (53.1%) had at least a junior college or higher degree.

There was no difference in the age of the participants among different regions, however a statistically significant difference was found in the educational levels of the participants among different regions (p<0.05); About 78% of health care workers who provide CC screening services in developed regions had achieved a junior college or higher education level. Only 30% of health care workers who were in less developed regions had achieved a junior college or higher degree (Table 1).

Total CC Knowledge Levels

The average total knowledge level score among all participants was 29.2±6.54, out of a possible range of 0 to 47, with 30 (46.9%) health care workers reaching the knowledgeable mark. Analyses by Chi-square test and ANOVA/t- test revealed a statistically significant difference in the total knowledge rate and scores among health care workers with different educational levels and who were in different regions (p<0.05). The knowledge rates and scores among workers who had junior college or higher degrees and who were in the most developed regions were significantly higher than those who had only senior/technical school degrees and who were in developed

Risk Factors of CC

The mean knowledge score for the risk factors of CC among all respondents was 3.28±2.04, out of a possible range of 0 to 7. Although the knowledge rate of risk factors

Table 1. Demographic Characteristics of Health Care Workers among Different Regions (n=64) (From Chi-square Test)

Characteristics	Most developed regions (N=18)	Developed regions (N=26)	Less developed regions (N=20)	Total frequency	χ^2	*p*
Age					0.127	0.939
<45	10(55.6)	14(53.8)	10(50.0)	34(53.1)		
≥45	8 (44.4)	12 (46.2)	10(50.0)	30(46.9)		
Education level					8.693	0.014
Junior college or higher	14(77.8)	14(53.8)	6(30.0)	34(53.1)		
Senior/Technical school	4(22.2)	12(46.2)	14(70.0)	30(46.9)		

Table 2. Differences in Knowledge Scores and Knowledge rate among Health Care Workers with Different Educational Levels (n=64) (From t-test or Chi-square test)

Educational level	Total Score		Risk Factors of CC		CC prevention		Clinical symptoms	
	Score X±SD	KR n(%)	Score X±SD	KR n(%)	Score X±SD	KR n(%)	Score X±SD	KR n(%)
Junior college or higher	31.35±5.92	22(64.7)	3.65±1.91	10(29.4)	3.94±1.72	16(47.1)	4.41±1.26	8(23.5)
Senior/Technical school	26.80±6.46	8(26.7)	2.87±2.13	10(33.3)	3.07±2.02	8(26.7)	3.80±1.35	4(13.3)
F(p)	8.663(0.005)	-	2.395(0.127)	-	3.503(0.066)	-	3.521(0.065)	-
X^2(p)	-	9.261(0.002)	-	0.114(0.736)	-	2.828(0.093)	-	1.088(0.297)

Educational level	Screening methods		Diagnostic tests		Understanding of the positive results	
	Score X±SD	KR n(%)	Score X±SD	KR n(%)	Score X±SD	KR n(%)
Junior college or higher	2.59±0.61	22(64.7)	2.18±0.39	22(64.7)	7.76±1.28	32(94.1)
Senior/Technical school	2.00±1.05	14(46.7)	2.27±0.58	14(46.7)	6.33±2.37	32(73.3)
F(p)	7.729(0.007)	-	0.543(0.464)	-	9.339(0.003)	-
X^2(p)	-	2.107(0.147)		2.107(0.147)		--(0.036)*

KR: Knowledgeable Rate; P<0.05 indicates a statistically significant difference between subgroups; *Fisher's Exact Test

of CC was only 31.3%, over half of participants correctly answered that history of sexually transmitted diseases" (52, 81.3%), "having multiple partners or partners who have multiple partners" (44, 68.8%) and "had sexual intercourse and children at a young age" (40, 62.5%) were risk factors for cervical cancer. Half of the respondents (32, 50.0%) knew "hormonal contraceptive use" was a risk factor for cervical cancer. However, nobody knew that "tobacco smoke" was a risk factor for cervical cancer, and only 22(34.4%) and 20(31.3%) knew "HPV infection" and "aged 30-65 years" were also risk factors for cervical cancer.

Analyses by ANOVA test revealed that the knowledge scores for risk factors in the most developed regions were significantly higher than in less developed regions (p<0.05) (Table 3). As shown in Table 4, health care workers in most developed regions were particularly more aware of the risk factors "having multiple partners or partners who have multiple partners" and "hormonal contraceptive use" for CC (p<0.05).

CC prevention

Most of the participants (60, 93.8%) considered that CC could be prevented. However, the average total knowledge score for prevention measures of CC among all participants was only 3.53±1.90, out of a possible range of 0 to 7. The knowledge rate for prevention measures of CC was only 37.5%. The majority of participants knew

Table 3. Differences in Knowledge Scores and Knowledge Rate Across Regions (n=64) (From ANOVA or Chi-square Test)

Regions	Total Score		Risk Factors of CC		CC prevention		Clinical symptoms	
	Score	KR	Score	KR	Score	KR	Score	KR
	X±SD	n(%)	X±SD	n(%)	X±SD	n(%)	X±SD	n(%)
Most developed	32.67±4.83[a]	14(77.8)[a,c]	4.22±1.35[a]	8(44.4)	4.44±1.29[a]	10(55.6)	4.11±1.41	2(11.1)
Developed	29.46±6.04[b]	10(38.5)[c]	3.15±1.91	6(23.1)	3.69±2.06[b]	10(38.5)	4.31±1.16	6(23.1)
Less developed	25.80±7.03[a,b]	6(30.0)[a]	2.60±2.44[a]	6(30.0)	2.50±1.73[a,b]	4(20.0)	3.90±1.48	4(20.0)
F(p)	6.102(0.004)	-	3.324(0.043)	-	5.902(0.005)	-	0.527(0.593)	-
X^2(p)	-	9.929(0.007)	-	0.320(0.361)	-	5.127(0.077)	-	1.029(0.598)

Regions	Screening methods		Diagnostic tests		Understanding of the positive results	
	Score	KR	Score	KR	Score	KR
	X±SD	n(%)	X±SD	n(%)	X±SD	n(%)
Most developed	2.78±0.43 a	14(77.8) a	2.40±0.68	14(77.8) a	8.00±1.28	16(88.9)
Developed	2.69±0.62 b	20(76.9) b	2.15±0.37	20(76.9) b	6.69±1.85	20(76.9)
Less developed	1.40±0.82 a b	2(10.0) a b	2.11±0.32	2(10.0) a b	6.80±2.46	18(90.0)
F(p)	29.123(0.000)	-	2.130(0.128)	-	2.760(0.071)	-
X^2(p)	-	25.289(0.000)		25.289(0.000)	-	1.630(0.507)

KR: Knowledgeable Rate; [a]indicates a statistically significance between most developed and less developed regions; [b]indicates a statistically significance between developed and less developed regions; [c]indicates a statistically significance between most developed and developed regions. For ANOVA test, P<0.05 indicates a statistically significant difference between subgroups; for Chi-square test, P<0.0167 indicates a statistically significant difference between subgroups

Table 4. Frequency of Correct Answer for Items About CC among Health Care Workers in Different Regions (n=64) (From Chi-square test)

Items	Most developed regions (N=18)	Developed regions (N=26)	Less developed regions (N=20)	Total frequency	χ^2	p
Section 1 Risk factors of CC						
Having multiple partners or partners who have multiple partners	18 (100.0)	18 (69.2)	8 (40.0)	44 (68.8)	15.879	0
History of Sexually transmitted diseases	16 (88.9)	24 (92.3)	12 (60.0)	52 (81.2)	7.626	0.022*
Hormonal contraceptive use	14(77.8)	12 (46.2)	6 (30.0)	32 (50.0)	8.909	0.012
Section 2 CC prevention						
Reduce number of sexual partners	18 (100.0)	16 (61.5)	8(40.0)	42 (65.6)	15.443	0
Using condom	14 (77.8)	12(46.2)	6(30.0)	32 (50.0)	8.909	0.012
Section 3 Symptoms of CC						
Inter-menstrual bleeding	12 (66.7)	18(69.2)	6(30.0)	36 (56.3)	8.174	0.017
Urinary frequency, urgency	0 (0.0)	2(7.7)	6(30.0)	8 (12.5)	7.489	0.015*
Section 4 Screening methods						
Pap smear or LBC	18 (100.0)	26(100.0)	16(80.0)	60 (93.8)	6.766	0.012*
VIA	14 (77.8)	20(76.9)	2(10.0)	36 (56.3)	25.289	0
HPV DNA test	16 (88.9)	22(84.6)	8(40.0)	46 (71.9)	14.717	0.001
Section 5 Diagnostic tests required						
Colposcopy	12 (66.7)	22 (84.6)	8 (40.0)	42 (65.6)	9.987	0.007
Biopsy	18 (100.0)	26 (100.0)	16 (80.0)	60 (93.8)	6.766	0.012*
Section 6 Understanding of the positive results						
Positive screening result means suffering from cervical precancerous lesions	16 (88.9)	18 (69.2)	10 (50.0)	44 (68.8)	6.674	0.036

*Fisher's Exact Test

Table 5. Logistic Regression Analysis of Factors Associated with Total Knowledge Rate (N=64)

Influence factors	B	Wald	P	OR	95%CI
Education					
Junior college or higher/ Senior or technical school	1.316	4.974	0.026	3.727	1.173~11.842
Regions					
Most developed /Less developed	1.614	4.131	0.042	5.022	1.059~23.807
Developed/Less developed	0.073	0.012	0.914	1.076	0.286~4.053

that "prompt treatment of STIs" (56, 87.5%), "having HPV vaccine before sexual debut" (46, 71.9%) and "reduce number of sexual partners" (42, 65.6%) were effective preventive measures. Half of the participants (32, 50.0%) correctly believed that "late marriage and late childbirth" and "using condoms" could prevent CC occurring. Only 16 (25.0%) and 2 (3.1%) believed that "no tobacco smoking" and "CC screening" could prevent CC occurring.

The results of the ANOVA test revealed a statistically significant difference in the knowledge scores for CC prevention measures among health care workers in different regions ($p<0.05$). The knowledge scores in most developed and developed regions were significantly higher than less developed regions ($p<0.01$) (Table 3). As shown in Table 4, health care workers in most developed regions were more aware of the prevention measures "reduce sexual partners" and "using condom" ($p<0.05$).

Clinical symptoms of CC

The mean total knowledge score for symptoms of CC among all participants was 4.13±1.327, out of a possible range of 0 to 9. The knowledge rate for clinical symptoms of CC was only 18.1%. Most participants correctly reported that "pelvic pain" (54, 84.4%), "post-menopausal bleeding (50, 78.1%), and "inter-menstrual bleeding" (36, 56.3%) were the symptoms of CC. However, few of the participants knew that CC patients could also experience the following symptoms "vaginal water" 20(31.3%), "abnormal vaginal discharge" (10, 15.6%), "urinary frequency, urgency" (8, 12.5%), and "bleeding after sexual intercourse, douching, or a pelvic exam" (4, 6.3%). Nobody knew that "menstrual periods that last longer and are heavier than before" was also one of the symptoms of CC. Furthermore, 46(71.9%) of the respondents incorrectly indicated "vulvar itching or burning sensation" as one of the symptoms of CC.

The results of the Chi-square test showed that there was a statistically significant difference in the knowledge rate of clinical symptoms among participants aged <45 years ($\chi 2=5.412$, $p=0.020$). Although the results of ANOVA test revealed no statistical difference in the knowledge scores for symptoms of CC among health care workers in different regions (Table 3), as shown in Table 4, health care workers in less developed regions were more aware of "urinary frequency, urgency" and less aware of "inter-menstrual bleeding " ($p<0.05$).

Screening methods and diagnostic tests for CC

The mean total knowledge score for CC screening methods and diagnostic tests among all participants was 2.31±0.89 and 2.22±0.49, out of a possible range of 0 to 4, respectively. Both of the knowledge rates for CC screening methods and diagnostic tests were 56.3%. The majority of participants correctly answered that "Pap smear or Liquid-based cytology (LBC)" (60, 93.8%), "HPV DNA testing (46, 71.9%), and "Visual inspection with acetic acid (VIA)" (36, 56.3%) were the screening methods of CC. However, 58 (90.6%) incorrectly regarded "colposcopy" as also one of the screening methods of CC. Most of the participants correctly reported that "Biopsy" (60, 93.8%) and "colposcopy" (42, 65.6%) were the diagnostic tests for detection of cervical pre-cancer.

The results of this study revealed a significant difference in the knowledge scores for CC screening methods among health care workers with different education degree and across regions ($p<0.001$) (Table 2 and Table 3). The knowledge scores for screening methods in less developed regions were significantly lower than those in the other regions ($p<0.001$), as shown in Table 4, health care workers in less developed regions were less likely to correctly answer the questions related to the "Pap smear or LBC", "VIA" and "HPV DNA testing" screening methods and "colposcopy" and "biopsy" diagnostic tests ($p<0.01$).

Understanding of the positive results

The average total knowledge score for understanding about the positive results of CC screening among all participants was 7.09±1.99, out of a possible range of 0 to 9. The knowledge rate for understanding of the positive results was 84.4%. The majority of participants correctly answered that "a positive screening result means there is cervical lesion, it needs further diagnosis" (62, 96.9%), "CC is a curable disease" (58, 90.6%), and "early CC can be cured" (46, 71.9%). However, many health care workers mistakenly believed that "positive screening result means suffering from cervical precancerous lesions" (14, 21.9%) and "positive screening result means suffering from early stage cervical carcinoma" (12, 18.8%).

The t-test results showed that the knowledge scores for understanding of the positive results of screening among health care workers with junior college or higher degrees were significantly higher than for those with senior/ technical school degree (Table 2). The knowledge rate of understanding of the positive results among younger workers (<45 years old) was significantly higher than among older workers ($p<0.05$). Although the results of ANOVA test revealed no statistical difference in the knowledge scores for understanding of the positive results of CC screening among health care workers in different regions (Table 2 and Table 3), as shown in Table 4, health care workers in less developed regions were more likely to mistakenly believe or were unsure that "positive screening result means suffering from cervical precancerous lesions" (10, 50.0%) ($p<0.05$).

A logistic regression analysis was used to further analyze the statistical difference factors associated with total knowledge rates, with "unknowledgeable" as the reference group. The results showed that there was a positive association between "knowledgeable" (>60% correct answers regarding CC screening) with higher education status and living in most developed regions. Health care workers with junior college or higher degree were about four times more likely to have a high knowledge of CC screening than those with only senior or technical school qualification. Similarly, health care workers living in most developed regions were about five times more likely to have a higher total knowledge about CC screening than those living in less developed regions (Table 5).

Discussion

In China, health care workers who provide clinical or community services in county level MCH hospitals are the people that women seek for family planning information and consult for maternal or gyneacological services. Hence, health care workers are expected to have an accurate understanding about CC and how to prevent it be able to anticipate and answer questions, effectively conduce services and seek further information as needed. However, this study has revealed that the knowledge level of many workers is not satisfactory, threatening the effectiveness of NCCSPRA

The major finding in this study is that with the exception of knowledge about understanding of CC screening results, overall knowledge about CC among the health care workers was low. The total knowledge rate of CC was 46.9% (based on % who achieved a score ≥60% for a range of questions). The sectional knowledge rates about CC risk factors, prevention, clinical symptoms, screening methods and diagnostic tests for CC were only 31.3%, 37.5%, 18.1%, 56.3% and 56.3%, respectively.

Quite a sizable percentage of the respondents (34.4%) was correctly able to identify HPV infection as a risk factor for CC. This is consistent with an earlier study in Tanzania (38.7%) (Urasa et al., 2011) and contrasts with the results of other studies done in Thailand and Pakistan, which showed that the majority of the nurses and medical workers (about 80.0%) were aware that HPV infection was the cause of CC (Ali et al., 2010; Nganwai et al., 2007). This result can explain why only 3.0% of the women in the high-incidence region of CC in China knew that HPV infection was a necessary factor inducing CC (Jia et al., 2013). Worryingly, in this study, none of the respondents knew that "tobacco smoke" was a risk factor for CC, which is similar to the results of studies in other countries where only a small proportion of health workers identified smoking as a risk factor (7%, 19.5%, 20.4%) (Ali et al., 2010; Awodele et al., 2011; Urasa et al., 2011). This may be explained by the fact that smoking is not a common practice among Chinese women and smoking is most commonly associated with lung cancer and not with other types of cancers in anti-tobacco campaigns.

A large proportion of the participants were aware that reducing number of sexual partners, using condoms, and having HPV vaccine before sexual debutwere effective for CC prevention. The proportions were higher than those reported in the study conducted among health worker in Thailand, which showed that 69.2%, 30.8% and 23.3% of the participants knew single sexual partner, using condoms and having HPV vaccine were CC prevention measures (Nganwai et al., 2007). However, only a few of the participants in this study (3.1%) believed that CC screening could prevent CC occurring. In comparison, 86.5% of the participants in the same study in Thailand knew that having regular CC screening could prevent CC (Nganwai et al., 2007).

This study found that extremely low percentages of the health care workers (31.3%, 15.6%, 12.5% and 6.3%) knew vaginal water, abnormal vaginal discharge, urinary frequency, urgency, and post coital bleeding were common presenting features of CC. This is very low compared to earlier studies conducted among nurses and medical workers in Nigeria, Turkey, Thailand and India (Nganwai et al., 2007; Ertem, 2009; Awodele et al., 2011; Rani et al., 2012). In fact, none of the respondents knew that dysmenorrheal (ie, longer or heavier menstrual periods), was one of the clinical symptoms of CC. These results emphasize the urgent need to increase awareness about clinical symptoms in health care workers who are involved in the primary care of women. If the health care workers lack the knowledge about symptoms of CC, it's difficult for them to advise women to correctly identify the clinical symptoms.

Most of the health care workers correctly stated the screening methods and diagnostic tests for detection of cervical pre-cancer. These results are significantly higher than the results of earlier studies conducted in Nigeria, India and Pakistan (Ali et al., 2010; Awodele et al., 2011; Rani et al., 2012). Although the WHO guidelines mention that colposcopy should not be used as a screening method (WHO, 2006, 2014), 90.6% of the participants regarded colposcopy as a screening method of CC. This result would very likely mislead women who seek CC screening service to make the wrong decision.

Although the majority of participants correctly answered the meaning of the positive screening results, about 20% of participants incorrectly believed that a positive screening result means suffering from cervical precancerous lesions or early stage cervical carcinoma. These incorrect beliefs in health care workers can mislead women, cause unnecessary stress of them and discourage them from attending screening or follow-up. The belief that death is inevitable when cancer is present has been identified as a barrier to participation in cancer screening (Powe and Finnie, 2003; Jia et al., 2013).

Another important finding of this study is that the regional socio-economic status was one of the key factors fond to influence the CC knowledge level among health care workers. The total knowledge and the knowledge scores of risk factors of CC, CC prevention and screening methods in less developed regions were significantly lower than in most developed or developed regions. The proportions of sectional knowledge among health care workers in less developed regions were significantly lower than the other regions. This result could be explained by

the level of education of these health care workers and lack of access to professional development training. The result of this study shows the educational level of health care workers in less developed regions was significantly lower than the other regions, revealing that knowledge level was dependent on formal education. The health care workers with a higher educational qualification were about four times more likely to be knowledgeable for total knowledge about CC screening than those with those with lower educational status. The knowledge rate was significantly higher among health care workers with higher education degrees than among those with lower education degrees. In less developed regions, 70.0% of the health care workers had only a senior/technical school degree as compared to those in most developed regions, 77.8% of whom had a junior college or higher degree. This fact would explain why there were higher proportions of correctly identified risk factors, prevention measures, symptoms, screening and diagnostic test and understanding the positive results among the workers from developed or most developed regions.

Results from many earlier studies indicated that the utilization of screening services was dependent on an individual's awareness of the importance of CC screening. Women who had higher levels of knowledge were more willing to participate in CC screening (Awodele et al., 2011; Jia et al., 2013; Urasa et al., 2011). The provision of knowledge about CC from health care workers can reduce the anxiety and stigmas associated with screenings and thus encourage participation (Jia et al., 2013). Therefore, to encourage women to participate in the NCCSPRA, there is an urgent need to improve the knowledge about CC of health care workers in county level MCH hospitals, especially in less developed regions of China.

The results of this research showed that the knowledge rates of screening and diagnostic methods and understanding of the positive results were significantly higher than the knowledge rates of risk factors, prevention measures and clinical symptoms among health care providers. These results suggest that program training is more focused on clinical operation and disease diagnosis and treatment, with less emphasis on information about risk factors, preventive measures and clinical symptoms (MOH, 2009b).

Hence, according to the results of this research, it is necessary to strength the formal education in program areas and makes the above information access to education in less developed regions in service training.

Limitations, This study only focused on the knowledge of the health care workers who provide CC screening services in NCCSPRA in county level MCH hospitals in 6 counties of China. The results of the study should be interpreted with caution because of its relatively small sample size, limited research areas, and convenience sampling method. The results should not be generalized to all health care workers who provide CC screening services in NCCSPRA. Additionally, this study only revealed that the difference in education degrees of health care workers may be the cause of disparities in knowledge level in different regions, but did not identity other possible influencing factors on such disparities, such as experience of health care workers. Despite these limitations, the results of this study provide a basis for planning future in-depth research prior to developing educational materials and planning interventions which base on training for the implementation of the NCCSPRA.

In onclusions, this is the first study to provide insight into the level of knowledge about CC among health care workers who provide CC screening service in NCCSPRA in county level MCH hospitals. This is important because the results highlight the inadequacy of their knowledge, especially for those in less developed regions of China. Health care workers play important roles as health educators and promoters as well as conducting clinical services. Therefore, unsatisfactory knowledge of CC may lead to negative impacts on women to participate in CC screening and impact negatively on outcomes through inaccurate information provision. To improve the quality of NCCSPRA, health education interventions are essential for health care workers, especially in less developed regions.

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References

Ali SF, Ayub S, Manzoor NF, et al (2010). Knowledge and awareness about cervical cancer and its prevention amongst interns and nursing staff in tertiary care hospitals in karachi, pakistan. *PloS one*, **5**, 11059.

Anttila A, Voti L, Sauvaget C, et al (2009). Cervical cancer screening policies and coverage in Europe. *Eur J Cancer Care*, **45**, 2649-58.

Arbyn M, Anttila A, Jordan J, et al (2010). European guidelines for quality assurance in cervical cancer screening. second edition--summary document. *Ann Oncol*, **21**, 448-58.

Awodele O, Adeyomoye AAA, Awodele DF, et al (2011). A study on cervical cancer screening amongst nurses in Lagos University Teaching Hospital, Lagos, Nigeria. *J Cancer Educat*, **26**, 497-504.

Clover K, Redman S, Forbes J, et al (1996). Two sequential randomized trials of community participation to recruit women for mammographic screening. *Prevent Med*, **25**, 126-34.

Ertem G (2009). Awareness of cervical cancer risk factors and screening behaviour among nurses in a rural region of Turkey. *Asian Pac J Cancer Prev*, **10**, 735-8.

Giorgi D, Giordano L, Senore C, et al (1999). General practitioners and mammographic screening uptake: influence of different modalities of general practitioner participation. Working Group. *Tumori*, **86**, 124-9.

Goss PE, Strasser-Weippl K, Lee-Bychkovsky BL, et al (2014). Challenges to effective cancer control in China, India, and Russia. *Lancet Oncol*, **15**, 489-538.

Huang Y, Zhou K, Li H, et al (2011). Knowledge, attitudes, and behaviour regarding breast cancer screening among women from different socio-economic regions in southwest China: a cross-sectional study. *Asian Pac J Cancer Prev*, **12**, 203-9.

IARC (2005). IARC handbooks of cancer prevention (Vol. 10). Geneva: IARC Press.
IARC. (2012). GLOBOCAN 2012: Estimated cancer incidence, mortality and prevalence worldwide in 2012. Retrieved September 5, 2014, from http://globocan.iarc.fr/Pages/fact_sheets_cancer.aspx?cancer=cervix
Jia Y, Li S, Yang R, et al (2013). Knowledge about cervical cancer and barriers of screening program among women in Wufeng County, a high-incidence region of cervical cancer in China. *PloS one*, **8**, 67005.
Jian WY, Chan KY, Reidpath DD, Xu L (2010). China's rural-urban care gap shrank for chronic disease patients, but inequities persist. *Health Affairs*, **29**, 2189-96.
Lancet T (2009). Women's health in rural China. *Lancet*, **374**, 358.
MOH. (2009a). Management plan for rural areas cervical cancer and breast cancer screening examination program. Retrieved June 24, 2009, from http://www.moh.gov.cn/fys/s7900/200906/cd3c33a7ad624a50b8100b262041dabe.shtml
MOH (2009b). Technical solution of cervical cancer screening program in rural areas of China. Beijing: MOH.
MOH (2013). China's Health Statistics Yearbook 2013. Beijing: Peking Union Medical College Press.
NBS (2014). National data Retrieved October 12 2014, from http://data.stats.gov.cn/workspace/index?m=hgnd
NCC, DPCB, and NHFPC (2013). Chinese Cancer Registry Annual Report 2013. Beijing: Military Medical Science Press.
Nganwai P, Truadpon P, Inpa C, et al (2007). Knowledge, attitudes and practices vis-a-vis cervical cancer among registered nurses at the Faculty of Medicine, Khon Kaen University, Thailand. *Asian Pacific J Cancer Prev*, **8**, 15-18.
Powe BD, and Finnie R (2003). Cancer fatalism: the state of the science. *Cancer Nursing*, **26**, 454-67.
Rani V, Seth S, Srivastava DK, Singh E (2012). Awareness of cervical cancer screening among nursing staff in a tertiary institution of rural India. *J Gynecologic Oncol (JGO)*, **23**, 141.
Rossi PG, Camilloni L, Cogo C, et al (2012). Methods to increase participation in cancer screening programme. *Epidemiologia E Prevenzione*, **36**, 1-104.
Shi JF, Canfell K, Lew JB, Qiao Yl (2012). The burden of cervical cancer in China: Synthesis of the evidence. *Int J Cancer*, **130**, 641-52.
Urasa M, Darj E, Medicinska och farmaceutiska v, et al (2011). Knowledge of cervical cancer and screening practices of nurses at a regional hospital in Tanzania. *African Health Sci*, **11**, 48-57.
WHO (2006). Comprehensive cervical cancer control A guide to essential practice. Geneva: WHO press.
WHO (2014). Comprehensive cervical cancer control-A guide to essential practice Second edition. Geneva: WHO Press.