Journal of Cancer Policy 19 (2019) 100181

Contents lists available at ScienceDirect

Journal of Cancer Policy

journal homepage: www.elsevier.com/locate/jcpo

Participation rate and its influencing factors of a model demonstration cervical screening programme in rural China

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ARTICLE INFO

Keywords:
Cervical cancer
Screening
Participation rate
Temperature
China

ABSTRACT

Objectives: To assess the participation rate of the cervical cancer screening programme during the first six years of operation and to explore practical factors that affect the participation rate in a screening demonstration programme in rural China.
Methods: A descriptive analysis was conducted to evaluate the participation rate of organised cervical cancer screening programme in Zhushan county from 2009 through 2014. Screening data were linked to the population data and the climate data to explore the effect of them on the participation rate in the screening programme.
Results: Of the 73,847 Pap tests from 59 events of mobile cervical cancer screening performed from 2009 to 2014, 93.6% of the screened women were in the target age groups (25–64 years). The screening participation rates by township were between 10% and 30% in each 2-year screening round. About half of eligible women underwent at least once Pap test over the six-year period. The recall rates for the second and third period were 11.3% and 17.2%, respectively. The participation rates were low when the uptakes of screening were in winter or summer seasons.
Conclusion: Our results indicate that the 2-year screening programme announced by the government cannot be achieved. The effort of the screening team in finding unscreened women by throughout the area could raise the participation rate reaching 49.5% within 6 years. Our study also revealed an association between the extreme temperatures at screening undertaken and the low participation rates. In planning cervical screening activities in an area should consider such the environmental factors.

1. Introduction

This article is an extension of our previous paper on the “Evaluation of a Model Demonstration Programme for the Control of Cervical Cancer in Rural China: A Cross-Sectional Study on Existing Databases from 2009 to 2014” [1] which provides more indicators of the cervical cancer screening programme in rural China. In summary, the study was conducted in Zhushan county of Hubei province in central China, where cervical cancer incidence is among the top five cancers [2]. We evaluated the organised cervical cancer screening programme in Zhushan County for both ongoing activities and outcome impact from 2009 through 2014. The indicators reported in the previous paper (Fig. 1) are accepted at the international level and can be compiled at the local screening unit. We have demonstrated in the previous paper that the available budget provided by the central government and the local resources could commit a coverage rate of screening at around 50% of the target female population within six years. We found that supplies were not sufficient to provide the screening service for the target female population in the area within two years as planned by the central government.

Participation rate is the most important factor contributing to the success of a screening programme. Low participation rate leads to less effectiveness [3]. In practice, the increase in screening attendance requires a better understanding of the factors influencing their participation. Many studies have explored factors associated with the participation of cervical cancer screening programmes from the perspective of participants [4–6]. But it's rare to look at the practical factors from a provider's point of view. In fact, external environmental factors such as disasters and climatic seasonality are also potential possible reasons for low screening uptake [7].

In complement to the previous article, this study aims to assess the participation rate of the cervical cancer screening programme down to

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https://doi.org/10.1016/j.jcpo.2019.100181
Received 4 October 2018; Received in revised form 4 January 2019; Accepted 9 January 2019
Available online 11 January 2019
2213-5383/

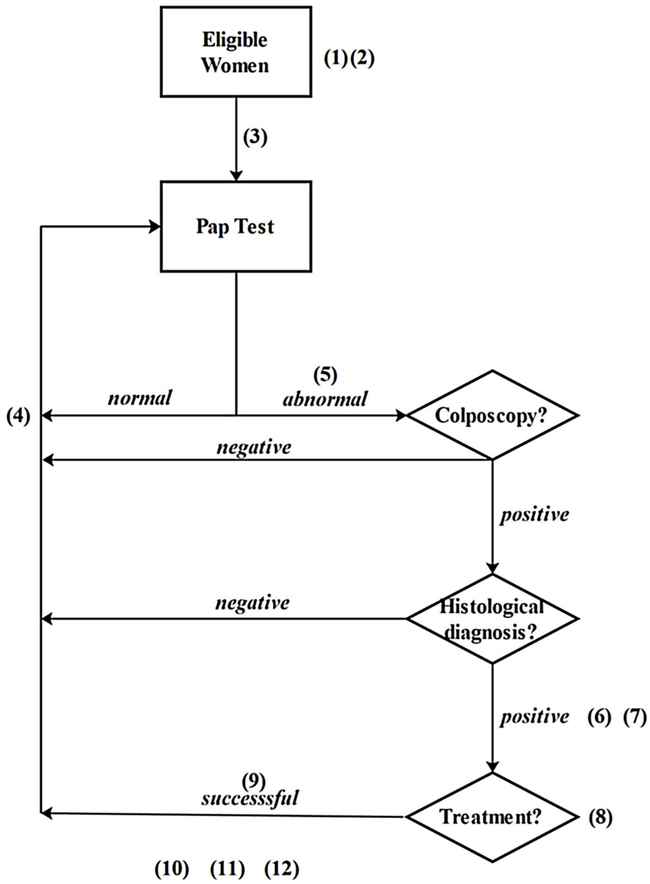

Fig. 1. Conceptual diagram of the screening process and corresponding indicators calculated at each stage.

the townships and to explore practical factors affecting participation rate in the screening programme in Zhushan County. The study in this county could reflect the quality of the screening programme in the low-income counties and provide information feedback to improve the performance of the national cervical screening programme policy for rural China.

2. Methods

2.1. Cervical screening programme in Zhushan County

Zhushan County has a total population of about 440,000 residing in an area of 3588 square kilometers where more than 80% of the land is mountainous. The county has four distinctive seasons, and the extreme weather often occurs during winter and summer. It is one among the first batch of the national poverty-stricken counties, and the majority of people in the county are living in rural areas. Agriculture and forestry dominate the county. Rice and wheat are the primary agricultural products. Around the third and seventh months of the Chinese lunar calendar which roughly correspond to April and August are busy farming seasons every year.

The organized cervical cancer screening programme in Zhushan County initiated from 2009. The county maternal and child health hospital was designated to implement the screening programme. The ThinPrep imaging system [8], an automated Pap smear instrument, was used for primary screening. The health personnel returned to the same township for early detection testing within approximately two years.

2.2. Study design and data collection

A descriptive analysis was conducted to evaluate the organised cervical cancer screening programme in Zhushan County from 2009 through 2014. Screening data were linked to the population data and the climate data to explore the practical factors that affect the participation rate in the screening programme.

The information of individuals participating in the screening programme including name, national identification number, age, address, and screening date from 2009 through 2014 was extracted from the screening institution in the county maternal and child health hospital. The researchers obtained the number of women in each township obtained from the Sixth National Population Census surveyed by the National Statistical Office in 2010 [9]. The Bureau of Statistics of Zhushan County provided the land area of townships to compute the population density. The monthly temperature data in each year were extracted from the National Meteorological Information Center [10].

2.3. Data analysis

The descriptive statistics of the variables in the study were in the form of frequency, median, and percentage. Screening participation rates were calculated and stratified by age group and township from 2009 to 2014. A multivariate generalized additive model [11] was fitted and plotted to visually identify potential nonlinear relationships between predictors (average monthly maximum temperature, target population size, land area, and population density) and participation rate. The output of the generalized additive model is the estimated smooth curves for the predictor variables which can indicate appropriate cut points for the continuous predictor variables. A log-level linear model was then fitted to illustrate the association between temperature and participation rate. We added to the model a potential confounding factor (farming season) as a dichotomous variable. We considered May and September of the Gregorian calendar as the busy farming seasons. From the linear model, we calculated the 95% confidence intervals and p-values. The *t*-test was used for making inference about the regression coefficient. A p-value of *t*-test less than 0.05 indicates that the coefficient is significantly different from 0. The F test was used for testing the statistical significance of the variable in the linear model. A p-value of F test less than 0.05 indicates that the variable is significant in the model. All statistical calculation and data visualization were performed using R software version 3.3.3 [12].

3. Results

Since 2009, organised cervical cancer screening programmes were conducted covering the entire county with a frequency of two years for healthy women aged 25–64 years. Approximately 120,000 women per year were in the targeted screening group. The number of target female population varied among townships (Fig. 2). Baofeng and Chengguan had the largest target female population (> 13,000 women) whereas Shenhe and Loutai had the smallest (< 4000). Between 2009 and 2014, the screening team performed a total of 73,847 Pap tests in all ages, 69,127 (93.6%) of which were in the target age group (25–64). A total of 59 screens were performed. The majority of townships were screened three times during these six years. However, Chengguan, which is the closest township to the maternal and child health hospital, was visited six times. Baofeng, Leigu, Yishui, Shangyong, and Wenfeng were screened four times respectively.

3.1. Participation of screening

Over the six-year period, the screening team screened about a half of the eligible women in the county. Fig. 2 shows the six-year participation rate by townships. The screening participation rates varied across townships and screening periods. The screening frequency

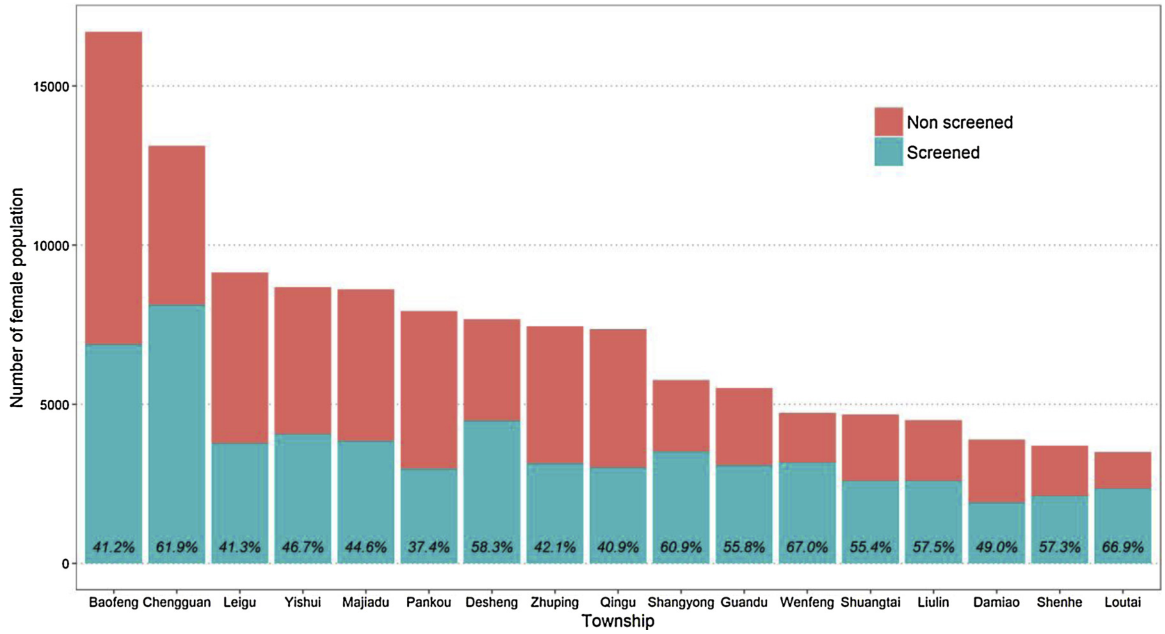

Fig. 2. The number of screened and non-screened target female population by township.2009–2014. (*The percentages represent the participation rates of each township during the entire period.*)

planned by the central government was every two years from 2009. In the second round (2011–2012) of screening, 2356 (11.3%) women had been screened in the first round (2009–2010). While in the third round (2013–2014) of the activity, the number of women tested at least once in the previous two rounds was 3976 (17.2%). About 76% of re-screened women aged within the range of 35 to 55 years.

3.2. Univariate relationship between temperature and participation rate

To test the hypothesis that seasonality may affect participation rate, we explored the association between temperature and participation rate. The average monthly maximum temperatures were below 10 °C in January, February, and December, while the temperatures were higher than 30 °C in June, July, and August. There was no screen performed in the first two months of the year in 2009–2014. The number of screens in other months ranged from four to seven times total in each month. The participation rates were low when the screens were in winters and summers. The participation rates were highest in April, June, and October. In December, the participation rates were consistently low, less than 15 percent (Fig. 3).

3.3. Multivariate analysis

Fig. 4 shows the relationship between the partial residuals from the generalized additive model and the four continuous predictors, average monthly maximum temperature, target population size, land area, and population density. According to the plots and p values, the nonlinear relationship between temperature and participation rate is significant whereas that of the other predictors is not. The participation rates peaked when the average temperatures were around 20 and 25 °C. The decrease in participation rate with the decline in warmth in cold weather was less steep than that with the rising temperature in hot weather. All the other three lines are more or less horizontal, and the p values are all higher than 0.05 indicating that the relationships between these variables and participation rate are not significant. We cut the temperatures into three intervals based on the result of the generalized additive model and the average maximum monthly temperatures in different seasons. We then fitted a multivariate log-level linear model. According to the results of the linear model, the participation rate shows no significant association with the target population size and population density (Table 1). The participation was not significantly different when screening practice was in busy farming seasons ($p = 0.36$). After adjusted for other variables, the monthly maximum temperature interval had a significant association with the participation rate. Practicing the screening in low-temperature seasons, i.e., less than 15 °, the participation rate would drop about a half (95% CI: 41% to 64%) on average compared to that in moderate temperature seasons. On the other hand, screening practice implemented in high-temperature seasons, i.e., higher than 28 °, participation drops to 82% (95% CI: 68% to 99%) of that of moderate temperature seasons.

3.4. Compliance with pathologically confirmation and treatment

A total of 4088 (5.7%) of women had positive (abnormal) primary screening test results (Table 2). A higher proportion of women aged 25–44 ha d suspicious test results, while 5.8% of all suspected cases were beyond the target age range of 25–64 years. There was no significant difference in age distribution among 256 confirmed cases. Among screened women confirmed with CIN grade I, about one-third received treatment in the hospital (Table 3). Early treatment rate for high-grade squamous intraepithelial lesion (CIN II+) was 95%. Only one screened woman with a result of cancer did not seek treatment.

4. Discussion

The current study aimed to extend the report on the evaluation of the effectiveness of a cervical cancer screening programme organised in central China. The research site is one of the national demonstration counties for cervical cancer screening programmes which follow the same rules and procedures. Because every demonstration site had a similar pattern of screening, we think our conclusion is representative. The summary of the first half of the results [1] is that the screening coverage by township was about 18% in each 2-year screening round and the overall 6-year coverage reached 49.5%. The recall rates for the second and third period were around 15%. The screening programme did increase the capture of women with precancerous lesion better than those with cervical cancer among those with age under 60. In this paper, the six-year participation rate by township varies from 37% to

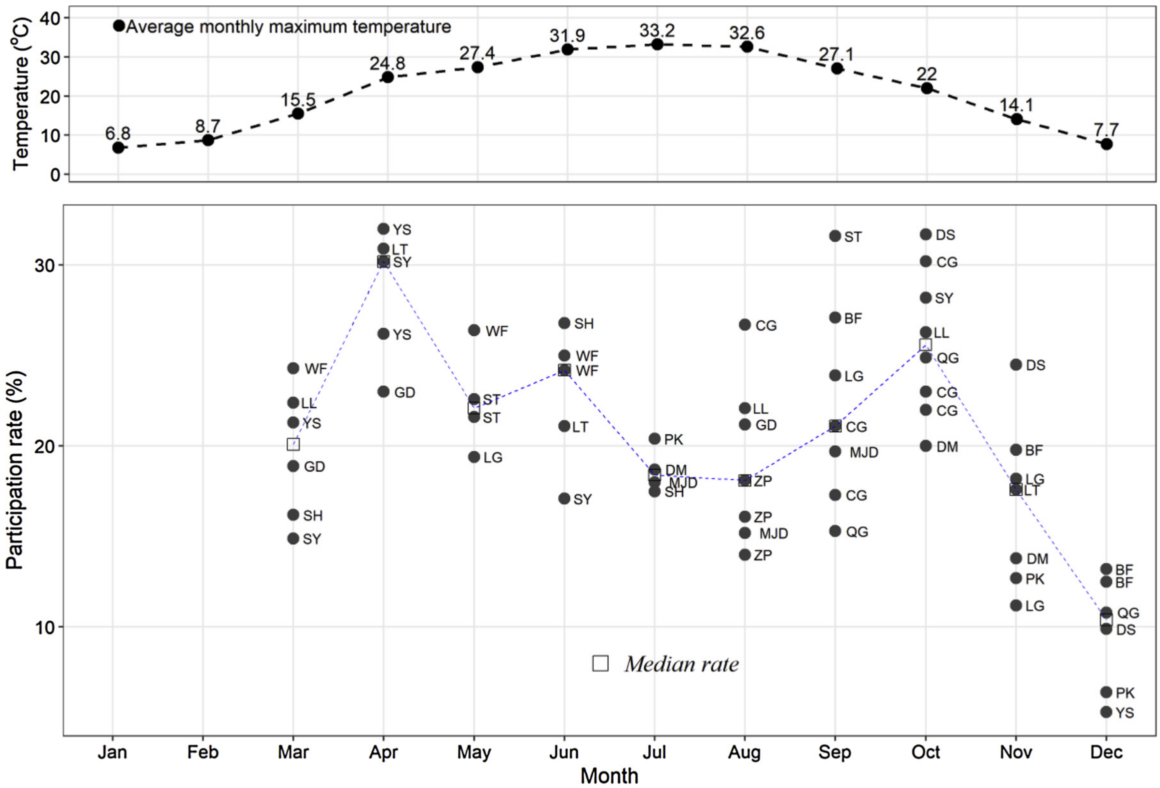

Fig. 3. Average monthly maximum temperature from 2011 to 2014 (upper panel) and Participation rate in each screening uptake by month during 2009 to 2014 (lower panel).

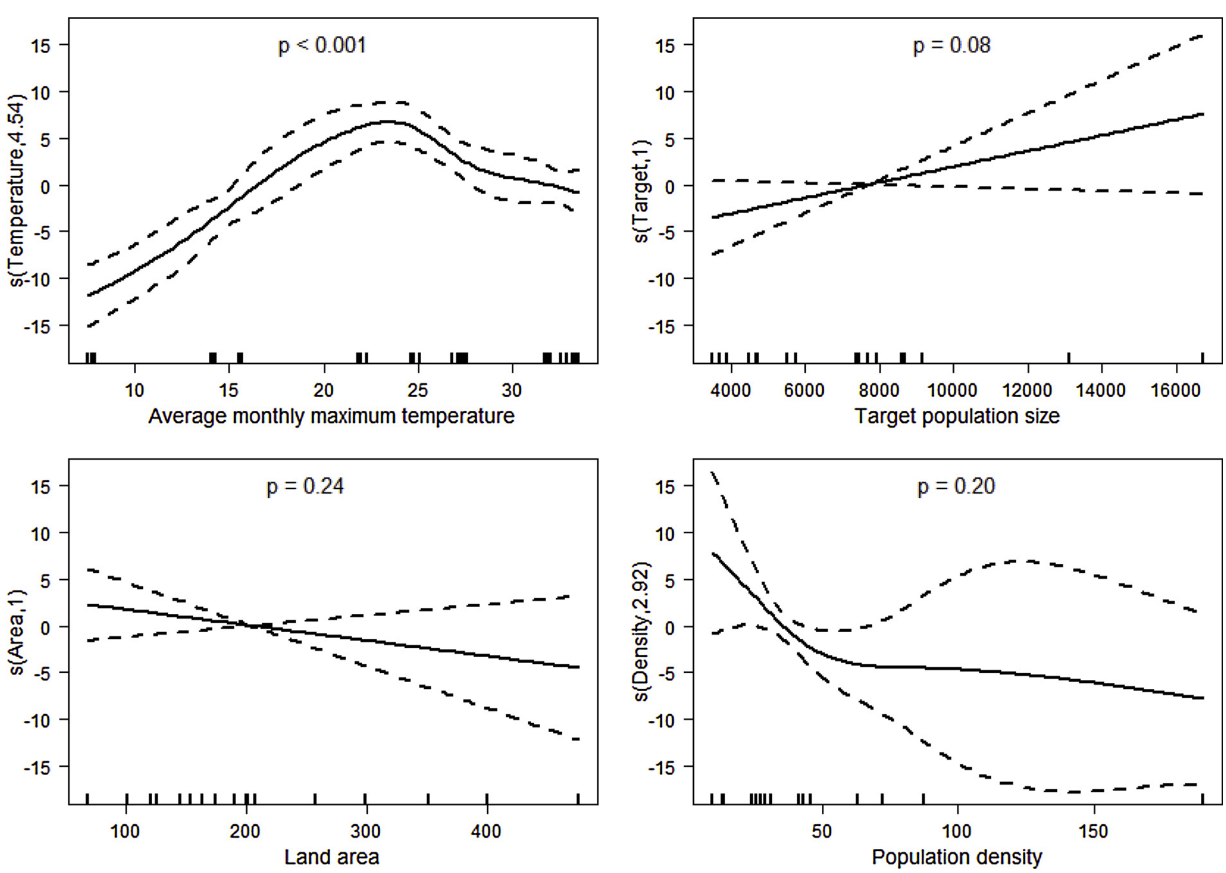

Fig. 4. Estimated smooth functions for the predictors in the multivariate additive model.

Table 1
Practical factors associated with screening participation rate in Zhushan County 2009–2014.

		Exp.coef[a](95% CI)		P(t-test)	P(F-test)
Temperature (°C)	ref. = (15,28]				< 0.001
	(0,15]	0.51	(0.41, 0.64)	< 0.001	
	(28,40]	0.82	(0.68, 0.99)	0.047	
Target population size (1000 women)	(cont. var.)	1.01	(0.97, 1.04)	0.681	0.681
Population density (1000 women/km^2)	(cont. var.)	0.77	(0.08,7.72)	0.823	0.823
Farming season	ref. = No	0.91	(0.73, 1.12)	0.359	0.359

[a] Exponential of Coefficients.

Table 2
Number and percentage of suspicious cases in different age group.2009–2014.

Age group	Screened	Suspicious	%
0–25	2,531	76	3.0
25–34	11,726	801	6.8
35–44	24,229	1,580	6.5
45–54	20,835	1,124	5.4
55–64	10,701	446	4.2
65 +	2,144	61	2.8
Total	72,166	4088	5.7

Table 3
Number of confirmed cases received treatment among screened women.2009–2014.

	Total	Treatment (%)	No treatment (%)
CINI	99	33 (33.3%)	66 (66.7%)
CINII	48	43 (89.6%)	5 (10.4%)
CINIII/In situ	52	52 (100.0%)	0 (0.0%)
Cancer	57	56 (98.2%)	1 (1.8%)

67% as shown in Fig. 2. Though the percentage of participation rate seemed to fit with the population size, the multivariate statistical analysis showed no effect of the predictor while the average monthly maximum temperature did (Table 1, Figs. 3 and 4). The peak age of suspicious Pap results appeared around the age groups 25–34 and 35–44 years (Table 2).

It is challenging to define quantifiable performance indicators over the entire series of activity for an organised screening programme especially given that the technologies and methods used to screen, diagnosis and treatment methods of cervical cancer are continuously evolving. The guideline developed by the Chinese Ministry of Health in 2009 recommended limited indicators to evaluate a cervical screening programme, i.e., screening frequency, participants rate, the prevalence rate of cervical lesion, the women's knowledge of gynaecological diseases. It sounds reasonable that those indicators need no sophisticated statistical analysis. However, the process and outcome indicators shown in our articles should be evaluated once in a while and some of them, such as the participation rate by township, are not difficult but essential indicators for local health workers to guide the target populations for the following years. To promote high-quality screening, the entire screening pathway, from coverage and uptake to cervical abnormality diagnosis and treatment, must be monitored as it is crucial that women who screened abnormal must be promptly managed to get proper care and treatment otherwise it is unethical to test them. We showed that with the linkage of screening database and information system of the hospitals in the area by the personal identification number, the local screening team could track the screenees with abnormal of suspicious smears.

About half of eligible women underwent at least once Pap test over the six-year period. The screening participation rates were between 15% and 20% in each 2-year screening round. This number is consistent with the participation rates reported from some other local surveys which were around 10% to 20% [13–15]. Short of cytopathologists and health workers for screening by Pap test was a significant reason reported for the low participation rate of screening programme [16]. In comparison with other countries, it is not true that the screening cycle in rural China is every two years as planned and announced by the Chinese government. In our reports, a period of six years could cover half of the target population. However, it is likely that a cycle longer than six years is possible as the participation rate in the later years was still constant in later years of the six-year period. The HPV vaccine was approved by the China Food and Drug Administration (CFDA) in 2016 and will gradually be made available in community health centres across 17 provinces. This new strategy may provide a better solution for Chinese women to fight against cervical cancer [17,18]. However, HPV vaccines are too expensive for the general public, especially for women in rural China. Thus, it will take a long time to implement the HPV vaccine across China. Moreover, the vaccination targets at children before the reproductive age, cytological screening can fill the gap in the population between vaccinated children and adults. The integration of screening and HPV vaccine may be more effective in acting as a comprehensive strategy for cervical cancer prevention and control in the future.

To complete the story, we investigated the association between the participation rate with demographic factors such as the size of the target population and environmental factors such as the average maximum temperature and cropping and harvesting time. Even the natural disasters such as floods and earthquakes strongly affect the participation rate to screening but these factors are not predictable, modifiable and manageable so we did not consider the events in the predictive model. Our regression analysis found that temperature at screening uptake links with the participation rate. The low screening uptake in the months with relatively cold and warm weather resulted in the low participation rates. This result is consistent with the study done in Poland in 2010 [7] which showed women do not attend the screening in the winter months. The lack of health workers makes the screening institution challenging to implement screening activities simultaneously among townships in the county. To fulfill the assigned annual tasks, they had to scatter screening activities in various months and go to different townships each year. Despite such restrictions, cervical screening institutions should give full consideration to climatic conditions during screening practice so that the resources are optimized. The spring and autumn seasons are the appropriate time for scheduled screening activities. The screening institution should avoid holding the field activities in November and December which have cold weather. In announcing the yearly schedule to the community, target women can make their plan and prepare themselves the appropriate time to participate in the screening programme.

The effectiveness of cervical cancer screening programme is directly related to the successful follow up of women who receive further testing and health care after a positive primary test result. In the whole 6-year period of this study, among near 4000 positive primary tests, only 255 cases were pathologically confirmed. This fact indicates a considerable proportion of women who screened but was not advised or did not go to the hospitals for tissue confirmation. Such a low confirmation rate deserves attention. The general recommendation for cases with CIN I can repeat the test in the following round of screening may not be possible when the screening team keeps changing the place for screening in the subsequent rounds. These women would lose the opportunity to be rescreened for some years, and their lesions might progress to overt malignancy. Failure to follow-up and investigate women with cytological abnormalities may exert pitfalls in the operation of cervical screening programmes in Zhushan county. This finding implies that the management of abnormal Pap smears should be improved or revised to reduce the risk of the progression of a precancerous lesion to overt cervical cancer. The location of residence and knowledge about cervical screening are the main reasons for low rates of compliance to confirmation [19,20]. We recommend that the government and medical institutes should consider promoting follow-up visits for patients recruited in the rest of the programme. The women in high-risk should be identified and recorded in the database for reminding, revisiting, or referring to the hospitals so that they get follow up or proper treatment. Furthermore, improving education about cervical screening in target populations is necessary.

In this study, about one-third screened women with CIN I received treatment as shown in Table 3. Nevertheless, the recommendation is that women could be followed by regular cytological surveillance with no increased risk of severe preinvasive lesions being undetected [21]. We recommend treatment strategies for preinvasive cervical lesions should be included in the Chinese guideline if the workload to the oncologic gynaecologists is not too high.

According to our best knowledge, this is the first comprehensive evaluation of one of the earliest cervical screening programme in the region, and several limitations should happen. First of all, some crucial performance indicators, such as specimen adequacy, colposcopy rate, and biopsy rate were missing calculated due to the lack of data. Secondly, we used secondary data to find the predictors influencing participation rate. We explored the practical factors from the providers' point of view rather than from the participants' aspect. Future studies could be conducted to examine other predictors associated with cervical screening attendance. Finally, the absence of cancer database in the county makes the data collection (i.e., incidence rate) an inconvenient task. The information system is indispensable to manage and evaluate the impact of the screening programme and ensure that target women would get adequate care. We recommend that an improvement of the information system is essential for future studies and holds the firm base in the calculation of the routine indicators of screening programme evaluation [22].

However, our findings indicate that organised screening programmes which are in the process of the expansion of a national-based screening programme must be encouraged. Moreover, there is an urgent need to review and revise the screening programme policy with consideration given to the findings presented here. The results hopefully could facilitate the development of the comprehensive guidelines for quality assurance for the organised cervical cancer screening programme in rural China.

Funding

This work was supported by the National Natural Science Foundation of China (Grant No.71774049); and the Foundation for Innovative Research Team of Hubei University of Medicine (No. FDFR201602).

Conflict of interest

None declared.

Ethical approval

Research Ethics Committee, Faculty of Medicine, Prince of Songkla University (REC 58-246-18-5)

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