Evaluation of the National Cervical Cancer Screening Programme in Singapore

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INTRODUCTION A retrospective observational study was performed to evaluate the effectiveness of CervicalScreen Singapore (CSS), a National Cervical Cancer Screening Programmme.

METHODS National trends on incidence, mortality of cervical cancer and carcinoma *in situ* of the cervix before and after the launch of CSS were examined. Linear regression was used to calculate the average annual percentage change in age-standardised incidence and mortality rates. We also examined the operational measures of CSS, such as the women who joined the CSS programme and the diagnostic accuracy of Pap smears. The study was confined to women who consented to join CSS at government-funded polyclinics.

RESULTS Nationally, there was a greater decline in the age-standardised incidence and mortality rates in the period 2004–2008 as compared to the period 1987–2003. Under CSS, a total of 99,759 Pap smears were performed on 81,087 women in the period 2004–2008. However, the number of first screens decreased from 18,434 in 2004 to 11,624 in 2008. Among women aged 25–69 years who had their first Pap smear screening and who were recommended for routine rescreen in three years, 10% had a subsequent rescreen within three years. Overall, the CSS programme was able to detect 0.37 invasive cancers per 1,000 screens in women aged 25–69 years.

CONCLUSION The CSS programme has contributed to a decline in the mortality and incidence of cervical cancer in Singapore. However, the challenges of increasing the screening uptake among eligible women need to be addressed.

Keywords: cervical cancer screening, effectiveness, evaluation
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INTRODUCTION

Opportunistic Pap smear screening has been made available in Singapore since 1964. In the 1980s, there was widespread use of Pap smears for cervical cancer screening associated with the planned parenthood programme. With the introduction of opportunistic Pap smear screening, incidence and mortality rates declined steadily. This could be due to the detection of early stages of cervical cancer, in which treatment could be instituted early. However, the overall incidence rate remained high (6.8 per 100,000) when compared to countries with organised population-based cervical cancer screening programmes, such as Finland (4.5 per 100,000) and Australia (4.9 per 100,000).[1]

In 2004, the Health Promotion Board (HPB), Singapore, launched a National Cervical Cancer Screening Programme, CervicalScreen Singapore (CSS), to invite women aged 25–69 years, who have ever had sex, to undergo cervical cancer screening once every three years. This screening programme was recommended by the National Committee for Cancer Care in view of the slow decline in the incidence of cervical cancer. Through this programme, eligible women received subsidised Pap smear screening at government-funded polyclinics. The programme also encouraged women to go for Pap smear screening at private clinics and hospitals through educational campaigns aimed at increasing awareness of cervical cancer screening and the CSS programme.

This study evaluated the effectiveness of the screening programme by looking at the outcomes, namely changes in the national incidence, mortality and carcinoma *in situ* (severe dysplasia or CIN III) rates before and after the launch of CSS, as well as the process indicators of CSS, such as the number of women who joined the CSS programme and the diagnostic accuracy of Pap smears at government-funded polyclinics.

METHODS

The evaluation was performed retrospectively using two sources of data – the CSS registry and Singapore Cancer Registry (SCR). The CSS registry was set up by HPB in 2004 to monitor the quality standards and evaluate the effectiveness of the screening programme. The registry sent personalised letters to eligible women to invite them to undergo Pap smear screening at government-funded polyclinics. Rescreen letters were also sent by the registry to encourage women participating in the CSS programme to go for rescreen at three-year intervals. The registry is linked to the polyclinics and public hospitals through a web-based Internet application system, and online screening data from women who had consented to join the screening programme were entered directly into the registry.

The screening results were tracked from the point the smears were taken for the women who had consented to join the

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screening programme to the point where those with abnormal smears were managed, as long as the women continued to be managed in government-funded polyclinics and public hospitals. The screening outcomes of women who had been to the government-funded polyclinics for rescreen at the three-year interval under the CSS programme were also tracked to the point of diagnosis at the public hospitals. However, CSS was unable to capture the data of women who had their Pap smears at private clinics or private hospitals. The programme was, therefore, unable to track women who were initially screened at government-subsidised polyclinics but subsequently followed-up for abnormal smears in the private sector.

The SCR is a population-based cancer registry that was started in 1968. Cancer registration in Singapore is comprehensive, as Singapore is a small country with a relatively compact and stable population. As there is good access to medical care, it can be expected that most cancer patients are diagnosed and treated in the local private and public hospitals where the abstraction of cancer data takes place. Matching of data from the two registries was carried out using common national identifiers – the National Registration Identity Card (NRIC) numbers. The resultant merged dataset was extracted in a Microsoft Excel file, with identifiers such as names and NRICs removed for analysis in the SCR. The merged dataset contained the information of women with normal and abnormal Pap smear results who had been to government-funded polyclinics for screening. Matching with the SCR enabled the outcome of women with abnormal Pap smear results, who subsequently went to private hospitals for further management as well as those diagnosed with cervical cancers, to be identified.

In the outcome evaluation, using data from the SCR, the average annual percentage changes in the national incidence and mortality rates of cervical cancer before (1987–2003) and after (2004–2008) the launch of CSS were compared, so as to determine whether the launch of CSS was associated with a greater decline in the national incidence and mortality rates of cervical cancer than would be otherwise expected. This was followed by quantifying the difference between the observed national incidence and mortality rates in the period 2004–2008 with the projected rates, using the rates in the period 1987–2003 for projection. The national incidence rates for cervical carcinoma *in situ* were also computed to monitor the effectiveness of CSS in the early detection of preinvasive cancers. Being national rates, the computation included cases of carcinoma *in situ* detected at the polyclinics, government hospitals and the private sector. The process of evaluation looked at CSS's operational measures at government-funded polyclinics for the period 2004–2008, and included the number of women who joined CSS as well as the diagnostic accuracy of Pap smear screening. This was achieved by analysing the dataset derived from matching the women in the CSS database with their outcomes in the SCR.

Statistical analysis was performed using the IBM Statistical Package for the Social Sciences Statistics 20 (IBM Corp, Chicago, IL, USA). In the outcome evaluation, age-standardised incidence and mortality rates of cervical cancer from 1987 to 2008 were computed using data from the SCR. All the age-standardised rates given in this paper were derived by the direct standardisation method using Segi's world population.[2] Linear regression was used to calculate the average annual percentage change (increase in incidence or mortality per unit increase in years) in age-standardised incidence and mortality rates. Applying the assumption that cancer incidence and mortality change at a constant rate, linear regression was used to project the age-standardised incidence and mortality rates for the period 2004–2008 using the corresponding rates in the period 1987–2003.

All women who consented to be screened under CSS at government-subsidised polyclinics during the period 2004–2008 were included in the process evaluation. Descriptive statistics, such as numbers, proportion and rates, are widely used in the paper to summarise the data or describe the attributes of the set of data. The diagnostic accuracy of Pap smears is expressed in terms of sensitivity, specificity, and positive and negative predictive values (PPV and NPV).

RESULTS

The age-standardised incidence rate for cervical cancer declined significantly ($p < 0.001$) at an average of 3.7% per annum, from 16.7 per 100,000 women per year in 1987 to 6.8 per 100,000 women in 2008. In the period 2004–2008 following the launch of CSS, the age-standardised incidence rate for cervical cancer declined significantly ($p = 0.025$) at an average rate of 8% per annum. Similarly, the age-standardised mortality rate for cervical cancer declined at a rate of 8.2% per annum ($p = 0.019$) during the same period, as compared to the period 1987–2003 where the rate of decline was only 2.8% per annum ($p < 0.001$).

Corresponding with the greater decline in age-standardised incidence and mortality rates for cervical cancer, the observed age-standardised incidence rates were 3.9% and 12.8% lower than the projected rates in 2007 and 2008, respectively, while the observed mortality rates were 5%–24% lower than the projected mortality rates for the period 2004–2008 (Figs. 1 & 2). The number of carcinoma *in situ* also declined during the study period, from 325 in 2004 to 287 in 2008 (Fig. 3). However, the proportion of stage I cervical cancer increased from 44% in 2004 to 49% in 2008 (Fig. 4).

Under CSS, a total of 99,759 Pap smears were performed on 81,087 women in the period 2004–2008. However, the number of first screens decreased from 18,356 in 2004 to 11,624 in 2008 (Fig. 5). Among women aged 25–69 years who had their first Pap smear screening and were recommended for routine rescreen in three years, 10% had routine rescreens within three years. The number of women aged 25–69 years who had gone for their first Pap smear screening and were recommended for routine rescreen in three years decreased from 11,945 in 2004 to 9,402 in 2008. Malay women had the highest loss to rescreen rate (92.2%), followed by Indian (91.2%) and Chinese (89.7%)

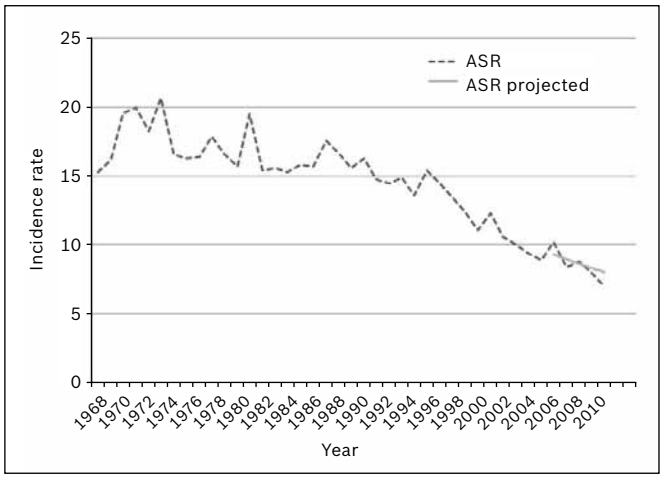

Fig. 1 Age-standardised incidence rates (ASR) of cervical cancer (1987–2003) and the projected incidence (2004–2008).

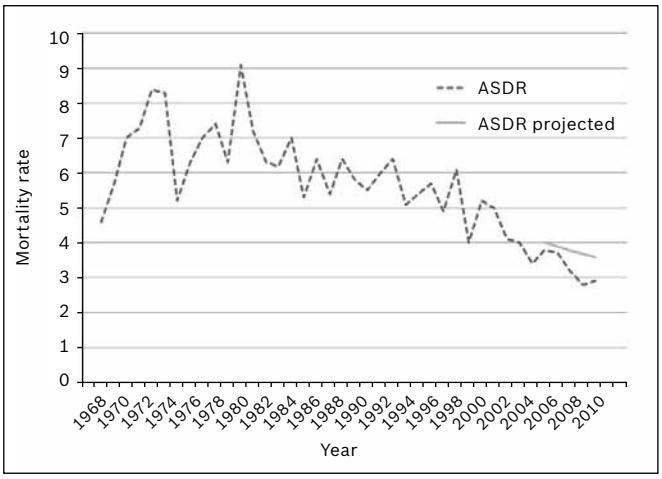

Fig. 2 Age-standardised mortality rates (ASDR) of cervical cancer (1987–2003) and the projected incidence (2004–2008).

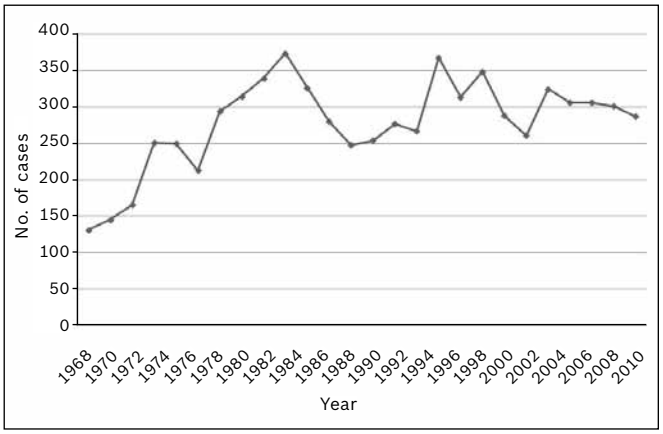

Fig. 3 Number of cervical carcinoma *in situ* cases among female residents in Singapore (1983–2008).

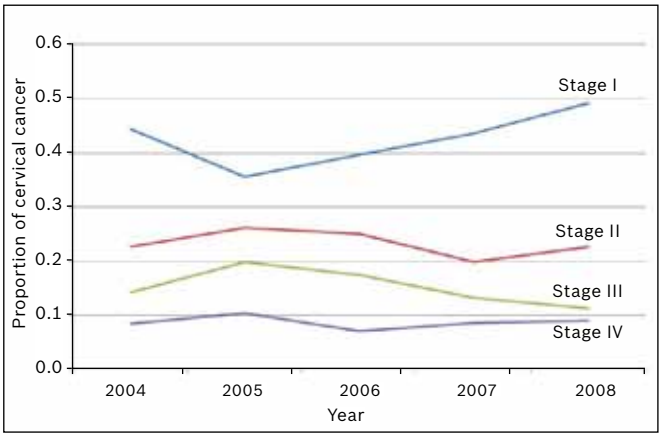

Fig. 4 Proportion of cervical cancer by stage (2004–2008).

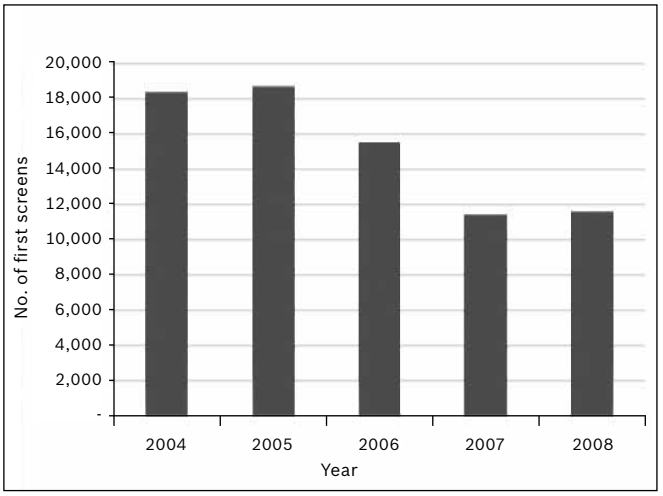

Fig. 5 Number of first screens under CervicalScreen Singapore (2004–2008).

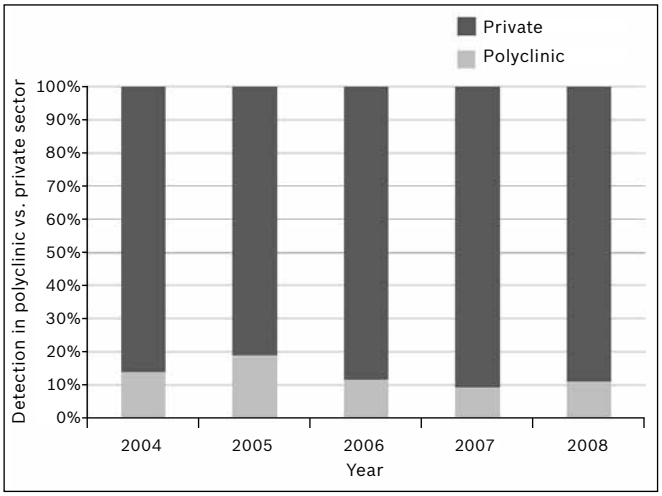

Fig. 6 Proportion of CIN III cases detected in polyclinics and the private sector (2004–2008).

women ($p < 0.001$). The number of women who had abnormal screens increased sharply from 553 in 2004 to 972 in 2005, but decreased to 240 in 2008.

Only a small number of women underwent biopsy. This included CSS clients with normal and abnormal outcomes. The biopsy rates among women with abnormal screens were 3.8% for first screen; 13% of women with abnormal first screens had assessments in restructured hospitals. The biopsy rate among women with abnormal screens and assessments in restructured hospitals was 40.7%. The sensitivity rate of the Pap smear test was 66.7% for first screens, while the specificity rate was 88%, and PPV and NPV were 57.1% and 91.7%, respectively.

Overall, the CSS programme was able to detect 0.37 invasive cancers per 1,000 screens in women aged 25–69 years. The detection rate was higher in older women – 0.47 for women aged 50–69 years and 0.16 for those aged 25–34 years. There

were also cancers detected between routine screening episodes. Five invasive cancers were detected during the interval between screening episodes. The previous smear results of all the five cases were negative for malignancy, with or without inflammatory changes. The age-standardised interval cancer incidence rate was 5.6 per 100,000 women. As CSS encourages women to go for cervical cancer screening regardless of venue, the proportion of CIN III detected in the private sector also saw an increase from 86% in 2004 to 89% in 2008 (Fig. 6).

DISCUSSION

Pap smear screening has had a huge influence on cervical cancer trends worldwide. Although the efficacy of the Pap smear test has not been subjected to randomised controlled trials, observational studies have shown that Pap smear screening is the main reason for the decline in cervical cancer incidence and mortality rates.[3,4] Evidence has also shown that the impact of Pap smear screening in reducing the incidence and mortality rates of cervical cancer is greater in organised screening programmes compared to opportunistic screening, when a screening coverage of 80% is achieved.[5,6]

Our evaluation of the effectiveness of the CSS programme was complicated by the fact that widespread opportunistic Pap smear screening had been occurring well before the implementation of CSS. The 1998 National Health Survey showed that 64.2% of Singaporean women aged 25–69 years had undergone Pap smears.[7] Our study was also limited by the fact that outcome measures such as incidence and mortality rates were national trends, while process measures were confined to government-funded polyclinics. However, despite these limitations, this study has shown, based on the outcome evaluation, a steeper decline in incidence and mortality rates for cervical cancer as well as a lowering of the observed rates as compared to the projected rates, after the implementation of CSS. The number of cases of CIN III detected nationwide (inclusive of non-CSS cases) has also increased since 1983 (Fig. 3). Although the organised screening programme was offered only at government-funded polyclinics, the marketing and communication efforts put forth by HPB at the national level had contributed to an increase in the awareness (69.3% in 2001 and 87% in 2007) and uptake (58.1% in 2001 and 74.1% in 2007) of Pap smear screening.[8] This could have led to the increase in the number of cases of CIN III detected nationwide (inclusive of non-CSS cases) and the corresponding decrease in invasive cervical cancers.

Pap smear screening detects preinvasive cervical cancer, and with optimal treatment of this preinvasive stage,[9,10] the incidence of cervical cancer should also decrease as a result of screening. The number of CIN III cases peaked slightly in 2004, which corresponded with the first year of implementation of CSS. It dropped after 2004, which corresponded with the decline in the number of women who joined the CSS programme (Fig. 5). As the trends of sexually transmitted infections (including HIV/AIDs) and smoking prevalence have not decreased in Singapore during the study period, these risk factors could not have contributed to a decline in cervical cancer incidence.[11,12] Therefore, early detection through Pap smear screening appeared to be the main factor in the decreased incidence of cervical cancer. However, as cervical cancer screening could also be done at non-government-subsidised clinics where there was no organised screening programme, it is thus difficult to quantify the decline in incidence of cervical cancer that was due to CSS. The increase in screening uptake from 58.1% in 2001 to 74.1% in 2007 could have contributed to a greater decline in the mortality rates following the implementation of CSS. It is also likely that the improvement in mortality trends was due to advances in the treatment of cervical cancer. This includes the use of a combination of chemotherapy and radiation to treat locally advanced cancer, as pelvic irradiation alone was unable to control locally advanced cancer in 35%–90% of the cases.[13]

With the efforts to increase awareness of cervical cancer screening nationally, and given that government-funded polyclinics have a smaller market share in the provision of primary care compared to the private sector, it was not surprising to see that the majority of the women had gone to the private sector for cervical cancer screening (Fig. 6). Efforts need to be scaled up in order to increase participation in the CSS programme for Pap smear screening and to narrow the knowledge-practice gap identified in National Health Surveillance Survey 2007.[8] The main reasons cited in the survey by women aged 25–69 years who had never had a Pap smear test were: (a) not necessary as healthy (38%); (b) not at risk (12.7%); (c) too young (21.1%); (d) never heard about Pap smear test (8.8%); and (e) not sexually active (5.5%).[8] These barriers are consistent with the findings from other studies conducted on the influence of women's knowledge, attitudes and beliefs on compliance with Pap smear screening.[14]

To reduce barriers to screening and improve screening attendance, multipronged communication and social marketing strategies have been adopted by HPB. Besides personalised invitation letters and mass media initiatives, workplace and community health promotion strategies have also been activated to increase awareness about cervical cancer screening and reach eligible women. Some of the main community platforms used to promote Pap smear screening and encourage women to go for regular screening include partnering with religious groups, community leaders, Voluntary Welfare Organisations and health advocates to impress on them the importance of good health and encourage their residents to go for regular Pap smear screening at the recommended frequency. Further research is required to determine the effectiveness of these marketing and community initiatives.

In 2008, HPB launched the Integrated Screening Programme, where residents aged 40–69 years were invited to be screened for chronic diseases at General Practitioner (GP) clinics registered under the Chronic Disease Management Programme. Under this programme, cervical cancer screening was also extended to all

female residents in Singapore. This programme is a promising initiative to improve the uptake of Pap smear screening among eligible women, as GPs play a pivotal role in advising women to go for cervical cancer screening at the recommended frequency.[15,16] Health literacy is one of the important determinants in women who joined the programme.[17,18] Given the cultural, linguistic and socioeconomic diversities of the target group, cervical screening recruitment materials (e.g. invitation letters and educational materials) need to be further evaluated so that appropriate health information can be readily accessible to eligible women and their family members. Moreover, with the introduction of human papilloma virus (HPV) vaccination in Singapore, the communication strategy will need to be refined in order to promote Pap smear screening, as HPV vaccination may pose further challenges to the participation of women in the CSS programme in future.[19]

The use of geographical mapping such as the Geographical Information Systems (GIS) technology in cervical cancer screening could also be explored to determine the Pap smear screening behaviours of women in the different regions of Singapore, especially among women who have never undergone a Pap smear and those who do not undergo regular screening. Information from GIS can guide further studies to identify barriers, such as access to Pap smear screening among the different age, ethnic and socioeconomic groups, as well as guide the development of more comprehensive and targeted strategies to improve screening uptake.[20]

In this study, we found that among women aged 25–69 years who had their first Pap smear screening and were recommended for routine rescreen in three years, only 10% had undergone a routine rescreen within three years. A high proportion of women were lost to follow-up. Overseas studies have shown that the proportion of loss to follow-up varied widely from 10% to 70%.[21] Goldhaber-Fiebert et al compared the proportion of women who were lost to follow-up in a community where health workers visited women who missed their appointments with another community without this additional service and found that in the former model, the proportion of loss to follow-up was reduced from 21% to 6% at six months, 39% to 10% at 12 months and 50% to 24% at 24 months.[21] Other studies have found that the risk of noncompliance with cervical cancer screening increased with age, the lack of a high school certificate, and among women who found cost to be a barrier to medical care. The strongest predictor of repeat screening was the belief that Pap smear is an effective screening tool, indicating that study participants endorsed beliefs consistent with current Pap smear guidelines.[22,23] To reduce failure in the delivery of cervical cancer screening services, Goins et al emphasised the need to implement multiple strategies, including increasing accessibility, giving general health education talks, and establishing a reminder and tracking system to ensure sufficient participants in the screening programme, which would in turn reduce the incidence and mortality rates of cervical cancer.[24]

Despite the decrease in the number of women who joined the CSS programme, other programme-specific parameters such as specificity, sensitivity and interval cancer rates, are comparable to those of screening programmes in other countries.[25,26] The CSS detection rate is comparable to the corresponding figures (0.008 to 0.4 per 1,000 screens) quoted in an overseas study.[27] The local interval cancer rate is also lower than that reported in an overseas study, i.e. 11.6 and 9.6 during the three-year interval.[28] These comparable parameters could be the result of quality assurance and improvement programmes that are in place in local laboratories and hospitals providing cervical cytology and colposcopy services. To further improve its quality, the CSS programme will explore the feasibility of using new technologies, such as liquid-based cytology, for population-based cervical cancer screening.

Despite the limitations of the CSS programme, it has contributed to a decline in the mortality and incidence of cervical cancer in Singapore. However, the challenges of increasing screening uptake among women need to be addressed. Further research to explore the barriers to screening compliance and to determine the effectiveness of our multipronged strategies in improving screening uptake is necessary.

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