Who receives, benefits from and is harmed by cervical and breast cancer screening among Hong Kong Chinese?

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ABSTRACT

Background To estimate the proportion of and characterize women who had received cervical and breast screening and to quantify the associated preventable burden of disease and potential iatrogenic harm.

Methods A total of 3484 Hong Kong Chinese women were interviewed in person. Screening prevalence and associated predictors, disability-adjusted life-years (DALYs), the numbers of false-positive tests and the resultant confirmatory procedures and related complications were estimated.

Results A total of 6.2% of women (≥18) reported regular pap but no mammography or clinical breast examination (CBE) as per local evidence-based guidelines, whereas among women aged ≥40 years, 5.2% reported regular screening by all three modalities and 55.3% had never been screened for either cancer. Women who underwent regular health checkups were consistently the most likely to have been screened, as were younger, married and socially advantaged respondents. Triennial pap screening would save 708 DALYs annually, or 528 more DALYs compared with the status quo. However, this would generate 28 600 repeat smears and 390 colposcopies from false-positive screens. Opportunistic mammographic screening averted 100 DALYs currently, but could have potentially reduced a further 546 with biennial screening. Mass screening mammography (CBE) would lead to 33 700 (20 200) false-positives per year requiring 29 900 (8300) repeat mammograms or ultrasonograms, 6800 (3000) biopsies and 620 (270) biopsy-related complications.

Conclusions Screening uptake patterns are suboptimal. By making explicit the possible risks and benefits based on this template, policy makers in developing Asia with a similar female cancer burden may be able to use the information to make evidence-based decisions that are consistent with local circumstances, values and preferences.

Keywords breast cancer, cervical cancer, DALYs, iatrogenesis, screening

Introduction

The benefit of screening for cervical cancer was first shown in case–control studies1 and subsequently through empirical evaluations of population-based programs.2–4 For breast cancer, eight randomized clinical trials demonstrated mortality reduction from routine mammography5 but not breast self-examination according to a large Chinese randomized trial in Shanghai.6 The verdict on clinical breast examination (CBE), defined as ‘an examination of the breast by clinical observation and palpation by a physician or other health professional’,7 remains unsettled.

Most western countries, especially those with more centrally executed health systems, such as Australia, Canada, the Nordic countries and the UK, have long successfully
implemented mass screening by cervical cytology (± human papillomavirus or HPV testing) and mammography for these two female cancers, respectively. In the US and other countries with less socialized health systems, on the other hand, many reports have documented a relatively lower screening penetration and the distribution of screening services is highly socio-economically patterned. A large knowledge gap, however, remains for most of the world’s female population, notably those from China and India who comprise almost 40% of the global total. In this analysis, we focus on Hong Kong Chinese women (comprising 95% of the local population) who are often a good sentinel or harbinger population that can provide reliable forward surveillance for the rest of China as it transits rapidly through demographic and epidemiologic changes with socioeconomic development, which Hong Kong has undergone in the last few decades (P. P. Woo et al., submitted for publication).

At the time of the field study in 2003, Hong Kong did not have organized screening for either cancer although a triennial recall program for pap screening based on voluntary enrolment has since been launched in 2004. Screening mammography is not recommended according to the Government’s Cancer Expert Working Group on Cancer Prevention and Screening due to the much lower incidence of disease in local women compared with Caucasian populations, on whom the original screening trials were performed, and thus the attendant iatrogenic harm and costs may well outweigh any potential benefit, especially in view of the continuing uncertainty about its effectiveness in western countries. Table 1 summarizes the current evidence-based recommendations concerning cervical and breast cancer screening in Hong Kong. Thus, the present study can illustrate cross-sectional uptake patterns from opportunistic screening in a developed Chinese society with a mixed medical economy.

<table>
<thead>
<tr>
<th>Table 1 Current recommendations for cervical and breast cancer screening in Hong Kong</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eligible age range (years)</strong></td>
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<tr>
<td><strong>Screening interval (years)</strong></td>
</tr>
<tr>
<td>Lower limit</td>
</tr>
<tr>
<td>Cervical cancer (Pap)</td>
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<tr>
<td>Breast cancer (MMG)</td>
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<tr>
<td>Breast cancer (CBE)</td>
</tr>
</tbody>
</table>

MMG, mammography; CBE, clinical breast examination.

**Methods**

**Data sources**

Data for this study were derived from the Population Health Survey, commissioned by the Government Department of Health and carried out between September 2003 and May 2004.

The survey covered the entire land-based non-institutional population of Hong Kong, excluding inmates of institutions, persons living on board vessels, foreign domestic helpers and non-Chinese-speaking ethnic groups. A probability sample of 4179 valid quarters were sampled; of which, 3009 quarters consist of 3035 households and 7084 persons were successfully enumerated and interviewed in person. The household response rate was 72%. Sampled data were weighted by age and sex to ensure representativeness.

**Statistical analysis**

We estimated the self-reported prevalence of screening by the three modalities, under different combinations and stratified by routine health check attendance (as a proxy for respondents’ preventive health orientation). We adhered to the formal definition of ‘screening’ where examinations were performed in the absence of symptoms. Women who were tested as a result of experiencing symptoms were considered as not having been screened in these analyses.

We generated adjusted odds ratios and associated 95% confidence intervals (95% CIs) for potential predictors by multivariable logistic regression. Covariables were selected based on previously identified confounders, data availability in the present survey and the principle of parsimonious model construction. They included socio-demographics, such as age group, marital status, place of birth, education level and monthly personal income; health status indicators including self-assessed health and smoking status; and a preventive health behavioral indicator of attendance at regular health checks.

Next, we quantified the potentially avertable disease burden from screening under different scenarios (i.e. no screening, status quo of opportunistic screening, organized screening at two- or three-yearly intervals for breast or cervical cancer, respectively) measured by disability-adjusted...
life-years (DALYs). We calculated DALYs following the methodology of the World Health Organization’s Global Burden of Disease studies, with weighting by age and using an annual discount rate of 3%.24–27

Detailed methods for estimating the reduction in DALYs for each cancer can be found in the Appendix section. We have chosen to estimate the proportion screened for cervical and breast cancers using different age groups as the denominator population, to denote those eligible to be screened. Given the sexually transmitted nature of HPV, the established necessary cause of cervical malignancy, and in keeping with local and international guidelines, we assumed that screening should take place starting at 18 years of age (in Hong Kong age of sexual debut differs only by 1–2 years later than in western countries). On the other hand, virtually, all international guidelines recommend starting breast screening no earlier than 40 years in the general population at average risk for cancer, therefore we adopted this age threshold when mammography or CBE was considered alone or in combination with pap testing. (Table 2)

In addition, we followed the recommended age ranges for screening by the Government Department of Health and the UK National Screening Committee when estimating the DALY burden and associated false-positivity and complications rate, i.e. respectively, 25–64 years for pap screening and 50–74 for breast screening.

Finally, we carried out a probabilistic sensitivity analysis using second-order Monte Carlo simulation to assess the uncertainty in the DALY and burden of false-positive estimation. Each input parameter was assigned a probability distribution to represent the underlying uncertainty (see Supplementary data Tables A and B), from which a random value was sampled to generate an outcome value. This process was repeated 1000 times to give 95% CI.

All analyses were performed using Stata version 8.2, R version 2.1.1, and Microsoft Excel.

Results
Applying age–sex population weights, the total sample of 7084 enrollees represented 5 683 900 persons of the local general population aged 15 years or above, comprising 2 574 100 men and 3 109 800 women. The Supplementary data Table C compares the socio-demographic characteristics between the 2003 Population Health Survey22 with the data from the 2001 population census28 and confirms that the present survey is representative of the general population on these measured variables. There were 3484 (representing 2 972 932 in the weighted sample) women aged 18 years or above interviewed (see Supplementary data Fig. A).

Table 2 shows the proportions of women aged 40 years or over (except for the ‘pap’ and ‘pap only’ categories which consider women aged 18 years or above) reporting different screening patterns overall and stratified by routine health check attendance. Overall, 36.0, 14.7 and 33.2% of Hong Kong Chinese women had a screening pap, mammographic and CBE at least once, respectively. Thirty-two percent of women aged 40 years or over attended routine health checkups compared with 27.5% for those 18 years or above. Most who underwent mammography or CBE also had a pap, for both the ever and regular categories. Women who reported undergoing regular health checkups were, on average, two to three times as likely to have been ever screened across most categories; whereas the gradient was a lot steeper for regular screening, ranging from a 2- to 20-fold difference. Only 6.2% of the ≥18-year-old female population followed the recommendations of the Department of Health’s Cancer Expert Working Group on Prevention and Screening15 (Table 1) to be regularly screened for cervical cancer but not for breast cancer, whereas 5.2% of women aged 40 or over reported undergoing regular screening by all three modalities and 55.3% had never been screened for either cancer.

Table 3 presents ever (never) screened rates by respondent characteristics and the results of the multivariable regression models. Clearly, those who underwent regular health checkups were the most likely to have been screened across all categories, i.e. it was the strongest and most consistent predictor in all the models. With the exception of mammography, women over 60 years were much less likely to attend screening compared with younger females as were single spinsters relative to those married (reaching significance at the 0.05 level in the ‘Pap’ and ‘CBE’ models). Respondents who were less socially advantaged, as indicated by education, income and place of birth (where mainland migrants are often considered worse off), had a lower likelihood of ever receiving pap and CBE, but to a much lesser extent for mammography. Self-assessed health was not predictive of screening behavior with the exception that those who were self-reportedly less healthy were more likely to have undergone a pap smear.

Table 4 shows the estimated disease burden quantified in terms of DALYs under different screening scenarios for Hong Kong Chinese. For 2001, breast and cervical cancers together were responsible for about 10 000 DALYs (in a 4:1 ratio) annually in Hong Kong with a total female population of about 3.4 million. Strictly adhering to triennial pap screening for the recommended age range would save 708 (511–794) DALYs, or 528 (371–605) more DALYs compared with the status quo, every year. Opportunistic
mammographic screening averted 100 (95% CI, 79–149) DALYs in 2001, but could potentially reduce a further 546 (95% CI, 502–575) if a policy of biennial screening for all women from 50 to 74 years was to be implemented.

The potential negative clinical impact of breast and cervical cancer screening is tabulated in Table 5. Assuming 100% coverage and uptake of the government’s recommended pap screening schedule, we could anticipate 28,600 (20,400–36,100) repeat smears generated by false-positive results and unsatisfactory samples. If the false-positive rate was the same on repeat pap, there would be 390 (160–710) colposcopies performed unnecessarily due to false-positivity. For breast cancer, mass screening mammography (CBE) would lead to 33,700 (20,200) false-positives per year requiring 29,900 (8,300) repeat mammograms or ultrasound scans, 6,800 (3,000) biopsies and 620 (270) biopsy-related complications (comprising events at different levels of severity although most of the complications would be relatively minor and easily resolvable). Table 5 also presents the corresponding statistics for status quo screening in Hong Kong for 2001. Interestingly, the negative impact for screening pap and CBE was greater in the status quo scenario than would otherwise be if mass, organized screening was adopted. This can be explained by the fact that 83.4% (89.7%) were screened more frequently than the recommended interval by pap (CBE) and many started screening at an earlier age than the recommended lower age limit (Table 1).

**Discussion**

**What is already known on this topic**

Despite Hong Kong’s advanced economy, excellent basic health indices, universal access to a comprehensive range of outpatient and inpatient services through a tax-funded health care system coupled with a parallel private system for those who are able and willing to purchase such care, and wide availability of all three screening modalities (albeit on a haphazard basis) for decades (pap had been offered locally since the 1970s and mammography since the 1980s), screening uptake remains very low where at least 50% of all eligible women in various categories had never been screened. This compares the screening prevalence of Hong Kong unfavorably with western developed countries where the ever screening prevalence for pap smear is over 90% in the US and has reached 80% in England and Wales. Three-quarters of Australian women aged 20–69 years reported having regular pap smears, 76% within the last 2 years and 82% within the last 3 years. Our findings illustrate that one cannot rely completely on socio-economic development and the availability of screening tests, i.e.

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**Table 2** Proportion of women (95% confidence intervals) aged 40 years or over reporting different screening patterns stratified by routine health check attendance

| None               | Ever (55.3 (52.8, 57.8)) | Regular NA | Papb (≥18 years) | Ever (36.0 (34.1, 37.8)) | Regular 21.5 (19.9, 23.1) | Pap only (≥18 years) | Ever (13.2 (11.9, 14.6)) | Regular 6.2 (5.3, 7.2) | Pap and MMG | Ever (1.3 (0.9, 1.9)) | Regular 0.4 (0.2, 0.8) | Pap and CBE | Ever (18.3 (16.4, 20.3)) | Regular 11.5 (9.9, 13.1) | MMGb | Ever (14.7 (13.1, 16.5)) | Regular 6.9 (5.7, 8.2) | MMG only | Ever (0.8 (0.5, 1.3)) | Regular 0.3 (0.1, 0.6) | MMG and CBE | Ever (1.5 (1.0, 2.1)) | Regular 0.6 (0.4, 1.1) | CBEb | Ever (33.2 (30.9, 35.6)) | Regular 19.8 (17.8, 21.9) | CBE only | Ever (2.4 (1.7, 3.3)) | Regular 0.7 (0.4, 1.5) | All three tests | Ever (11.1 (9.6, 12.7)) | Regular 5.2 (4.2, 6.4) |

MMG, mammography; CBE, clinical breast examination; NA, not applicable.

aAll categories include women aged ≥40 years except for ‘Pap only’ where the inclusion criterion by age is ≥18 years.

bIncluding those who reported this test only or in combination with one or both of the other two tests.
Table 3 Ever screened rates, odds ratios and associated confidence intervals for different screening patterns by respondent characteristics

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>None</th>
<th>Pap* (&gt;18 years)</th>
<th>MMG^</th>
<th>CBE^</th>
<th>All three tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>30–39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40–49</td>
<td>41.2</td>
<td>0.54** (0.35, 0.82)</td>
<td>14.6</td>
<td>1.00</td>
<td>45.4</td>
</tr>
<tr>
<td>50–59</td>
<td>50.2</td>
<td>0.87* (0.54, 0.98)</td>
<td>21.9</td>
<td>2.12** (1.45, 3.10)</td>
<td>37.5</td>
</tr>
<tr>
<td>60–69</td>
<td>71.2</td>
<td>0.31*** (0.20, 0.47)</td>
<td>12.5</td>
<td>1.16 (0.70, 1.94)</td>
<td>20.4</td>
</tr>
<tr>
<td>≥ 70</td>
<td>81.4</td>
<td>0.09*** (0.05, 0.15)</td>
<td>6.7</td>
<td>0.54 (0.29, 1.00)</td>
<td>9.9</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>51.2</td>
<td>1.00</td>
<td>46.6</td>
<td>1.00</td>
<td>36.6</td>
</tr>
<tr>
<td>Single</td>
<td>61.7</td>
<td>3.52*** (1.74, 7.09)</td>
<td>11.5</td>
<td>0.11*** (0.07, 0.16)</td>
<td>16.8</td>
</tr>
<tr>
<td>Divorced/separated/widowed</td>
<td>70.7</td>
<td>0.76 (1.72)</td>
<td>27.1</td>
<td>0.90 (0.61,1.33)</td>
<td>8.8</td>
</tr>
<tr>
<td>Place of birth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>43.7</td>
<td>1.00</td>
<td>40.1</td>
<td>1.00</td>
<td>16.6</td>
</tr>
<tr>
<td>Mainland China</td>
<td>64.8</td>
<td>1.50** (1.14, 1.97)</td>
<td>30.1</td>
<td>0.60*** (0.48, 0.76)</td>
<td>12.6</td>
</tr>
<tr>
<td>Elsewhere</td>
<td>58.5</td>
<td>0.82 (0.51, 1.33)</td>
<td>19.3</td>
<td>1.52 (0.80, 2.91)</td>
<td>29.7</td>
</tr>
<tr>
<td>Education level</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Primary or below</td>
<td>68.1</td>
<td>0.65** (0.50, 0.86)</td>
<td>11.9</td>
<td>0.95 (0.66, 1.37)</td>
<td>21.1</td>
</tr>
<tr>
<td>Secondary</td>
<td>42.4</td>
<td>1.00</td>
<td>42.3</td>
<td>1.00</td>
<td>16.2</td>
</tr>
<tr>
<td>Tertiary or above</td>
<td>31.3</td>
<td>0.93 (0.50, 1.74)</td>
<td>31.4</td>
<td>0.93 (0.64, 1.35)</td>
<td>31.3</td>
</tr>
<tr>
<td>Monthly personal income (HK$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10 000</td>
<td>59.0</td>
<td>1.00</td>
<td>33.1</td>
<td>1.00</td>
<td>13.2</td>
</tr>
<tr>
<td>10 000–19 999</td>
<td>32.1</td>
<td>0.52* (0.30, 0.91)</td>
<td>43.1</td>
<td>1.59** (1.16, 2.18)</td>
<td>18.7</td>
</tr>
<tr>
<td>≥ 20 000</td>
<td>20.4</td>
<td>0.30** (0.14, 0.65)</td>
<td>61.0</td>
<td>2.37*** (1.50, 3.77)</td>
<td>35.6</td>
</tr>
<tr>
<td>Self-rated health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent/very good</td>
<td>51.3</td>
<td>1.01 (0.69,1.48)</td>
<td>34.3</td>
<td>1.05 (0.78, 1.41)</td>
<td>14.7</td>
</tr>
<tr>
<td>Good</td>
<td>55.4</td>
<td>1.00</td>
<td>33.5</td>
<td>1.00</td>
<td>15.1</td>
</tr>
<tr>
<td>Fair/poor</td>
<td>56.5</td>
<td>0.65** (0.49, 0.87)</td>
<td>38.6</td>
<td>1.52*** (1.21, 1.92)</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Table 3 Ever screened rates, odds ratios and associated confidence intervals for different screening patterns by respondent characteristics.
opportunistic, unorganized screening, to achieve a satisfactory coverage of the target population.

**Main finding of this study**

In Hong Kong, a major explanation for this suboptimal performance concerns the way our health system is organized. Although the state-funded system directly provides for >90% of total inpatient bed-days, 70% of ambulatory services are delivered in the private market where an almost exclusively fee-for-service remuneration mode has precluded a preventive orientation to care. In fact, government-funded services generally provide screening services at a charge that is similar to what the private sector demands. Moreover, there is no functional primary care or family medicine system and consequently almost no continuity of care and ‘doctor-shopping’ is rife.30,31 In short, there is no incentive to keep patients’ well-being as opposed to providing symptomatic relief and practicing curative medicine to treat established disease.

Moreover, the ‘inverse care law’ is as relevant in today’s Hong Kong with respect to screening as it was first proposed by Julian Tudor Hart 35 years ago based on observations of the UK National Health Service.32,33 The strong socio-economic patterning of screening utilization appears to bear out this theoretical construct in that the haphazard nature of the largely private market for screening services has resulted in the suboptimal distribution of screening despite an adequately resourced health care infrastructure and a highly educated and healthy public. Moreover, older women were much less likely to have been screened; however, cancer risk increases exponentially with age, again demonstrating the inverse relationship between need and service provision.

Our findings in Hong Kong do not bode well for mainland China. There is already accumulating evidence of increasing health care disparities as China has transitioned from a planned to a market economy. Payments for health services have increased in both urban and rural areas, while health insurance coverage declined throughout the 1990s. Among the urban population, particularly the poor, access to formal health services has worsened and become more inequitable in the last decade. At the same time, the urban–rural divide in health care access has widened considerably.34,35 More than 90% of China’s 100 000 new cervical cancer cases each year are borne by rural women. If these observations on health care disparities in terms of curative services are representative and/or predictive of preventive care utilization and that the Hong Kong findings accurately forecast an emerging trend for the rest of this rapidly
developing country, starting from the increasingly prosperous eastern coastal cities sweeping westwards inland to rural townships, the impact on cancer prevention and control would be dire.

Although the incidence of cervical cancer is only one-quarter of that of breast cancer (Table 1), the avertable DALYs from screening are larger (708 for cervix versus 646 for breast), reflecting a much greater preventable fraction of disease. Moreover, we previously demonstrated a looming breast cancer epidemic in local Chinese (mostly due to westernization of lifestyle habits) but in the younger age groups (<50 years) who derive much less benefit, if any, from mammographic screening. For women between the ages of 40 and 49 years, the absolute reduction in breast cancer mortality due to screening gradually increases over this decade of life, only appearing several years longer after the initiation of screening than for older women. Limited resources are most likely best utilized in the expedited diagnosis and treatment of breast cancer patients rather than by active case-finding through an equivocal screening intervention. As Peto and co-workers have argued, most of the 25–30% mortality reduction observed in the US and UK were derived from the use of hormonal and polychemotherapy.

Whereas regular pap examinations are recommended in Hong Kong but not practiced by 78.5% of women aged 18 or over, mass screening for breast cancer is contraindicated according to evidence-based guidelines although one in 15 women in the potentially eligible age range of 40 or over undergo routine mammography and one in five women have their breasts regularly examined by health care providers. This again underlines the need for an organized approach to screening rather than adopting a laissez-faire and permissive attitude to the unregulated promotion and delivery of interventions with the implied promise of benefit but actually pose a substantial risk of clinical harm. On the population level, we have shown that while all screening tests are expected to produce false-positives and associated confirmatory tests, a particular problem with breast screening is the invasive nature of the consequences including biopsy and related complications. Among Hong Kong’s 700 000 women aged 50–74, we would expect almost 10 000 unnecessary biopsies annually for those who receive a falsely positive MMG and CBE result. If this scales linearly for all Chinese women, and we have no reason to believe otherwise, the recent planned effort to screen 1 million mainland Chinese women for breast cancer over the next 6 years by the Chinese Anti-Cancer Association with the support of the American Cancer Society could well lead to massive unintended iatrogenic harm as has been projected herewith.

**Limitations of this study**

Several caveats bear mention. First, the cross-sectional nature of this survey precluded the examination of the
Table 5 Potential negative clinical impact of screening per year for the Hong Kong population, 2001

<table>
<thead>
<tr>
<th></th>
<th>Status quo (95% confidence limits)</th>
<th>Triennial pap/biennial MMG or CBEa (95% confidence limits)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of false-positive casesb</td>
<td>32 600 (21 000–43 800)</td>
<td>16 300 (10 500–22 000)</td>
</tr>
<tr>
<td>Number of repeat smears due to false-positive cases and unsatisfactory samplesc</td>
<td>57 100 (40 600–72 000)</td>
<td>28 600 (20 400–36 100)</td>
</tr>
<tr>
<td>Number of colposcopies for the false-positive casesd</td>
<td>800 (330–1400)</td>
<td>390 (160–710)</td>
</tr>
<tr>
<td>MMG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of false-positive casese</td>
<td>15 900 (14 200–17 700)</td>
<td>33 700 (29 900–37 400)</td>
</tr>
<tr>
<td>Number of confirmatory diagnostic imaging (MMG/ultrasound) tests for the false-positive casesf</td>
<td>14 100 (12 600–15 700)</td>
<td>29 900 (26 600–33 200)</td>
</tr>
<tr>
<td>Number of biopsies (open/core/aspiration) for the false-positive casesg</td>
<td>3200 (2900–3600)</td>
<td>6800 (6100–7600)</td>
</tr>
<tr>
<td>Number of biopsy-related complicationsh</td>
<td>300 (240–340)</td>
<td>620 (520–710)</td>
</tr>
<tr>
<td>CBE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of false-positive casesi</td>
<td>27 000 (13 500–43 600)</td>
<td>20 200 (10 100–32 600)</td>
</tr>
<tr>
<td>Number of confirmatory diagnostic imaging (MMG/ultrasound) tests for the false-positive casesj</td>
<td>11 100 (5500–17 900)</td>
<td>8300 (4100–13 400)</td>
</tr>
<tr>
<td>Number of biopsies (open/core/aspiration) for the false-positive casesk</td>
<td>4000 (2000–6500)</td>
<td>3,000 (1500–4900)</td>
</tr>
<tr>
<td>Number of biopsy-related complicationsl</td>
<td>360 (180–600)</td>
<td>270 (140–440)</td>
</tr>
</tbody>
</table>

MMG, mammography; CBE, clinical breast examination.

*Assuming 100% screening coverage of the 25-64 age group for pap and 50-74 age group for MMG/CBE for the year 2001.

bBased on an average false-positive rate of 2.4%.48

cBased on the distribution of cytology results among women with abnormal cytology in Hong Kong in 2001.51,52

dAssuming the same probability of a false-positive case on repeat smear as the initial smear; workup protocol according to The Hong Kong College of Obstetricians and Gynaecologists’s guidelines on the management of an abnormal cervical smear.50

eBased on a false-positive rate of 10%.17, 49

fProportion of diagnostic workups performed within one year after false-positive mammography and CBE.53

gIncluding vasovagal reactions, prolonged bleeding, extreme pain, hematoma and wound infection or dishisence.54–56

hBased on a false-positive rate of 6.0%.5,17

iBased on a false-positive rate of 6.0%.5,17

Another evolution or natural history of screening uptake over time and suffers from the usual caveats of recall error, uncertain temporality and the inability to infer causality of observed associations. However, we can make conclusions about the eventual status of opportunistic screening patterns within a developed Chinese population context. Secondly, we omitted an economic dimension to the analysis and refer interested readers to the formal cost-effectiveness analyses undertaken in this population published separately.39,40 We instead focused our attention on the clinical benefit and harm of screening. Thirdly, we did not consider the ongoing controversy regarding the efficacy19 and effectiveness20 of screening mammography in western populations. Taking an approach that biases toward mammography screening, we adopted a 20% meta-analytic relative mortality reduction by assuming that this effect translates linearly from Caucasian women who have at least twice the incidence as Hong Kong Chinese. This procedure per se may have overestimated the beneficial effect of screening.17 Fourthly, we did not explicitly estimate the negative consequences of overdiagnosing carcinoma in situ (CIS) and subsequent overtreatment due to a lack of detailed understanding of the natural history of CIS. Evidence from the US SEER program indicates a 7-fold increase in ductal CIS incidence over the last two decades that can be mostly attributed to screening.41 Such diagnosis, in turn, dictates at least lumpectomy and adjuvant radiotherapy as the current, best standard of care where these procedures carry substantial morbidity.42 Lastly, our analysis did not take into account the recent advances in cervical cancer biology. With the prospect of primary prevention of cervical cancer by a prophylactic HPV vaccine,43 recombinant DNA technologies may render the prevention
and eradication of the vast majority of cervical cancer cases a real possibility. Nevertheless, we anticipate that there will always be a useful role for cytologic screening especially for the substantial proportion of cancers that are not associated with the prevalent subtypes (e.g. 16 and 18).

What this study adds
In summary, we have presented population-based estimates of current cervical and breast cancer screening prevalence from opportunistic uptake, the expected benefits and harms. Screening patterns are suboptimal both in terms of absolute coverage and the types of tests received. There is a real mismatch between the likely need for screening and access to services by socio-demographic and economic status which should be urgently redressed through targeted social marketing and outreach interventions that minimize barriers of access for vulnerable subgroups as indicated in the multivariable modeling results. By making explicit the possible risks and benefits of a decision to be screened, policymakers may be able to use this information to support discussions with the public about the provision of mass screening programs and to make evidence-based decisions that are consistent with local circumstances, values and preferences.

Supplementary data
Supplementary data are available at Journal of Public Health online.

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Appendix: Methodology
To estimate the reduction in DALYs through pap screening, we computed the expected number of incident cases by applying standard risk reduction estimates conferred by cervical cytology (adjusted for status quo screening), as per the International Agency for Research on Cancer (IARC) study,44 to current (i.e. 2001) local rates reported by the Hong Kong Cancer Registry.45 An overall mortality to incidence (M/I) ratio of 0.30 based on local observed data from 1972 to 2001 was used to derive the expected number of cancer deaths.

For breast cancer, we adopted a mortality reduction of 20%, which was the summary estimate from a meta-analysis of the eight primary trials,17 in the 50 years or over age group given biennial mammography screening compared with no screening. We assumed that there would be no change in incidence from mammography screening because there is no discernible pre-malignant stage in breast cancer, unlike cervical cancer. Mammography detects established cancer, and mortality reduction is effected through stage shift with no impact on the incidence pattern. Nevertheless, screening can reduce morbidity by shifting cancer stage at diagnosis earlier. We accounted for this expected change in YLDs as a result of screening by adjusting the disability weights based on historical pre- versus post-screening stage distributions in the US, by referencing SEER data in 1975–9 (pre-screening) and 2002 (post-screening).46 The current local stage distribution for 2001–4 was adopted in estimating the status quo scenario.47 To quantify the adverse iatrogenic burden associated with screening, we computed the number of false-positive tests, associated extra number of confirmatory procedures (colposcopy for pap screen positives and repeat mammographic or ultrasound examinations ± biopsy for mammography screen positives) and the expected incidence of breast biopsy-related complications. We assumed a false-positive rate of 2.4% (1.6–3.2%) for pap smears,48 10% (9–11%) for mammograms49 and 6.0% (3.1–9.8%) for CBE.7 Positive pap smears, depending on the extent of cytologic abnormality, entail different confirmatory interventions ranging from a repeat test to immediate colposcopy. Applying the clinical practice guidelines/algorithms promulgated by the Hong Kong College of Obstetricians and Gynaecologists50 to the distribution of test results from the American College of Pathologists-accredited cervical cytopathology laboratory of Queen Mary Hospital (which processes the largest number of cervical smears locally),51,52 we estimated the expected number of repeat paps and colposcopies generated by false-positive screens and unsatisfactory samples. For breast cancer, the potential number of confirmatory tests (repeat mammography/ultrasoundography) and biopsies (open/core/aspiration) were calculated according to the proportion of diagnostic workups performed within 1 year after false-positive
mammography and CBE as per Elmore et al. We estimated the expected number of biopsy-related iatrogenic complications (including vasovagal reactions, prolonged bleeding, extreme pain, hematoma and wound infection or dishisence) by applying an average reported incidence of 9% (8–10%).

References


