



## Review

## National Cancer Screening Programs and Evidence-Based Healthcare Policy in South Korea

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## ABSTRACT

**Background:** South Korea has managed its National Cancer Screening Program (NCSP) since 1999 with free cancer screenings for the five major types of cancer (stomach, liver, colorectal, breast, and cervical cancer). Despite the tremendous amount of government funding, the necessity of this policy and scientific evidence pertaining to it have been questioned.

**Objective:** This study reviewed the NCSP's effectiveness and its evidence.

**Findings:** First, the lead-time bias of diagnosis and the length-time bias regarding the average survival time may increase the misunderstanding that the early detection of cancer will contribute to lower mortality rates and higher survival rates. Second, the positive predictive values (PPVs) of the five major types of cancer checked by the NCSP have remained at 0.6–5.7%. The sensitivity of the screening programs also stood at less than 50% on average. **Conclusion:** This study showed that the NCSP program has been less effective, as shown by its low PPVs and sensitivity values, and that its anticipated contribution to lowering the number of cancer-related deaths may have been a product of biased reasoning. To develop the NCSP, adequate explanations of the benefits and potential risks of cancer examinations as well as the accuracy of examinations need to be provided to patients.

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## 1. Introduction

Cancer is the leading cause of death in South Korea. In 2011 alone, 71,000 people succumbed to cancer, which caused approximately 27% of the 257,000 deaths that year [1]. Approximately 305 of 100,000 people got cancer in 2010, almost one-and-a-half times compared to 220 in 1999 [2]. Compared to other industrialized countries, the age-standardized cancer incidence rate per 100,000 in South Korea is 333.6 for males and 297.0 for females, which

is higher than those of the UK (male: 280.8; female: 260.5) and Japan (male: 247.3; female: 167.6) [3]. The benefit rate – the ratio covered by health insurance out of the total medical cost except for non-payment items – was almost 90% in South Korea, which means an amount of 4.2 trillion won was nationally spent on cancer treatments [4]. This is the reason behind the emergence of national efforts to reduce the incidence of cancer and the number of deaths caused by cancer as political challenges in the public healthcare field. The World Health Organization has encouraged the creation of national cancer control programs in order to help combat the disease, reduce the loss of life, and enhance the quality of life for patients and families [5].

However, South Korea and Japan have National Cancer Screening Programs (NCSPs) in place as a cancer-management policy at the national level. South Korea has

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**Table 1**  
Guidelines of the National Cancer Screening Programs in South Korea.

	Target populations	Frequency	Types of test
Stomach	40 yrs or over	Every two years	Endoscopy or upper gastrointestintography
Liver	40 yrs or over high risk group <sup>a</sup>	Every six months	Liver sonography and alpha fetoprotein
Colorectal	50 yrs or over	Every one year	Fecal occult blood test
Breast	40 yrs or over (female)	Every two years	Mammography and clinical breast examination
Cervix	30 yrs or over (female)	Every two years	Pap smear

<sup>a</sup> 40 yrs and over with HBsAg-positive, anti-HCV-positive or liver cirrhosis results.

operated its NCSP since 1999, providing medical aid beneficiaries who have less accessibility to healthcare services with free cancer screening for stomach, breast and cervical cancers. Since its establishment, the services offered by the program have gradually expanded to accommodate those in low-income brackets who fall below the 20% health-care premium criterion set in 2002, with colorectal cancer screening added to this service in 2004 [6]. Currently, adults who fall below the 50% criterion pay no deductible for the top five cancer checkups (stomach, liver, colorectal, breast, and cervical cancer), and only 10% of the early screening bill is charged for those at the 50% level or higher [7]. Despite the generous amount of government funding and efforts to increase the exam reception rate, the validity of and scientific evidence pertaining to this policy have been questioned [7]. In other words, it is necessary to prove the effectiveness of the objectives of the NCSP, which is to promote early detection, and to provide treatment in an effort to increase the survival rate and lower the mortality rate.

This study reviewed scientific evidence concerning whether the NCSP can lower cancer mortality rates and raise cancer survival rates while remaining effective and avoiding causality bias. This study also looked at problems and remedies pertaining to the NCSP, during which we explored the implications of the South Korean case for other advanced nations.

## 2. Backgrounds of the Korean National Cancer Screening Program

In 2012, the NCSP recorded an examination reception rate of 63.4% [8]. Here, the examination reception rate refers to the percentage of people who receive cancer screening through the NCSP among those eligible for the five cancer screening programs included in the NCSP. The aforesaid figure is almost 25% jump from 38.3%, the examination reception rate for the year 2004. This resulted from the government's efforts to encourage cancer screening through media publicity and from the incentive of free screening. Co-developed by the National Cancer Center of Korea and relevant societies in 2001, the five cancer screening programs were revised and supplemented based on recommendations pertaining to the five cancer screening programs suitable for mass screening [8]. The program budget was financed from the National Health Promotion Fund (50%), national taxes (25%), and local taxes (25%). The program is now spearheaded by community health centers. At the beginning of the year, the Ministry of Health and Welfare formulates a program plan and directs it together with the budget to community health centers. After undertaking such a screening program according to

the program plan for one year, community health centers report their program output to the Ministry of Health and Welfare at the end of the year. Those eligible for cancer screening are directly notified by the National Health Insurance Corporation (NHIC), and examinees receive screening at a medical institution mandated by the NHIC. Regarding the screening of stomach cancer, breast cancer, and colorectal cancer, the program includes verifications of cancer through an additional inspection in case any disease is detected during the inspection of the first screening (Table 1). However, only few studies reviewed the effectiveness of the NCSP and the number of cancer patients detected by the NCSP over the last years. This program is currently based on the hypothesis that cancer screening can lower cancer mortality rates and raise cancer survival rates, but scientific evidence in support of this has yet to be fully discussed. Accordingly, this study examined whether such a hypothesis about the NCSP is unbiased and effective.

## 3. Review of the National Cancer Screening Program: bias and effectiveness

### 3.1. The two plausible biases inherent in the assumptions of the National Cancer Screening Program

The early detection of cancer makes use of screening tests. Referring to primary tests conducted to determine quickly and clearly those who are likely to have the disease regardless of the existence of symptoms, these are distinguished from diagnostic tests, whose aim is to discover the symptoms or causes of cancer. However, screening tests can contain two biases leading to the misunderstanding that these tests are effective.

The first one is the lead-time bias of the diagnosis (Fig. 1). This refers to the inference that cancer screening helps to prolong patients' survival time even in cases where screening does not at all help to reduce the mortality rate of the disease because an effective treatment does not exist despite the discovery of cancer through early detection strategies [4]. Let us suppose that stomach cancer takes three years from the onset to death and that a patient is screened for the disease six months after its onset. In such a case, this patient will survive for two and a half years. However, for a stomach cancer patient who has not been screened at all starts to show symptoms only two years after onset, if he or she is screened at that moment, the survival time will amount to one year. Thus, according to these results, screened patients survive a year and a half longer than unscreened patients. In reality, however, there has been no gain whatsoever from earlier detection. Furthermore, if the progress of the disease does not improve, the

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