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Master's Thesis of International Studies

A Comparative Study on Health Insurance System in China and South Korea：

on the Perspectives of Universal Health Coverage (UHC) of Gastric Cancer Screening

한중 건강보험체계의 비교 연구：

국민 위암검진지원적 시각

February 2021

Graduate School of International Studies

Seoul National University

Area Studies Major

Shuwei ZHAN

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Examiner Cheong Young-Rok

Submitting a master's thesis of International Studies

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Graduate School of International Studies
Seoul National University
Area Studies Major

Shuwei ZHAN

Confirming the master's thesis written by
Shuwei ZHAN
February 2021

Chair Moon Woo-Sik (Seal)

Vice Chair Rhee Yeong-Seop (Seal)

Examiner Cheong Young-Rok (Seal)

Abstract

Gastric cancer is responsible for the majority of deaths and it is one of the most important barriers to increasing life expectancy in East Asia. Cancer screening is a helpful tool to find out the disease before symptoms appear, and thus can prevent and control cancer. Korea has launched National Gastric Cancer Screening Program (NGCSP) since 2005. It is still controversial whether a universal coverage of gastric cancer screening is worth the cost or not. This paper explored the above research question by carrying out comparative study of South Korea and China. The former had a universal health coverage of gastric cancer screening while the latter only had a very limited coverage of gastric cancer screening. The author argued that a universal coverage of gastric cancer screening is cost-effective. "Cost-effectiveness" of the system was quantified by two metrics, utility of the system and the growth rate of total gastric cancer cost. By comparing these data of the two countries, the researcher found that the utility of the Korean NGCSP is high. The gap between "NGCSP screening rates" and the "total gastric cancer screening rates" was less than 10% and the screening rates of NGCSP is higher than other cancer types in the National Cancer Screening Program. Moreover, the growth rate of total gastric cancer cost in Korea has dropped from around 10% to 2% after NGCSP has launched while the growth rate of gastric cancer cost in China is high up to a level around 7%. With the above findings, we can reach the conclusion that, generally, to cover gastric cancer screening service into the national health insurance system is cost-effective, and it also have positive effects on the prevention and control of gastric cancer.

Keyword: Universal Health Coverage, Gastric Cancer Screening, Cost-Effectiveness, China, South Korea

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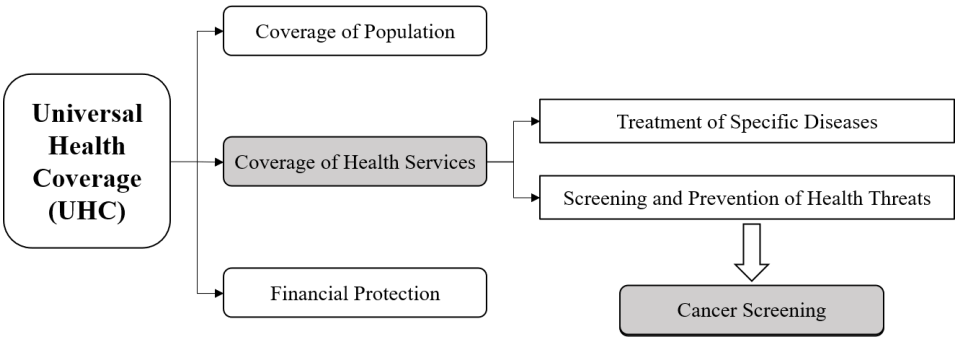
Chapter 1. Introduction

1.1. Study Background

Universal Health Coverage (UHC) has always been the goal for every country when developing its public health insurance system. UHC, according to World Health Organization, means that all individuals and communities receive the health services they need without suffering financial hardship (2019). A universal system can be measured from three dimensions (see Figure 1), including population coverage, coverage of health services and financial protection. Effectiveness of a universal health system depends on its fulfillment of all these three dimensions. By "coverage of health services", it means not only providing treatment of diseases, but also the screening and prevention of health threats that as close as feasible to people's daily life. One of the most important services provided in the prevention and control of noncommunicable diseases is cancer screening.

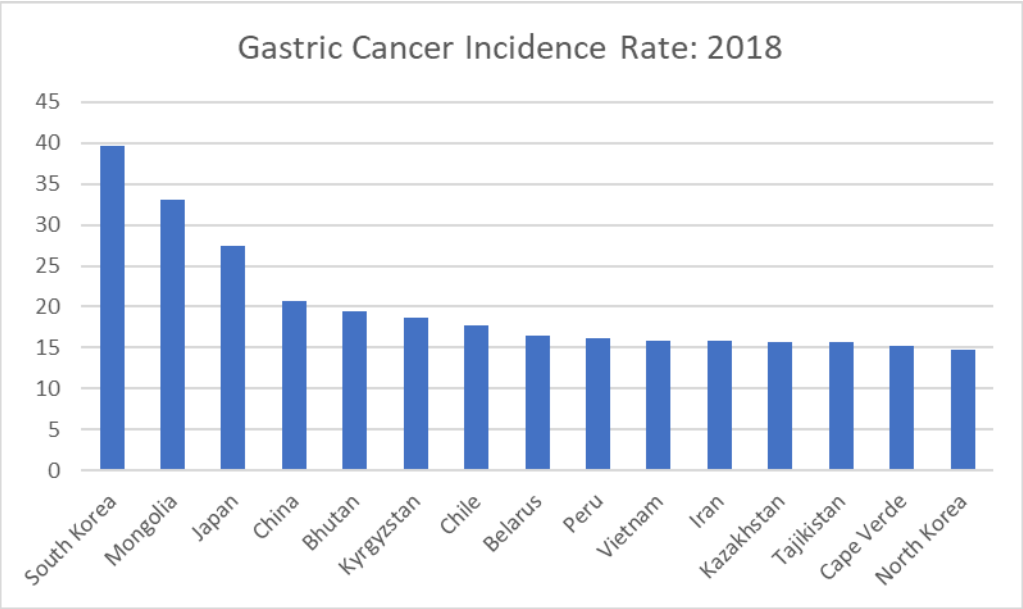
Figure 1. *Three Dimensions of Universal Health Coverage (UHC)*



Cancer has ranked as the leading cause of death and the single most important barrier to increasing life expectancy in the 21st century, and Asia is the most severely afflicted area of cancer. In 2018, Asia had the highest incidence and mortality of cancer among all continents, which were up to 48.4% and 57.3% of world's total respectively (GLOBOCAN). If narrowing down this scope, in East

Asia, gastric cancer is the greatest threats among all. Till 2018, top four countries with the highest incidence rates of gastric cancer are all in East Asia (see figure 2). Both Korea and China occupied a very high position in this list. But a noticeable difference between these two countries is that Korea has established universal gastric cancer screening system since 2005 while China still lacks such service.

Figure 2. *Gastric Cancer Incidence Rate in 2018*



Source: World Cancer Research Fund

Many previous researches have showed that early detection of gastric cancer can significantly improve patients' survival rates, quality of life and reduce cancer cost (2019). Ten-year survival is more than 90% for people whose cancer is diagnosed at stage one, compared with 5% for those whose disease is found at stage four (Pietrangelo & Chen, 2020). Moreover, cancer cost for gastric cancer increase in sequence from stage one to stage four. This is the theoretical basis for Korea to launch National Gastric Cancer Screening Program.

Even though screening itself can be useful, the effect of a universal health coverage of gastric cancer screening remains controversial. The effectiveness of a NGCSP should still be evaluated from the perspectives of cost. If no one use the

existed service (low utility leads to the waste of expenditure), or the cost burden of the service itself is too heavy and do nothing to reduce the financial burden of cancer patients (low cost-effectiveness), even a universal coverage of gastric cancer can do nothing to the prevention and control of the disease. However, there is still a large research gap on this topic that no systematic quantitative evidence can prove the actual necessity for such health coverage from the perspectives of cost. More solid evidence can also be provided from the comparison with a country that totally lacks the same program.

Therefore, research question of this paper is that, "is it cost-effective to launch a national cancer screening program of gastric cancer". To explore this question, the author chose China and South Korea, which have large gap on the coverage of gastric cancer screening into their national health insurance system, as subjects to conduct a comparative study.

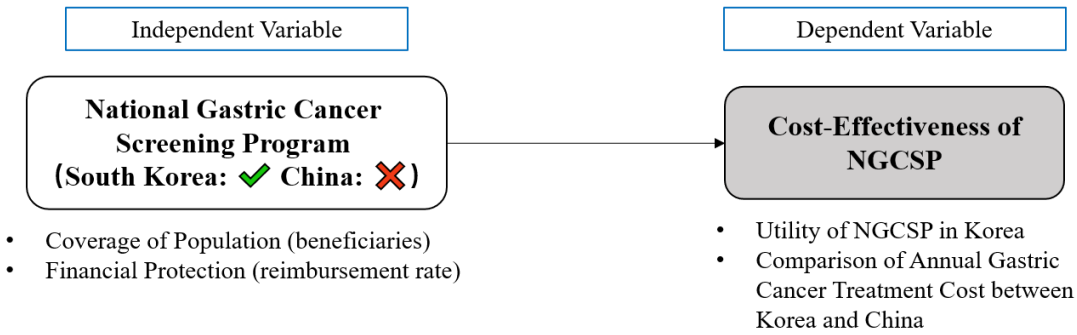
Cost-effectiveness of cancer prevention and control is evaluated from two dimensions. One is the utility of the program. Because targeted people's utility of service also means the utility of government expenditure on the program. In the circumstances that direct utility of cost is not accessible, this can be a metric from other way round. The other one is the trend of annual gastric cancer cost of Korea and China.

The main argument of this paper is that "the national gastric cancer screening program in Korea is cost-effective". If this argument stands true, it is supposed to find that the utility of NGCSP in Korea is relatively high since its establishment and the annual gastric cancer cost of Korea is on a reducing trend or slower growing trend since NGCSP has launched, especially compared to the annual gastric cancer cost of China.

1.2. Research Framework and Methodology

The theoretical framework of this research is as followed:

Figure 3. *Theoretical Framework of This Paper*



The two countries, China and South Korea are appropriate to be the subjects of this research because of two reasons. One is that both of them are East Asian countries. They both have a very high gastric cancer incidence and mortality among all over the world. Yet another reason is that they have a large gap regarding the coverage of gastric cancer screening in the national health insurance system.

South Korea has launched the National Cancer Screening Program (NCSP) since 1999 and expanded nation-wide in 2005, with free or super low-cost cancer screenings for the five major types of cancer (stomach, liver, colorectum, breast, and cervix uteri cancer) (Kim & Lee, 2017). The Korean National Gastric Cancer Screening Program (NGCSP) aims at providing gastric cancer screening every two years for high risked group, which is people above 40 years old. Lower bracket contributors of Korean National Health Insurance (NHI) and Medical Aid Program (MAP) beneficiaries can use the service for free, while upper 50% contributors of NHI need to pay 10% of the expense. The current NGCSP mostly use the techniques of upper gastro-intestinography (UGI) or gastrointestinal endoscopy (biopsy) to deliver the screening.

However, unlike the nation-wide coverage in South Korea, China hasn't included cancer screening program into national health insurance system due to the affordability of central government and the asymmetry of regional health situation. Even though from 2005-2012, the National Health Commission (NHC) of China has carried out four experimental programs aiming at preventing and controlling cancer as Major Public Health Service Projects to some demanded people in certain areas, the coverage of gastric cancer screening in such programs can hardly be competitive with a national-wide coverage especially for the populous China.

Utilizing such difference as independent variable, this study will first evaluate the different coverage of national gastric cancer screening in Korea and China. According to the three dimensions of UHC mentioned above, a health service provided in the national health insurance system is necessary to be evaluated from the other two main aspects of UHC, both the scale of beneficiaries and the level of financial protection. Based on the program information of NCSP provided by South Korea National Cancer Center, matching the qualified conditions of beneficiaries and reimbursement rate into the current demographics and government health expenditure of South Korea can reach the quantified calculation of the coverage. As for the data of China, those government programs (Major Public Health Service Projects) revealed no official statistics, it is only possible to reach estimated number of beneficiaries. Considering the large gap of coverage, estimated value can also be sufficient for comparison.

Second, to testify the result, this research needs to evaluate the cost-effectiveness of a universal health coverage of gastric cancer screening. It is difficult to access to direct data of spending and effect in both countries, so the author chose to detour from the other perspectives that can reflect the cost-effectiveness of NGCSP. One metrics used here is the utility of NGCSP. As mentioned, a universal health coverage program with only a very small number of users can be only a waste of government spending. The utility of NGCSP measures the gap between the total gastric cancer screening rates and the gastric cancer

screening rate based on recommendation. “Cancer screening rates based on recommendation” means the percentage of population that takes the screening with the benefit of NGCSP. The other metrics here is the change of annual gastric cancer cost in the countries. The main effect of screening to identify the risk of cancer at its early stage so as to receive treatment timely. The treatment cost is much different between early stage patients and those in the late stage of disease. If NGCSP is effective, the annual cost should be decrease or increase with a very low growth rate, especially when compare to a country that have no such program. Because the NHI also burden a large proportion of the total cancer treatment cost for contributors, from such perspectives, if the program can reduce the total cost of gastric cancer annually, it is also saving the cost of the national insurance system and can be viewed as cost-effective.

1.3. Motivations and Significance

In the recent decades, East Asian countries are the countries with the highest incidence of gastric cancer, monopolizing the top rankings of gastric cancer incidence and mortality. South Korea has been leading the highest incidence rate of gastric cancer for over ten years. However, since China is more populous, although the incidence rate of gastric cancer ranking is lower than Korea or Japan, the absolute number of gastric cancer patients in China ranks first in the world. Every year, half of the new cases of gastric cancer in the world occurs in China. The prevention and control of gastric cancer is more significant to East Asian countries than any other countries in the world.

On seeing the above situation, if considering the benefits of early diagnosis of the disease, East Asian countries is in the greatest need of the service to save more lives. However, even though screening itself is beneficial, the effect of a nation-wide coverage of gastric cancer screening service still worth the work to explore. If the utility is too low, or a heavy expenditure of the program can only bring vague

effect or a very small reduction of cost, even launching a national program of cancer screening can become only formalistic and fail to benefit the people. More research to clarify the effectiveness of a national cancer screening program from different perspectives can be of great help to the public health policy formation in both China and South Korea and this is the main motivation for the author to conduct the research.

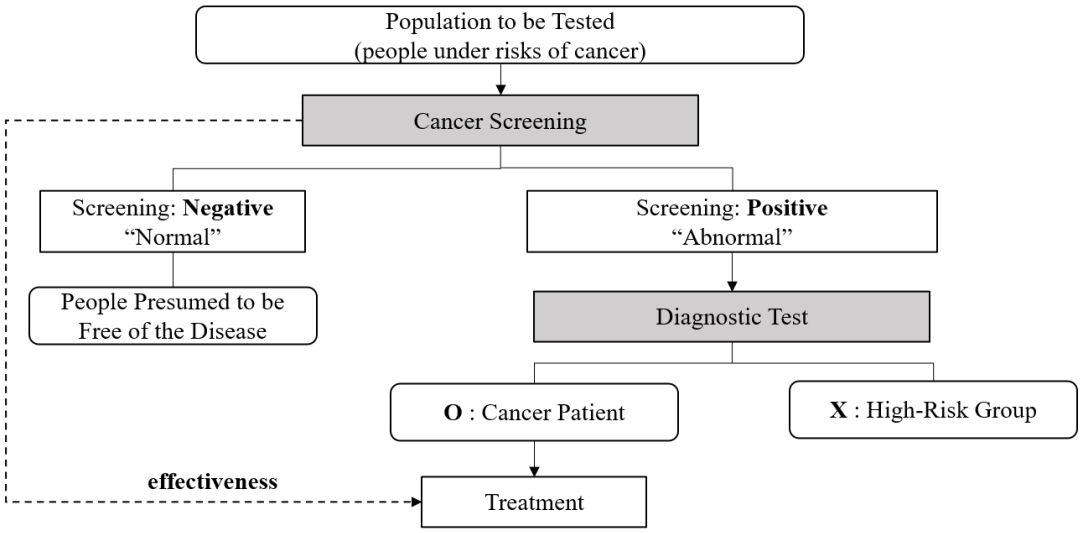
A comparative study can be reference for the country that has not yet established a national cancer screening program like China. If a universal health coverage of gastric cancer screening is proved to be cost-effective, this can not only serve as the evidence for the necessity of including noncommunicable diseases prevention like cancer screening into national health insurance system in the category of gastric cancer prevention and control, but also as inspiration for the development of universal health coverage for other service. In a hierarchy health insurance system like the Chinese one, even though the nation-wide coverage of cancer screening is difficult to realize, it is also useful for municipal government to consider adding gastric cancer screening program into the local health insurance system referring to the South Korean example, especially for the coastal areas and central China, where gastric cancer is always the leading threat of health. As for Korea, it can be inspiration for the future expansion of noncommunicable diseases prevention in the national health insurance system.

Chapter 2. Literature Review

2.1. Mechanism of Cancer Screening and Previous Studies on NCSP

Screening is not direct diagnosis of disease, but defined as a preliminary step, using quick and simple test to identify tested people (without any symptoms of cancer), suspected to have the disease (US National Cancer Institution, 2020). People tested positive in the screening process still need definitive diagnostic test and medical examination to reach the final result (see figure 3).

Figure 4. *Procedure of Cancer Screening*



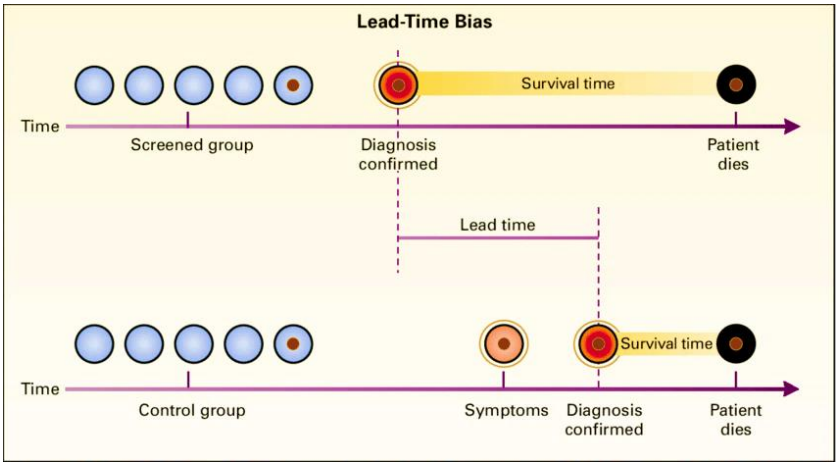
The indirect procedure from screening to final diagnosis causes the possibility of deviation of result, and thus the effect of cancer screening on the actual prevention and control of cancer remain controversial.

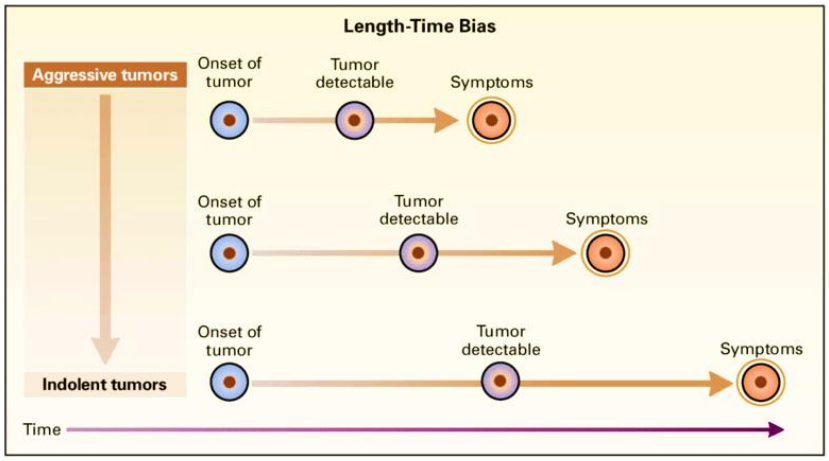
There are a series of values can evaluate the screening process from the two layers of classification. As for the first classification of screening, Sensitivity and False-Negative Proportion (FNP) define the ability of screening to identify the true patients from the tested group. A high FNP means the chance to miss cancer patient

and give them negative screening result (which means out of risk of cancer). This proportion of patients might miss the timing to receive proper treatment and suffer heavier disease burden when the disease deteriorates. Specificity and False-Positive Proportion (FPP) measure the ability for cancer screening to identify healthy people from the tested population. A high FPP might be a waste of time and resources. It will cost burden to the government expense on the cancer screening program and lower the effectiveness of it. After the classification of the diagnostic process, there is Positive Predictive Value (PPV) measuring the probability that subjects with a positive screening test truly have the disease. These values can evaluate the cancer screening program from the inner mechanism of the screening system.

A comprehensive evaluation of effectiveness still needs to analyze the effect after this whole process of evaluation. Most researchers choose the values of Mortality Rates and 5-Year or 10-Year Survival Rates to see if the screening can have any positive effect on prevention and control of cancer. However, in 2000, Patz et al. experimented on lung cancer screening and put forward the concept of Lead-Time Bias and Length-Time Bias (see figure 4). Lead-Time Bias refers to the phenomenon where early diagnosis of cancer before symptoms appear falsely makes it look like people are surviving longer, while Length-Time Bias means overestimation of survival duration due to the relative excess of cancer detected that are asymptomatically slowly progressing, while fast progressing cancer are detected after giving symptoms. This bias might lead to the misunderstanding that it is because of screening that mortality rates of cancer decreased and survival time prolonged.

Figure 5. *Lead-Time Bias and Length-Time Bias*





Source: Patz et al. Screening for Lung Cancer. (2000).

There are many researchers testified the effectiveness of NCSP from a general analysis of the whole program. In 2015, Jung's research had found out that the Positive Predictive Values (PPVs) of the five major types of cancer, checked by the NCSP have remained low at 0.6–5.7%, and in the meantime, the sensitivity of the screening programs also stood at less than 50% on average. This research evaluated from the cancer screening system itself, and proved less effectiveness of NCSP. Moreover, Jung agreed with the concept of bias developed by Patz and consider that lower mortality rates and higher survival rates in Korea were only the mistakes of lead-time bias of diagnosis and the length-time bias regarding the average survival time. However, the PPVs and sensitivity evaluated by Jung were all average value of all the cancer types in NGCSP. If viewed from details, the PPV of National Gastric Cancer Screening is relatively higher than the other four. There is still a possibility that even though the NCSP of all the five cancer types is not effective,

but NGCSP itself still has its value.

Kim and his colleague also found NCSP lacking effectiveness from the perspectives of copayment cutoff (2017). In NCSP, screening of some cancer types (stomach, liver and breast cancer) is not completely free but with a copayment cutoff for certain groups. For these types of cancer, those groups eligible for free screening have a higher screening take up rates and thus more cancer cases can be detected. However, the increase in cancer detection is quickly crowded out by cancer detection through other channels such as diagnostic testing and private cancer screening. Further, compliers are much less likely to have cancer than never takers. From these perspectives, NCSP remained less effective in reducing mortality. It is an urgent necessity for NCSP to quickly expand the screening take up rate so as to combat such negative effects. This research also viewed from the average values of all tested cancer types. But the take up rates of stomach, liver and breast cancer screening vary. With more knowledge of stomach cancer and more promotion of stomach cancer screening of the government, the take up rates of stomach cancer screening by NCSP is the highest among all the five cancer types. Crowd-out effect on NGCSP is much less than other cancer types, so the effectiveness NGCSP from the above perspectives is still vague.

2.2. Previous Studies on the Effectiveness of NGCSP

Because the five cancer types themselves have different characteristics on their incidence, mortality and survival, in various previous research, still many scholars chose to evaluate the effectiveness on them separately, and also from specific aspects of effectiveness instead of the general effect of the whole program.

In the research of Jun et al., they evaluate the screening technology used by the NGCSP. The NGSCP currently uses the method of Upper Gastro Intestinography (UGI) or Gastrointestinal Endoscopy (Biopsy) in gastric cancer screening. Jun et al.'s research designed to testify the effectiveness of NGCSP from

the diagnosis of gastric cancer according to the screening history and screening methods. Their research found out that gastric cancer screening by endoscopy was more strongly associated with a diagnosis of localized stage gastric cancer compared with screening by UGI. That is, technique like upper endoscopy can effectively reduce the mortality rate for those screened and it also proved to be more cost-effective compared to upper gastrointestinal (UGI) series examinations (2017).

The NCSP is designed to be a long-term program that provides screening for risked group on a regular basic instead of only a once-in-a-life-time service. For gastric cancer screening, eligible people can take gastric cancer screening every 2 years. In the research of Kim et al., they designed comparative studies between the regular participants of National Gastric Cancer Screening Program (NGCSP) and people only taking opportunistic screening. By evaluating the early gastric cancer detected rates, Kim and his colleagues reached the conclusion that NGCSP itself is effective and a compliance to the program is necessary (2013).

Cost-effectiveness is one common point for researchers to focused on when evaluating the effectiveness of NCSP. In most of such researches, cost-effectiveness is measure by Incremental Cost-Effectiveness Ratio (ICER), which defined by the cost per life-years saved.

Cho et al.'s research presented the studies on the cost-effectiveness of gastric cancer screening with different screening methods. In this research, the subjects designed to be people aged 40 years or over during 2002-2003 and cost included direct, indirect, and productivity-loss costs associated gastric cancer. The research found that to increase 1 life-year, additional costs of approximately 14,466,000-15,014,000 KW and 8,817,000-9,755,000 KW were required for UGI and endoscopy, respectively. Therefore, this research concluded that endoscopy should be recommended as a first-line method in NGCSP since its cost-effectiveness (2013).

Suh et al. also evaluate the cost-effectiveness of NGCSP. In their population-based study, average ICER of NGCSP was tested to be 22,169,769 Korean won (US

$20,309) per Life-Year Saved, which was less than the Korean gross domestic product (GDP) per capita in the same period, and thus, NGCSP is proved to be cost-effective.

The above-mentioned researches on cost-effective all use outdated database, with the former testified the subjects using NGCSP from 2002-2003 while the latter evaluated the screened group of NGCSP in 2004 and their follow-up situation. More recent evidences are required on the topic of cost-effectiveness of NGCSP. That's why the author choose this topic even though there were previous researches on the same topic before.

The main research purpose of this paper is to fill the research gap of a current version of cost-effectiveness evaluation of NGCSP and use such evidence to prove the necessity to cover cancer screening service into the national health insurance system. In the next session, we will start the research from comparing the similarity and difference of the current gastric cancer screening program in both Korean and Chinese national health insurance system, including the structure of program and the data of population coverage and financial protection. The author also planned to compare the development of gastric cancer control in Korea and China from the perspectives of mortality and Disease Burden as additional reference to evaluate gastric cancer control in the two countries comprehensively.

Chapter 3. Gastric Cancer Screening in Korea and China

3.1. Gastric Cancer Screening in Korea and China

The National Cancer Screening Program (NCSP) in South Korea was first launched in 1999 to provide free cancer screening services for low-income Medical Aid recipients. Since then, the NCSP has gradually expanded its target population to include the National Health Insurance (NHI) beneficiaries and gradually developed into a national health program since 2005. To avoid confusion, in this research, we define the starting year of NCSP to be 2005 and compare the effect of NCSP mainly based on the outcome from that year on. The latest structure of Korean NCSP can be summarized into the following table 1.

Table 1. *Structure of NCSP in South Korea*

	Targeted Population	Frequency	Test or Procedure	Copayment Rate
Stomach	40 & over(adults)	every 2 years	Upper Gastro-Intestinography (UGI) or Gastrointestinal Endoscopy (biopsy)	Upper 50% of NHI: 10% Lower income bracket (50%) and MAP** beneficiaries: no individual payment
Liver	40 & over with high risk group*	every 6 months	Abdominal Ultrasonography + Serum Alpha-Fetoprotein test (Combined)	No individual payment
Colorectum	50 & over (adults)	every 1 year	(1st test) Fecal occult blood test (FOBT) (2nd test) Colonoscopy (biopsy) or Double Contrast Barium	Upper 50% of NHI: 10% Lower income bracket (50%) and MAP beneficiaries: no

			Enema	individual payment
Breast	40 & over(women)	every 2 years	Mammography	Upper 50% of NHI: 10% Lower income bracket (50%) and MAP beneficiaries: no individual payment
Cervix Uteri	20 & over(women)***	every 2 years	Pap smear	No individual payment

*40 & over with HBsAg positive or anti-HCV positive or liver cirrhosis

** MAP: The Medical Aid Program

***Revised in 2016 (changed age cutoff from 30 to 20)

Source: SSIS, South Korea

Gastric cancer screening is a regular program ever since the NCSP has launched. NGCSP has targeted a wild range of population. Based on the 2019 demographic data of South Korea, adults above 40 years old occupied 56% of the total population. It means that for gastric cancer screening, over half of the population is eligible to access to the service in 2019.

Beside the comprehensive coverage of population, financial protection of the NCSP is also satisfied to most beneficiaries. Even though NGCSP hasn't been guaranteed a full coverage of expenses, lower income contributors of NHI and MAP beneficiaries still have a 100% reimbursement rate while the upper 50% of NHI contributors need to pay only 10% of the expenses. It is safe to say that population-based gastric cancer screening program is provided almost for free in South Korea.

Considering these two aspects, a wide coverage of population and a high level of financial protection, Korean people have almost no obstacles to access to the service.

However, gastric cancer screening is not yet a regular program covered in the Chinese national health insurance system. Even though in these recent years,

many NPC members tried to carried out this issue during the NPC and CPPCC two sessions, National Health Commission (NHC) of China still considered it too heavy a burden to afford a universal coverage of screening for any cancer type. Instead, from 2005 to 2012, Chinese government successively launched four cancer screening programs customized different regions, among which three of them included gastric cancer screening service, to fill this gap of health service (see table 3). These four programs are carried out under the Major Public Health Service Project of China, and directly financing by the NHC, which are not the same financing channel from the national health insurance system. Cancer screening service under these programs is 100% government funded. Due to such high burden on government expenditure, the coverage of these programs are all very low.

Table 2. *Cancer Screening Programs in China*

Programs	Launch Year	Screening Services	Coverage
Cancer Screening Program in Rural China (CanSPRC)	2005	Upper Gastrointestinal Tract (Esophagus&Stomach), Colorectum, Liver, Nasopharynx, Lung	263 counties (2.8m people)
Cancer Screening Program along Huai River Basin	2007	Esophagus, Stomach, Liver	32 counties
Cancer Screening Program in Urban China (CanSPUC)	2012	Lung, Upper Gastrointestinal Tract (Esophagus&Stomach), Breast, Colorectum, Liver	45 cities (0.86m people)
Breast and Cervical Cancer Screening Program for Rural Women	2009	Breast, Cervix Uteri	B: 1651 counties (30m women) C: 2118 counties (100m women)

Starting from 2005, Cancer Screening Program in Rural China (CanSPRC) was the earliest launched one. CanSPRC is financed by the central and provincial level finance sector, and targeted to provide free screening for 5 types of cancer that prone to have early symptoms. To be specific, these are upper gastrointestinal tract (including esophagus and stomach), liver, colorectum, nasopharynx and lung cancer, among which upper gastrointestinal cancer screening is the main focus. Till 2019, CanSPRC has established screening stations in 263 rural counties and accumulating coverage of the program has reach 2.8 million people. The basic operation method of the program is that every county might choose to provide free cancer screening for one cancer type prevailing in the area, and specifying screening group through questionnaire or other survey. The size of the screening group for each county is around a thousand at average. That is, based on the 2019 data, even if all the 263 counties carry out cancer screening on gastric cancer, there are only 263,000 rural people at most can access to the service. The actual coverage of the program on gastric cancer screening might be even less than this number.

The operating mechanism of the Cancer Screening Program along Huai River Basin is very much the same as the CanSPRC. Starting from 2009, this program is more like a supplementary one to fill the vacancy when CanSPRC has not yet cover the area along Huai River Basin. The Huai River Basin is specific refer to Jiangsu, Anhui, Shandong and Henan provinces, where upper gastrointestinal tract (including esophagus and stomach) prevailing. Based on the 2019 statistics, this program has covered 32 counties along the area. If using the same calculating method as the CanSPRC, the program can provide gastric cancer screening of to around 32,000 people at most.

To summarize, the CanSPRC and Cancer Screening Program along Huai River Basin together provide cancer screening service (mainly for gastrointestinal tract) for rural areas. Through these two programs, around 0.053% of rural population at most are eligible to the service. The scale of such programs in China were still very small.

As for urban sector, in 2012, the government launched Cancer Screening Program in Urban China (CanSPUC), which aimed at providing early cancer screening service of five common types of cancers, including lung, upper gastrointestinal tract (esophagus and stomach), breast, colorectum and liver. Up to 2019, the CanSPUC has covered 45 cities in 20 provinces. Originally, screening objects of the program are local household resident population between 40 to 69 years old, in 2016 age limit was expanded to 74 years old. It doesn't mean that all people among this age group in the covered areas can receive cancer screening. This program planned to choose one or two mega cities (population more than half a million) in each of the province, and decided screening candidates through questionnaire of risk assessment. In each of the province, the program target to screen not less than 10,000 candidates in total of all designated cancer type. This amount of 10,000 should be evenly allocated to each of the cities chosen. For example, Guangdong province has long been covered in this program. In 2019, CanSPUC might plan to provide screening for 10,000 residents. As the cities chosen, Guangzhou and Shenzhen will each have 5,000 spots for screening, and each of the five types of cancer can have 1,000 citizens to access to the service. Based on such mechanism, the total number of gastric cancer screening candidates in 2019 might be around 40,000. Urban population in 2019 occupied 60.3% of the whole Chinese population, so this program can cover a merely 0.0047% of urban residents for gastric cancer screening.

All in all, without a universal health coverage of gastric cancer screening, the Major Public Health Service Projects serving as supplementary program were far less than enough as for the coverage of beneficiaries in China.

Table 3. *Comparing Gastric Cancer Screening Program in South Korea and China*

	South Korea	China
Universal Health Coverage of Gastric Cancer Screening	Yes	No
Program	National Gastric Cancer Screening Program (NGCSP)	Major Public Health Service Projects
Coverage (2019)	**56%** of total population (40+ adults)	**0.0047%** of Urban Population less than **0.053%** of Rural Population
Financing Sources	National Health Insurance Service (NHIS) Medical Aid Program (MAP)	National Health Commission (NHC)
Financial Protection	10% Out-Of-Pocket expenses for upper 50% contributors of NHI and free for lower 50% NHI contributors and MAP beneficiaries	Free

From the above analysis of two subjects, it is obvious that the way South Korea and China operating gastric cancer screening is very different (as compared in table 4). With a relatively comprehensive national health insurance system, South Korea has long established a universal health coverage of gastric cancer screening as one branch of national health insurance service. The Korean NGCSP is funded by the NHIS and MAP, which is the same financial foundation for the national health insurance. NCSP has been quite a solid government program to provide gastric cancer screening service for risky population groups under free of very low expenses.

On a contrary, gastric cancer screening is not a regular service within the national insurance system. Because it still has the necessity of such kind of public health service, Chinese government carried out different cancer screening programs targeted people in different areas under the name of Major Public Health Service Projects. These programs are mainly funded by the NHC and other related departments of different level, which is very different from the

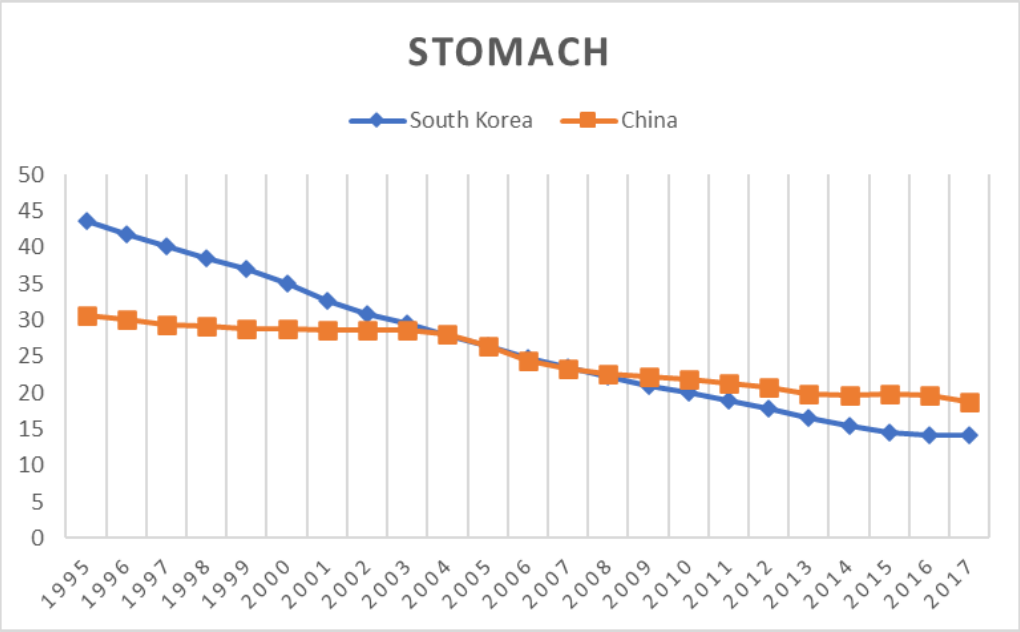
national insurance system. However, the coverage competence of gastric cancer screening in China are still too weak to compare with that in South Korea.

3.2. Comparing Gastric Cancer Mortality

It is also necessary to compare the basic situation of gastric cancer in the two countries, because even though the incidence rates are high in both the countries, if the mortality and disease burden diverge, the necessity of the program might also be different. In this part, the author will compare the mortality rate in the past two decades in the two countries.

The data of mortality rates from 1995 to 2017 of South Korea and China are collected from the Our World in Data, Cancer Database. Our World in Data is a project of the Global Change Data Lab, a registered charity in England and Wales and it rely on the work of a global community of scholars to build up its Cancer Database. The original source of cancer mortality by different cancer types and by countries are the Institute for Health Metrics and Evaluation, an independent population health research center at University of Washington (UW) Medicine. This center provides rigorous and comparable measurement of important health problems such as cancer. Here Mortality Rates calculate the number of deaths from different types of cancer per 100,000 individuals. Moreover, to allow comparisons between countries, this metric is age-standardized. To visualize the data, the author create graphs to help understanding the difference of mortality rates in Korea and China (see Figure 7).

Figure 6. *Age-Standardized Mortality Rates of Stomach Cancer (1995-2017)*



Mortality rates of gastric cancer have a large divergence between South Korea and China. Even though both the mortality rates are on a decreasing trend, the extent of decrease varies. It is obvious that, with a higher starting mortality rates in 1995, South Korea has much larger extent of decrease that its mortality rates became lower than China's in the recent years.

Comparing the detailed number of stomach cancer mortality rates, from 1995 to 2005, the period before cancer screening became a universal health coverage program, mortality rates decreased a lot in South Korea from 43.59 to 26.38, a relative 39% drop. Mortality rates in China also drop from 30.69 to 26.45, a relative 14% reduction, which is lower than that of South Korea. From 2008 onward, South Korean mortality rates of stomach cancer continue lower than that of China and the trend has not been reversed. In south Korea, the mortality rates dropped by 47% to 14.09 in 2017. In China, it dropped by 29% to 18.83. The decreasing trend of gastric cancer mortality rates in Korea has been continuous for all the two decades, and no specific larger change can be found ever since NGCSP has launched since 2005. Even though the relative change of mortality rates of gastric cancer in the past decades diverge a lot in the two countries (see table 5), there is no other changes of mortality rate more

than the original decreasing, and thus it is hard to attribute the positive development of mortality to the national cancer screening program.

Table 4. *Gastric Cancer Mortality Rates Change in South Korea and China (2005 vs. 2017)*

South Korea				China			
2005	**2017**	**absolute**	**relative**	**2005**	**2017**	**absolute**	**relative**
26.38	14.09	-12.29	-47%	26.45	18.83	-7.62	-29%

3.3. Comparing Gastric Cancer Disease Burden

Mortality rates only measure the absolute deaths from cancer, but for most cancer patient, the impact of cancer on their lives is more than that. As for a deadly cancer type like gastric cancer, many patients live with cancer for long periods with disability. Hence it is also important to capture the morbidity of living situation caused by cancer. In this part, the researcher will compare the disease burden rates of gastric cancer between the two countries.

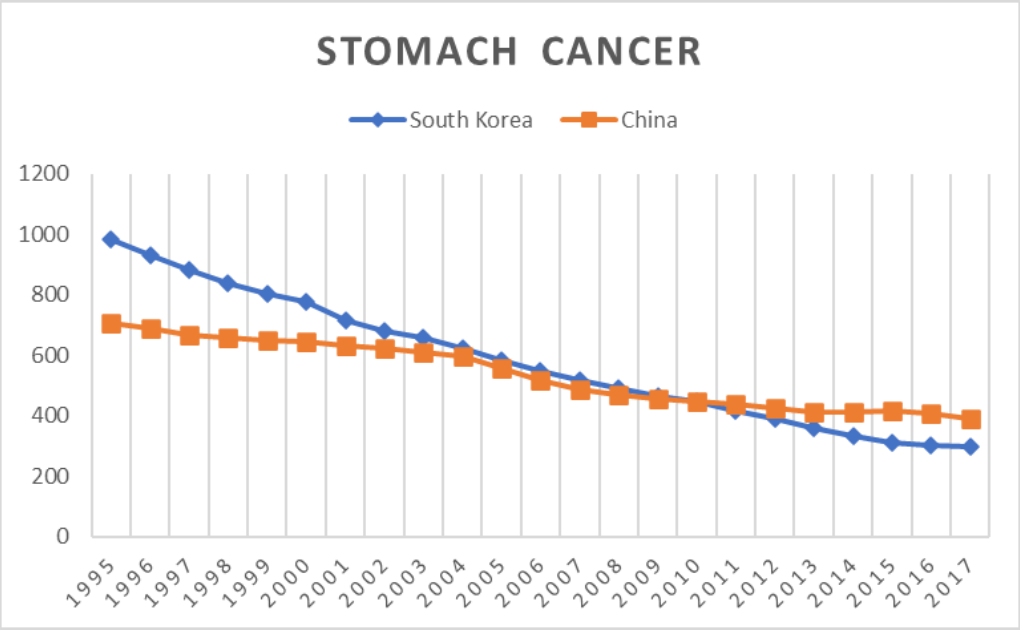
Disease burden was quantified by the metric Disability-Adjusted Life Year (DALY), which takes into consideration both years of life lost due to premature death and from years lived with cancer. One DALY equals one lost year of healthy life. The higher is the number of DALY, the heavier is the disease burden of a country. Disease burden rates here are age-standardized, representing the DALY per 100,000 individuals.

The same as mortality rates, the data of disease burden rates are also from the Our World in Data, Cancer Database, whose original data are based on the researches from Institute for Health Metrics and Evaluation (IHME), an independent population health research center.

Disease burden has a very close relation with mortality, and thus the graphs

of disease burden rates are generally in a very similar pattern with those of mortality rates (see figure 8). The same as mortality rates, disease burden rates of gastric cancer have an obvious divergence between South Korea and China. Even though the disease burden rates of stomach cancer are on a decrease trend both in Korea and China, the extent of decrease of the disease burden rates of South Korea is much larger than those of China.

Figure 7. *Age-Standardized Disease Burden Rates of Stomach Cancer (1995-2017)*



Disease burden rates of stomach cancer were once very high in South Korea, reaching 983.56 in 1995 and dropped to 586.09 in 2005. The decreasing rate of this time period was 40%. This means that stomach cancer has caused long time of suffer to those patients at the late stage of disease. In 2017, the Korean disease burden rates left to be 297.43, comparing to that in 2005, the number has dropped by a half. The relative decrease extent was 49%, high than the previous decade. This has been a great breakthrough on reducing disease burden of stomach cancer for Korea people. On the other hand, in China, at the very beginning, the disease burden rates were 705.36. Later, it dropped by 21%

and became 559.61, which was still slightly less than that of South Korea. But till 2017, the disease burden rates in China left to be 391.66, whose extent of decrease was not as large as that in South Korea.

To summarize the comparison of disease burden rates as the following table 6. The past years witnessed a general decreasing trend of disease burden in both Korea and China. The age-standardized disease burden rates of stomach cancer in Korea had much larger reduction. On the contrast, in China, the extent of reduction of disease burden rates for stomach cancer are much smaller. Even though the decreasing scale of South Korea was much larger, the same as mortality rates, if seeing the trending graphs, the trend of change has no obvious difference before and after the NGCSP was carried out. It is also hard to tell whether the decrease of disease burden in South Korea can be attributed to the NGCSP or not.

Table 5. *Disease Burden Rates Change in South Korea and China (2005 vs. 2017)*

South Korea				**China**			
2005	**2017**	**absolute**	**relative**	**2005**	**2017**	**absolute**	**relative**
586.09	297.43	-288.66	-49%	559.61	391.66	-167.95	-30%

Chapter 4. Effectiveness Evaluation of Cancer Screening in South Korea and China

From the previous part, the author has illustrated the different operating system and different coverage of service of gastric cancer screening and their effect on mortality and disease burden. In this part, we will start to compare the outcomes of cost from the gastric cancer screening program. As explained by the researcher in the introduction part of this paper, the author chose the other way round to testify the utility and annual disease cost that can reflect the cost-effectiveness of the NGCSP. This is mainly because that the direct spending of NGCSP is not available and it is hard to measure the life-year saved of gastric cancer by the NGCSP with the current database of the Korean NCSP. Therefore, to compare the utility, that is, the screening rates with or without NGCSP and to compare the growth trend of annual gastric between Korea and China are also solid indicator to testify the cost-effectiveness of the NGCSP.

4.1 Utility of NGCSP in Korea

In this part, the author will measure the utility of NGCSP. Gastric cancer is a very common cancer type in Asia and many people already have much knowledge about it. Moreover, there are also many other accessible channels for gastric cancer screening than NGCSP. Because of not enough promotion or ineligibility of the NGCSP, some people might fail to use the service of NGCSP and take cancer screening in other institutions, and thus cause a low utility of the NGCSP. As mentioned earlier, if NGCSP has only a small number of users, it will descend to be a waste of government health expenditure. Measuring the utility is also an important part to testify the cost-effectiveness of the program. The benchmark for the utility comparison was the gap between the overall

screening rates of gastric cancer in Korea and its gastric screening rate based on recommendation. The overall gastric cancer screening rates measure the percentage of individuals who have undergone gastric cancer screening at least once in their lifetime. The "recommendation-based cancer screening rates" is the percentage of people who are eligible recommended by NGCSP to take gastric cancer screening and also actually using this service of the program.

Data of screening rates originally came from the Korean National Cancer Screening Survey (KNCSS). It is a nationwide annual cross-sectional survey conducted in the past two decades, which reports data of the overall screening rates of both organized and opportunistic cancer screening programs of the five designated cancer types including in the Korean NCSP. KNCSS data were collected using a structured questionnaire. In this paper, the author chose to evaluated both the lifetime screening rates and the screening rates based on recommendations of gastric cancer.

From previous analysis of the program structure of NGCSP, the program has a comprehensive coverage of population and a high level of financial protection. With such beneficial program, Korean people supposed to have fewer and fewer obstacles to receiving gastric cancer screening service. Hence, once the NGCSP has launched since 2005, the screening rates of cancer were on a generally increasing trend (as seen in table 6 and figure 8).

Table 6. *South Korea, Comparing Gastric Cancer Screening Rates (2005-2014)*

year	05	06	07	08	09	10	11
General Cancer Screening Rates	48.5	53.5	55.3	65	65.1	76.7	76.2
Gastric Cancer Screening Rates based on Recommendation	39.4	43.3	45.6	53.5	56.9	65.1	64.6

Gap	9.1	10.2	9.7	11.5	8.2	11.6	11.6

(follow the preceding table)

12	**13**	**14**	**15**	**16**	**17**	**18**
77.9	80	83.4	83	85.2	84	85.5
70.9	73.6	76.7	74.8	73	72.2	72.8
7	6.4	6.7	8.2	12.2	11.8	12.7

*Screening rate based on recommendation: percentage of individuals who have undergone screening as part of the National Center Screening Program or based on the recommendation of NCSP

*Screening rate = (number of screened individuals / candidates) X 100%

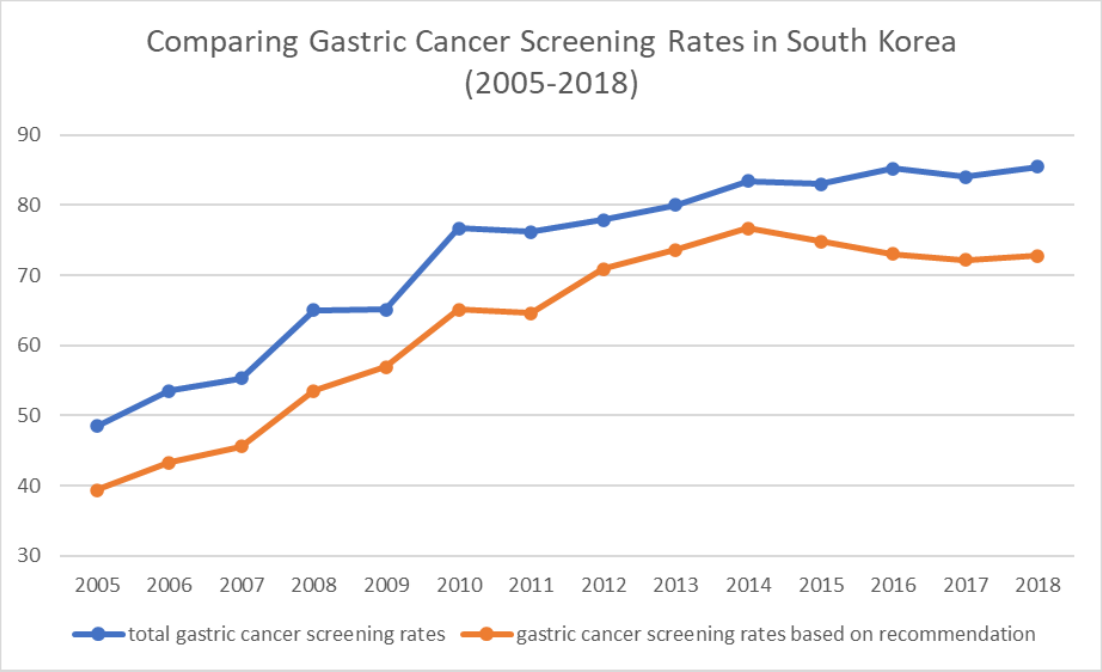
*Source: Korean National Cancer Screening Survey,

The overall gastric cancer screening rates increased rapidly from 2005 to 2018. Originally, the general screening rates of gastric cancer was 48.5%. Less than half of population had the sense to take gastric cancer screening once in their lifetimes. Till 2018, the number of this category had almost doubled and jumped up to 85.5%. Even though it fluctuated in some years, it didn't reverse the fast-growing trend of the screening rates.

On the other hand, the screening rates based on the NGCSP recommendation also increased rapidly till 2014 and slightly dropped in the following years. When the NGCSP first launched in 2005, the NGCSP screening rate was 39.4%, a 9.1% gap compared to the overall gastric cancer screening rates. Till 2014, the NGCSP screening rates climbed up to 76.7%, and the gap between general screening rates and recommendation-based screening rates continuously declined to 6.7%. Since then, the NGCSP began to dropped slowly and till 2018, it fell back to 72.8%. It is still at a relatively high level if viewed from the general numbers all these years. But with a still increasing general screening rates, the gap has become large and climbed up to 12.7%, which was

the highest ever since the NGCSP has launched.

Figure 8. *South Korea, Comparing Gastric Cancer Screening Rates (2005-2018)*



To visualize the number of screening rates into grapes like figure 8, we can see the growing pattern and the difference of change more clearly. As for the total gastric cancer screening rates, it rapidly grew from 2005 to 2018 and seemed the increasing trend will even go on in the following years. From 2005 to 2011, the recommendation-based gastric cancer screening rates grew in an almost same pattern to the total ones, the gap of them remain at a stable level around 10%. In the following three years, from 2012 to 2014, the NGCSP screening rates began to grow faster than the total, and the gap between them once narrowed to a level around 6%. Since then, the NGCSP screening rates began to fall, and the gap of the two kinds of screening rates returned to the number around 10%. If seeing the detailed number, the 2017 recommended screening rate is 72.2% while the 2018 one is 72.8%. With such a recovery trend of number, it is possible that from 2018 on it would also be a growing trend in

this category.

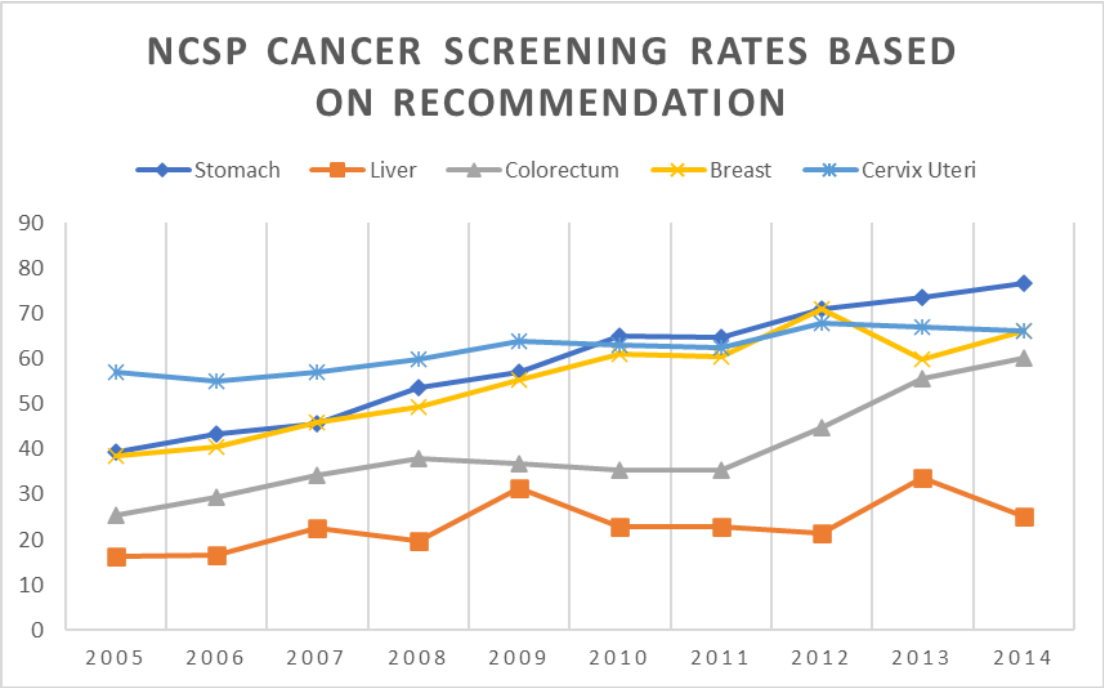
To sum up, the gastric cancer screening rates were growing rapidly from 2005 to 2018. The total cancer screening rates increased by 37%, from 48.5 in 2005 to 85.5 in 2018, almost twice as much as the beginning value. Although the recommendation-based cancer screening rates fluctuated in recent years, it has also experienced a large extent of growth, from 39.4% to 72.8%. The gap between the two kinds of screening rates was relatively stable and remained at the level of around 10%, with the highest of 12.7% appeared in 2018 and the lowest 6.4% appeared in 2013. The recommendation-based cancer screening rates were stably reached a level more than 50%. The gap between these NGCSP screening rates and the total gastric cancer screening rates was also remained at a stable level around 10%. From these perspectives, it is safe to reached the conclusion that the utility of NGCSP in Korea is high when comparing with the overall gastric cancer screening rates in the country.

As for the relatively larger gap in the period of 2014-2018 between the total gastric cancer screening rates and the recommendation-based screening rates, one possible reason for this change is the increasing number of gastric cancer screening takers within the younger age group. The age cutoff of the NGCSP is 40 years old. However, in these recent years, cancer patient had a low-aging trend. Many young people in their 30s and even 20s now have more knowledge and increased sense of health care. These group of young people will choose to take cancer screening even without the financial support of national health insurance system. The KNCSS included the survey of all age group and thus, the gap between the total gastric cancer screening rates and the NGCSP screening rates diverged from 2014 to 2018.

To consolidate the evidence of the utility of gastric cancer, one other useful material is to compare the gastric cancer screening rates with the screening rates of the other cancer types (liver, colorectum, breast and cervical cancer) included in the Korean NCSP.

To analysis from the overall perspectives, till 2014, ten years since NCSP has been launched, the average cancer screening rate based on recommendation of all the five cancer types was 67.3%. The NCSP cancer screening rates of all cancers increased in different extent within this ten-year period (as shown in figure 9). From the figure, it is obvious that NCSP has enlarged impact on Korean people regarding cancer prevention, and the users of the service is still growing among the national population.

Figure 9. *South Korea, NCSP Cancer Screening Rates based on Recommendation (2005-2014)*

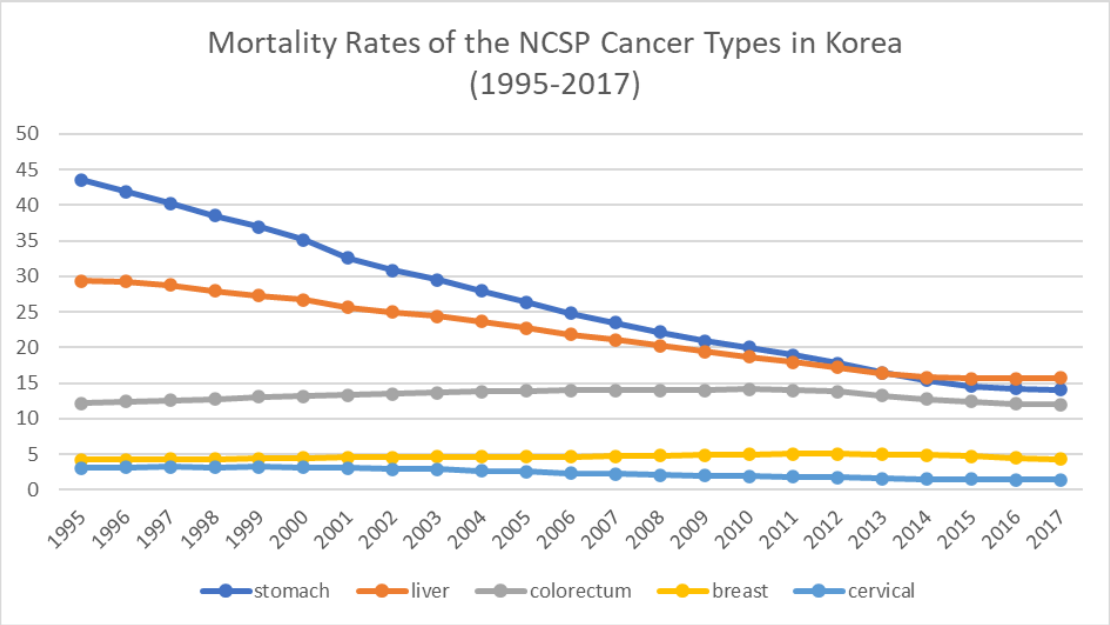


To analysis the details, in 2014, stomach cancer had the highest screening rate based on the recommendation (76.7%), followed by cervix uteri cancer (66.1%), breast cancer (66.0%), colorectum cancer (60.1%), and the high-risk group of liver cancer (25.2%). From the point of view of growth, screening rate of colorectum increase the most. It has increased by more than double the number in 2004, relative growth of which was high up to 137%. Followed by the growth of gastric cancer screening rate, whose relative increase was 95%

and breast cancer 72%, liver cancer 55%. Screening rate of cervical cancer increase the least, with an 16% increasing rate in those past ten years. In 2005, when the NCSP was launched, the recommended-based gastric cancer screening rate was not the highest among all cancer types, which was much lower than the screening rates of cervical cancer. The gap between gastric and cervical cancer screening rates was up to 17.6%. However, a decade after that, in 2014, the NGCSP screening rates became the highest one among the five cancer types, leading the runner-up cancer type by 10.6%. From the above analysis, we can tell that the utility of the NGCSP is the highest one through the ten-year development of the national coverage of cancer screening. The conclusion that the utility of NGCSP is satisfied can also be support from the evidence presented in this part when comparing with the other cancer types covered in the NCSP.

The reason for this trend is mainly due to the high incidence and mortality of gastric cancer in Korea. Gastric cancer is the one and only most common and deadly cancer in Korea, the incidence rate of gastric cancer is much higher in Korea than any other country in the world (as explained in Chapter 3). The mortality rate of gastric cancer in Korea once has been very high, especially when compared to other cancer types in the NCSP (see figure 10). With the development of the NGCSP, gastric cancer mortality rate dropped by a large extent but still at a relatively high level in comparison to the other cancer types. Seeing such situation, the NCSP attached more attention to the prevention of gastric cancer, designing the largest coverage scale of NGCSP and also carrying out many promotions on gastric cancer screening. Korea people have well understanding of the disease burden of gastric cancer and have much awareness of the prevention of it. As a result, the screening rates of stomach cancer became the highest among all, which is a very useful way to increase the cost-effective of the NGCSP. From the utility analysis of the NGCSP via the comparison of the gastric cancer screening rates, it is vivid that the NGCSP can be viewed as cost-effective from this angle.

Figure 10. *South Korea, NCSP Cancer Mortality Rates (1995-2017)*



4.2 Comparing Cost of Gastric Cancer in Korea and China

The other metrics to serve as evidence is the change pattern of annual gastric cancer cost in the countries. The main value of screening is to recognize the risk of it at early stage. It is very effective to increase survival and reduce disease burden to the household if the patients can get treatment at early stage. The cost of treatment varies greatly among different stage. If NGCSP is effective, annual costs should decline or increase at a slower growth rate, especially compared with countries without such schemes like China. Since the Korean national health insurance also covers a significant proportion of the cancer treatment cost. Therefore, the program can be considered cost-effective if it reduces the total annual cost of gastric cancer and saves the cost on gastric cancer treatment of the national insurance system.

Data collected in this part is from various sources, most of which is from previous researches in some recent period. Because most of the data regarding

cancer treatment cost of a specific cancer type is not available in both Korea and China. Still some scholars did some researches on the topic of annual gastric cancer treatment cost in the countries. Based on the probable reliability of these researches, we try to compare the data of cost.

With a high incidence of gastric cancer, the Korean gastric cancer cost is at a relatively high level than many other countries. As shown in figure 11, in 2000, the annual gastric cancer cost of Korea reached 912.6 million dollars. It is also clear in the chart that the number of annual cancer cost is generally increasing through all these years. In 2005, the total gastric cancer cost was 1411.3 million dollars while in 2015, the number has climbed up to 1547.3 million dollars. Even though it also fluctuated and decreased in some year like that in 2009, which was 1512.3 million dollars, while the 2008 number was 1543.4, the overall trend of the gastric cancer cost in Korea is a relatively flat growing line. In this 15-year duration, the annual gastric cancer cost has been almost two folds of the origin, a still very large number.

But seeing the growth rates of the gastric cancer cost, this result will turn out to be acceptable. Within the period from 2000 to 2005, the growth rate was relatively high and stay at around 10%. The highest was 11% in the year 2003 while the lowest was 8% in 2005. However, in the following ten years since 2005, the growth rate of gastric cancer has an obviously decrease. In 2006, the first year after the NGCSP was launched, the growth rate of annual gastric cancer cost rapidly dropped to 2%, much lower than the level before. And this trend also continued. Till 2015, the growth of total gastric cancer cost has stayed stably at a level around 1%. In some years like 2009, 2014 and 2015, negative growth appeared and the growth rate was -2%, -3% and -2% respectively. That is, even though the number of gastric cancer treatment cost is still a very large number in Korea, the change pattern of the annual cancer cost is developing in a positive way, and hopefully the costs will be stable or start to decrease.

Figure 11. *South Korea, Gastric Cancer Cost and Growth Rates (2000-2015)*

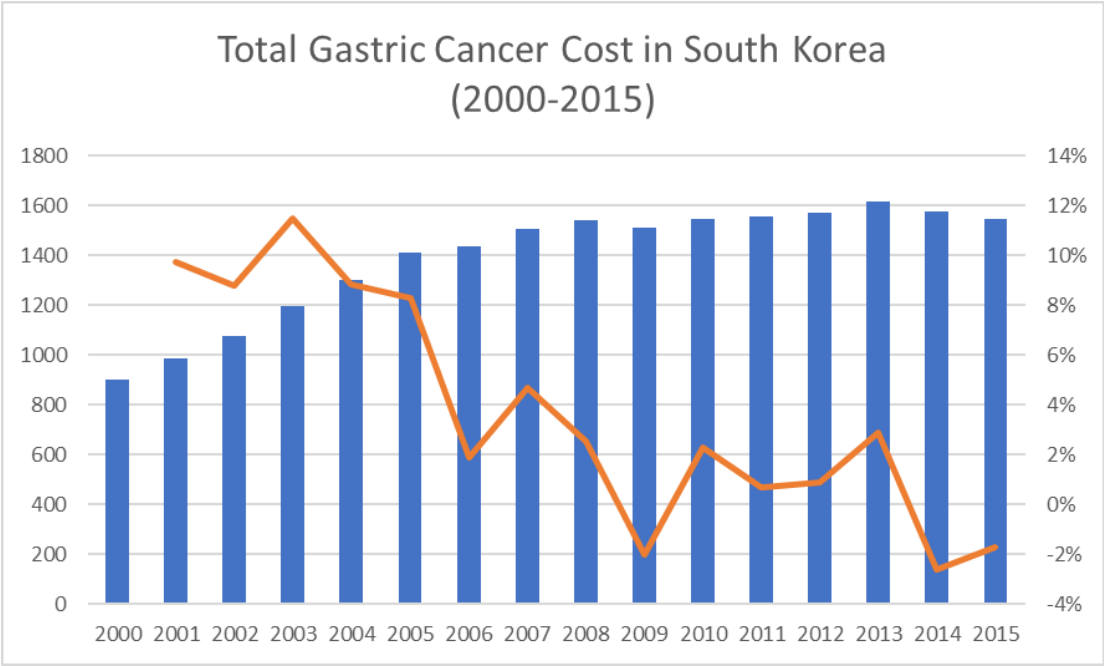
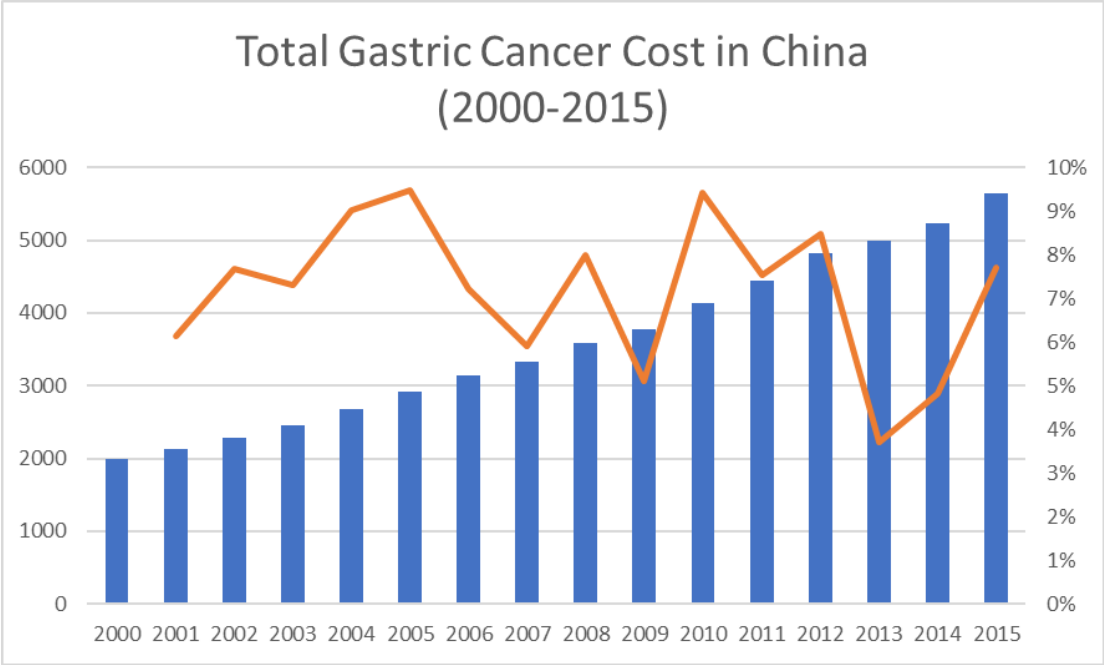


Figure 12. *China, Gastric Cancer Cost and Growth Rates (2000-2015)*



The most possible factors leading to the change is the establishment of the NGCSP. Seeing the graph in figure 11, before 2005, the growth rate of gastric

cost fluctuated and stay at a high level of 10%. However, it is obvious that from 2005 onward, the average number of growth rate has dropped to a much lower level than before, at around 1-2%. Negative growth also appeared, and those year with negative growth rates were all after 2005. To evaluate the effective of the program, it is important to find out the difference it has created before and after the time it has been launched. From the data presented here, the watershed of change is obvious at the time around 2005. Therefore, it is highly likely that the change of gastric cancer cost growth rate was the outcome of the establishment of the NGCSP.

Comparing the total gastric cancer cost of China (see figure 12), the difference is very clear. Even though the Chinese incidence rates of gastric cancer is much lower than Korea, with an unbeatable magnitude, the total gastric cancer cost is spectacular. In 2000, the total gastric cancer treatment cost added up to 1983.9 million dollars, almost double the number in the corresponding period. The gastric cancer cost kept rising and till 2005, when NGCSP was launched in Korea, the Chinese gastric cancer cost was already reached 2927.3 million dollars. At the end, in 2015, the total gastric cancer climbed up to 5639.4 million dollars, almost three folds the beginning number of its own, and around 3.6 times the corresponding number in Korea.

As for the growth of total gastric cancer cost in China, the trend is very volatile. From 2000 to 2001, the growth rate was 6%, slightly lower than Korea, while till 2015, when the growth rate in Korea became negative, the Chinese gastric cancer cost growth rate was 8%, still staying at a relatively high level. Within these 15 years, the highest growth rate had reached 9%, while the lowest 4%. From the graph in figure 12, we can tell that the growth rates remained at a level around 6-7%. No negative growth can be found in this period. With such trend, at last, the total number of gastric cancer cost in China still stay at a very high level and is possible to climb up to higher level.

Figure 13.1 *Comparing Total Gastric Cancer Cost*

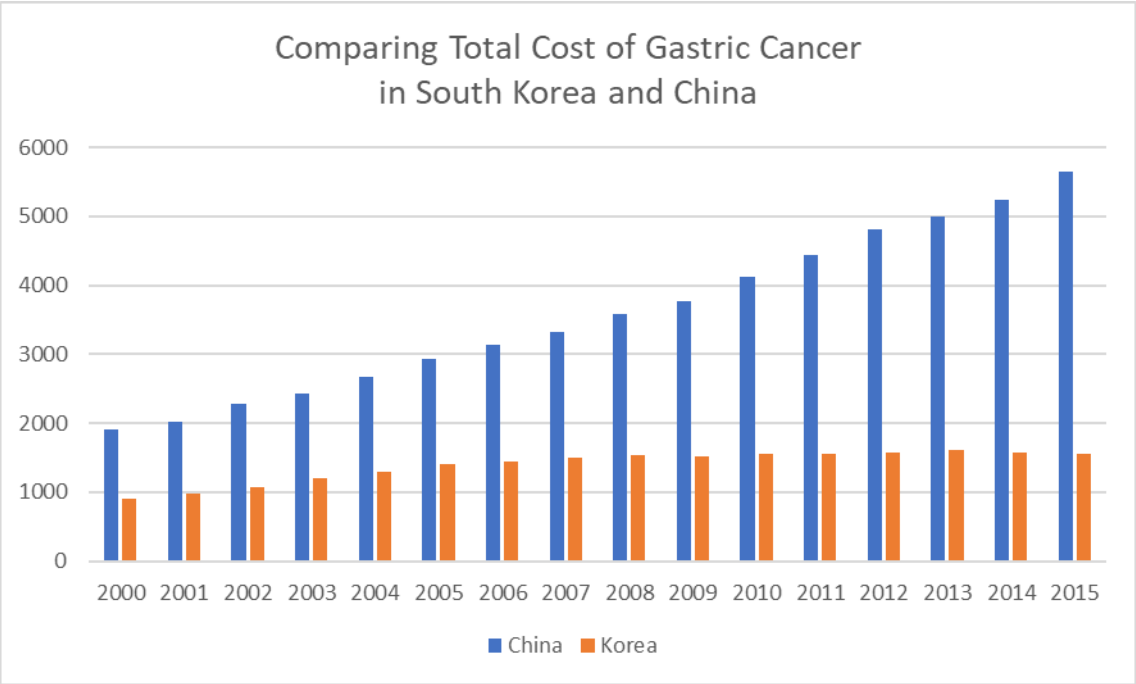
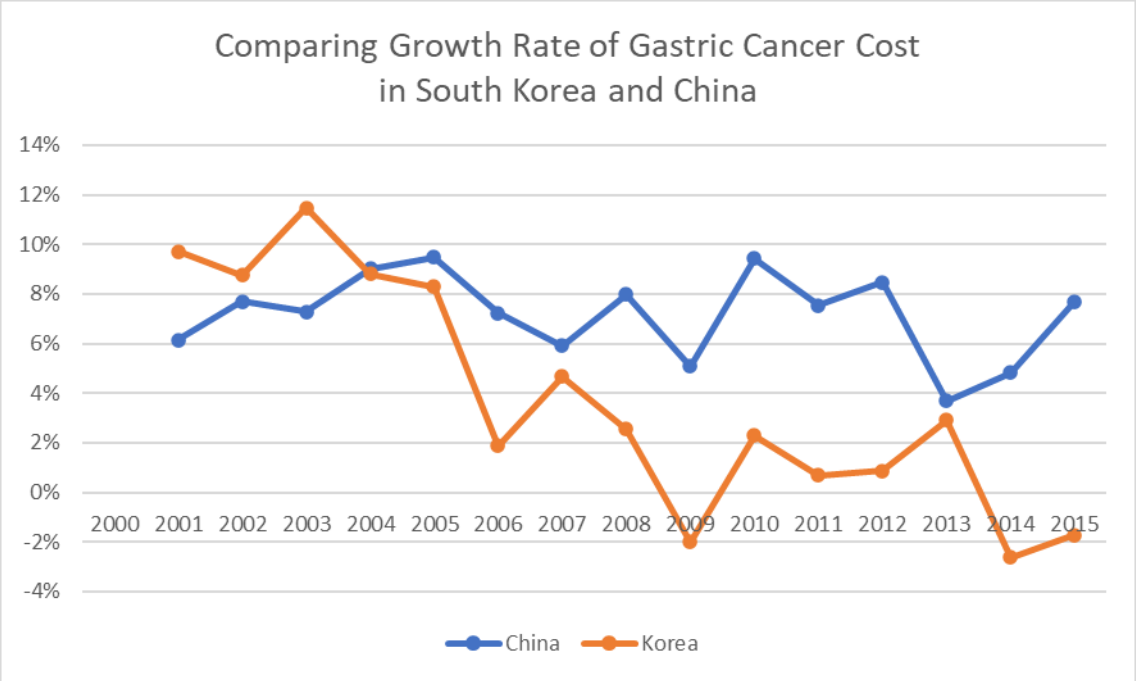


Figure 13.2 *Comparing Growth Rates of Total Gastric Cancer Cost*



To combine the data of the two countries as figure 13.1 and figure 13.2, the

difference will be more obvious. As figure 13.1 shows, from 2000 to 2015, the growing trend of total gastric cancer cost in Korea tended to become stable. In the first half before 2005, gastric cancer cost in Korea also increased rapidly, but such trend was intercepted since 2005 and the growth slowed down. On the other hand, in China, the total gastric cancer cost grew continuously and rapidly. From 2005 to 2015, the gap of gastric cost between Korea and China became larger, and this gap will even become larger than the current level. That is, even though China has a much lower gastric cancer incidence than Korea, Chinese people still spend much more on the disease than Korean.

The contrast of gastric cancer cost growth rate is vivid in figure 13.2. The year 2004-2005 has been the watershed. Since then, the Korean growth rate of gastric cost continuously dropped and stayed at a much lower level than before. On the other hand, the Chinese growth rate fluctuated around a relatively high level and have no sign of decrease.

To sum up, from the above results of comparison, one conclusion is obvious. That is, from the perspectives of total gastric cancer treatment from 2000 to 2015, NGCSP is generally cost-effective, especially when compared to a country without national coverage of gastric cancer screening like China. Because cancer screening is effective in recognizing gastric cancer patients at their early stage and the cost of treatment at early stage is much lower than the cost in later period of the disease. As a result, the total gastric cancer cost declined or grew in a much slower pace. This result convincingly proved both the effectiveness and cost-effectiveness of the national gastric cancer screening program in Korea. The successful example of Korea can also serve as an inspiration to the prevention and control of gastric cancer in China.

Chapter 5. Conclusions

5.1 Main Findings

This paper focuses on the research question whether a universal health coverage of gastric cancer screening is cost-effective or not. The author argued that a universal health coverage of gastric cancer screening is cost-effective especially when compared with a country without such system like China.

The researcher designed to carry out comparative study between Korea and China on the cost-effectiveness of the Korean National Gastric Cancer Screening Program (NGCSP), while China has not yet launched such universal health system. That is, on the coverage of gastric cancer screening, these two countries have a large gap, which made them appropriate to be the subjects in this research.

In South Korea, NGCSP has launched nation-wide as a regular service since 2005 to provide gastric cancer screening for adult above 40 years old under free or very low cost. The coverage ratio of NGCSP was over half of the population (based on 2019 standard).

On the contrary, China has not yet included cancer screening of any cancer type as a regular part in the national health insurance system. Instead, it used four kinds of Major Public Health Project, among which gastric cancer screening was included, to fill the gap of lacking government-funded cancer screening service in some specific areas. However, compare to the magnitude of China, the coverage ratio of these projects was too small compared to the universal coverage of Korea.

As additional reference, the author also added on the comparison of gastric cancer mortality rates and disease burden rates from 1995 to 2017 between Korea and China. The purpose of such reference is to avoid the possibility that the NGCSP itself is not effective. If mortality and disease burden rates developed in a negative

trend in Korea, the NGCSP itself as public health protection program might be not effective or have only a very limited effect on gastric cancer prevention and control. If so, it is no need to explore cost-effectiveness, because the investment of government expenditure has no visible effect on controlling the deaths and disease burden of gastric cancer. In the meantime, if mortality and disease burden kept on deteriorated in China, then, it is not appropriate to carry out comparative studies. Because it is self-evident that lacking of cancer screening system is the reason for the deterioration of gastric cancer prevention and control in China.

In the comparison, the author found out that age-standardized mortality and disease burden rates were all on a decreasing trend in both Korea and China from 1995 to 2017. However, as for Korea, there is no specific difference of the decreasing trend before and after NGCSP was launched. From the perspectives of mortality and disease burden rates, it is hard to find solid evidence showing the effectiveness of NGCSP directly.

As for the comparison of dependent variable, to quantify cost-effectiveness of a universal coverage system of gastric cancer screening, the author first measured the utility of the Korean NGCSP and then compare the total gastric cancer cost between Korea and China.

First, utility was defined by the gap between total gastric cancer screening rates and the NGCSP recommendation-based screening rates. The data of cancer screening rates were from the National Cancer Screening Survey of Korea. The evaluation of utility from 2005 to 2018 found that the NGCSP utility is satisfied. The total gastric cancer screening rates kept increasing from 45.5% to 85.5% while the NGCSP screening rates also increased from 39.4% to 72.8%. The gap between these two types of cancer screening rates remained at a level between 10%, with the highest being 12.7% and the lowest 6.4%. This is generally acceptable. When compared the recommendation-based screening rates of gastric cancer with the other cancer types in NCSP, the author found that the extent of increase of gastric cancer screening rate was considerable and till 2014, gastric cancer screening rate

has leaped up to the highest among all the cancer type in NCSP. Hence, it is convincing to say that the utility of NGCSP is high enough.

Second, because lacking direct data of gastric cancer screening cost and life-year saved by the NGCSP, the author detour to compare the total gastric cancer cost of Korea and China. The principle here is that gastric cancer cost at early stage is much lower that late stage. Screening is a tool to detect cancer at its early stage. If screening is effective, the total cost should decrease or increase at a slower pace. Since cancer treatment cost is one of the most important items in national health insurance in both Korea and China, it is also reasonable to evaluate cost-effectiveness from this angle. It is found that even though total gastric cancer cost was all on an increasing trend in Korea and China, the growth rate of the Korean one was much lower than China's. After NGCSP was launched in 2005, the growth rate of gastric cancer cost in Korea dropped from a level around 10% to around 2%, with negative growth also appeared in some years. On the contrary, gastric cancer cost was rapidly adding in China under a relatively high growth rate around 7%. The result obviously showed that NGCSP was cost-effective in the past two decades.

To put all the analysis in a nutshell, this paper showed solid evidence to prove two main findings. One is that the utility of NGCSP was relatively high when compared to the total gastric cancer screening rates and other cancer types in NCSP. Yet another is that the NGCSP is proved cost-effective to control the total gastric cancer cost because more patients can receive treatment at early stage. Therefore, the argument of this paper was proved to be true that it is cost-effective to launch a national cancer screening program on gastric cancer.

5.2 Limitations of the Research

There are two limitations need to be noticed in this research.

First, in the comparison of dependent variable, the data of gastric cancer cost was collected not from the same sources but from different researches, this might lead to the asymmetry of standard. To ensure objectivity, the other data for comparison like mortality rates and disease burden rates were collected from third-party research institutions that not belong to Korea or China. And for each metric, data were from the similar source so as to avoid different standard of measurement. However, these principles couldn't be realized in the data of gastric cancer cost. One reason is because of the opacity of cost data. The official data of cost in this category was not open to the public or it was published in a not time-efficient way. In Korea, even though they have KNSS to carry out cancer survey regarding cancer cost annually, the data of cost was not fully accessible in the latest report. In China, the national survey on cancer was not an annual one but was carried out every five years and the result would delay to open to the public two or three years after the survey. The latest cancer survey in China was the 2018 one, but the data of that one was still not yet accessible. Therefore, even though the author detour from other ways and managed to collect data of gastric cancer cost from different sources, the standard of the statistics can be different. Possible debates can be aroused regarding the data of this metric.

Second, the scale of data investigation can also be a limitation in this paper. It is mainly due to the incomplete of the Chinese data. In most metrics used in this research, the data of Korea was national data while the Chinese data was sampled from limited cancer registries in some areas of the country. With a long development of cancer control in Korea, they have a comprehensive system on the national cancer survey by the professional institution KNSS. Just like their affordability to launched a national cancer screening program, Korea also have the ability to carry out integrated survey. However, national health insurance system still has a long way to go in China because of the magnitude and the government affordability. They had no specific institution to conduct specific survey on national cancer data like the KNSS. Even though China had a cancer data survey every five years, it is

also controversial that that survey was truly a universal calculation of data or not. Because of the above-mentioned problem, it is unavoidable that the scale of data might be different between Korea and China.

Therefore, based on the above analysis of limitation, if there is follow-up research on this topic, it is suggested to use cost data reveal by the same institution or from the same research to guarantee the consistent standard of calculation. Especially for the Chinese data, the author considered to collect data from other sources mainly because the latest cancer survey data was still not accessible. When the 2018 cancer survey data of China is published, it is also suggested to update the gastric cancer cost data based on that latest official statistics instead of detour to collect from other ways.

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Abstract in Korean

위암은 대부분의 사망에 책임이 있고. 그것은 동아시아에서 기대수명을 증가시키는 가장 중요한 장벽 중 하나이다. 암 검사는 증상이 나타나기 전에 병을 발견하는 데 도움이 되는 도구이며, 암을 예방하고 통제할 수 있다. 한국은 2005 년부터 국가 위암 검진 프로그램(NGCSP)을 시작했다. 보편적인 위암 검진은 실제적인 가치가 있는지 아닌지는 여전히 논란이 되고 있다. 본 논문은 한국과 중국의 비교 연구를 수행함으로써 위의 연구 문제를 탐구했다. 한국의 국민건강보험에서 보편적인 위암검진 서비스을 가지고 있는 반면 중국에서 위암 검진 서비스를 있는 범위가 매우 제한적이었다. 저자는 위암 검진의 보편적 보장이 비용 효율적이라고 주장했다. 시스템의 "비용 효과"는 시스템의 효용성과 총 위암 비용의 증가율이라는 두 가지 지표로 정량화되었다. 이 두 나라의 데이터를 비교함으로써, 이 연구는 한국 NGCSP 의 효용성이 높다는 것을 발견했다. "NGCSP 선별 비율"과 "총 위암 선별 비율" 사이의 차이는 10% 미만이었고 NGCSP 의 선별 비율은 국가 암 검사 프로그램의 다른 암 유형보다 높았다. 또 NGCSP 가 출범한 뒤 국내 전체 위암비 증가율은 10% 안팎에서 2%로 떨어진 반면 중국의 위암비 증가율은 7% 안팎까지 높아졌다. 위의 조사 결과에 의하면, 일반적으로, 위암 검진 서비스를 국민 건강 보험 시스템에 포함시키는 것이 비용 효과적이며, 위암 예방과 관리에 긍정적인 영향을 미친다는 결론에 도달할 수 있다.

주요어: 의료보험, 위암검진, 비용효율성, 중국, 한국

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