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The impact of the expanded long-term care
insurance out-of-pocket expenses reduction
policy on long-term care and medical utilization

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The impact of the expanded long-term care
insurance out-of-pocket expenses reduction
policy on long-term care and medical utilization

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ABSTRACT

The impact of the expanded long-term care insurance out-of-pocket expenses reduction policy on long-term care and medical utilization

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Background: The expansion of the long-term care insurance (LTCI) out-of-pocket expenses (OOPs) reduction policy was implemented in August 2018 to reduce the burden of long-term care (LTC) service utilization for low-income recipients of LTCI and to broaden their coverage. As a result, the standard for reduction of OOPs, which was reduced by 50% for those in the 25% or lower income decile of insurance premiums, was expanded to 60%, and a new 40% reduction was applied to the 26–50% group. This study aims to analyze the changes in the utilization and expenses of LTC and medical services due to the expansion of the LTCI OOPs reduction.

Methods: Data from the National Health Insurance Service-Elderly sample Cohort between 2014 to 2019 were used in this study. The participants of this study were LTCI

beneficiaries who had the same income decile in 2017 and 2019 and used long-term care services in both years. After the implementation of the policy, it was divided into two case groups according to the reduction rate of OOPs (an additional 10% group and 40% reduction group) with a control group that did not receive OOPs reduction. The control group was selected through 1:3 propensity score matching according to gender, age, LTC grade, Charlson comorbidity index, and disability of each case group. As a dependent variable, LTC and medical services utilization and expenses were analyzed together. The study model was the difference-in-differences method (DID), focusing on the interaction terms of the case groups and control groups before and after the implementation of the policy, and the generalized estimation equation model was used as a statistical analysis method.

Results: The expanding LTCI OOPs reduction policy was related to changes in the utilization and OOPs of LTC and medical services, and these changes differed depending on the amount of OOPs reduction. As a result of DID analysis, regarding LTC services, compared to each control group, the additional 10% group had a 15.7% decrease in OOPs ($p<.0001$), and the 40% reduction group had a 5.8% increase in LTC services utilization ($p=0.0084$), a 14.6% decrease in OOPs ($p<.0001$), and a 5.5% increase in total expenses ($p=0.0077$). Regarding medical utilization, only in the 40% reduction group, the total medical OOPs decreased by 20.5% ($p =0.0021$) and the total medical expenses decreased by 21.4% ($p =0.0028$). As a result of subgroup analysis, the additional 10% group decreased

the length of stay (LOS) by 18.9% ($p=0.0217$). On the other hand, in the 40% reduction group, the number of outpatient visits increased by 9.6% ($p=0.0044$), outpatient OOPs increased by 11.6% ($p=0.0163$), and outpatient total expenses increased by 10.9% ($p=0.0491$). In addition, LOS decreased by 35.3% ($p=0.0009$), inpatient OOPs decreased by 29.3% ($p=0.0025$), and total inpatient expenses decreased by 27.9% ($p=0.0043$). In addition, there was no change in the hospitalization LOS in acute hospitals, but in long-term care hospitals (LTCHs) the LOS decreased by 30.2% ($p=0.0182$) in the additional 10% group and by 45.8% ($p=0.0053$) in the 40% reduction group compared to each control group. Furthermore, there was no change in total LTC and medical expenses, while total LTC and medical OOPs decreased by 11.8% ($p<.0001$) in the additional 10% group and by 17.7% ($p<.0001$) in the 40% reduction group compared to each control group.

Conclusions: The expansion of the LTCI OOPs reduction policy reduced not only LTC services for low-income beneficiaries but also OOPs for medical services. Furthermore, the utilization of LTC services and outpatient services increased and the utilization of inpatient services decreased. However, since these effects may vary depending on the amount of OOPs reduction, it is important to consider all possible consequences of how this policy will change the utilization of LTC or medical services through various research. Under circumstances where the role of LTC services is expected to increase due to population aging, our study has made a meaningful contribution to Korea's expansion of the LTCI OOPs reduction policy by identifying the effects of the expansion by dividing it into LTC

and medical service utilization. In the future, we expect that various policy grounds for improving the economic accessibility of service utilization will be presented through active research to derive appropriate OOPs for the utilization of LTC services by low-income populations.

Key words: long-term care insurance, out-of-pocket expenses reduction, long-term care utilization, medical utilization.

I. Introduction

1. Background

The elderly population in all countries is increasing exponentially¹. As the world ages, interest in the health of elderly people has become an indispensable aspect of policymaking.

Of particular note is that South Korea is experiencing an unprecedentedly compressed aging population.² People aged 65 and over represented 16.6% of the population in 2021, and this is expected to reach 20.5% by 2025 and 37.4% by 2048, making it the oldest country among Organization for Economic Co-operation and Development (OECD) countries.³ Owing to its rapidly aging population, South Korea is already at parity with the United States (16.7%) and the United Kingdom (18.9%), and is expected to take just seven years to reach a “super-aged society” (where the proportion of the population aged 65 and over is more than 20%) much faster than Austria (53 years), the United Kingdom (50 years), the United States (15 years), and Japan (10 years).

In 2003, the World Health Organization (WHO) emphasized that “as the need for long-term care (LTC) is rapidly increasing in many parts of the world due to the aging of the global population, national values and health and social policies should consider LTC”.⁴ Accordingly, South Korea introduced long-term care insurance (LTCI) in July 2008 to prepare for rapid aging and to ease the social and economic burden of families through

institutionalization of care. In 2009, the “expansion of the out-of-pocket expenses (OOPs) reduction of LTCI” was introduced in 2009 to revitalize the use of LTC services for low-income families and to improve equity among LTCI recipients. The policy was further amended in August 2018 to expand targets and reduce rates to broaden the coverage of LTCI. Owing to the policy revision, the group with a health insurance premium amount of less than 25% (which had received a 50% OOPs reduction before August 2018) would receive an additional 10% OOPs reduction. In addition, the group with 26%–50% of the health insurance premium amount received no OOPs reduction previously but subsequently received a 40% OOPs reduction from August 2018.

Initially, the number of LTCI beneficiaries was 214,000 (3.1% of the population aged 65 and over); however, in 2020, this had increased to 9.3% of the elderly population (754,000), which is about three times more.^{5,6} Despite this quantitative increase in the number of beneficiaries of LTC services, the high level of OOPs for the low-income group reduces access to LTC services. Moreover, it has been pointed out that there are restrictions on the use of services for those on a low income compared to those with a high income.^{7,8} Furthermore, income level affects the use of LTC services for the elderly and the choice of LTC services (institutional care services and home- and community-based services [HCBS]).⁹ A study of HCBS beneficiaries reported problems with unmet health care needs due to OOPs.^{10,11}

In the case of South Korea’s LTCI, recipients have to pay a certain percentage themselves and there are non-coverage LTC parts such as institutional care and day and

night care services. Therefore, an individual's low level of income can be a significant burden on the use of LTC services. However, studies on the field of LTC have indicated an association between the utilization of LTC and medical services^{11,12} and the number of beneficiaries who will benefit from long-term care services out of the total population, quality of service management, system satisfaction, infrastructure,¹³⁻¹⁵ and burden of care and service effects of families.^{2,16}

Although OOPs actually borne by the beneficiary can have a significant impact on the use of LTC services,¹⁷ there are very few studies on the level of service use according to OOPs in addition to income level.⁷ In particular, after the implementation of the 2018 expansion of OOPs reduction of LTCI, research on LTCI beneficiaries was conducted only in terms of improving equity.⁷ Therefore, because the evaluation of policy effectiveness was limited, it is necessary to evaluate the policy effect through various criteria other than equity.

Accordingly, the aim of this study was to investigate the effectiveness of the policy by examining changes in LTC and medical utilization before and after the expansion of the LTCI OOPs reduction policy in August 2018. Furthermore, through the results of this study, I intend to present reference materials for improving future appropriate service use of LTCI beneficiaries for the elderly.

2. Study Objectives

The purpose of this study is to investigate the effect of the expansion of LTCI OOPs reduction on LTC and medical utilization for those eligible for LTCI OOPs reduction.

The study objectives are as follows:

- (1) To investigate the effect of the expansion of LTCI OOPs reduction policy on LTC service utilization among users of LTC services.
- (2) To investigate the effect of the expansion of LTCI OOPs reduction policy on medical service utilization among users of LTC services.
- (3) To investigate the effect to the expansion of LTCI OOP reduction policy on overall LTC and medical expenses among users of LTC services.

II. Literature Reviews

1. Policy background

1) Long-term care

There is an increasing demand for LTC benefits for the elderly who have restricted ability to maintain their daily lives. This is due to demographic and social changes such as aging, increasing life expectancy, increasing women's economic activities, and decreasing family care. Global demand for LTC is expected to grow by up to 400% over the next few decades due to increased longevity and advances in medical technology and treatment.¹⁸

LTC is characterized by services that focus on care rather than cure. LTC is one of the phases of care that provides long-term services necessary to maintain daily life for people with chronic and complex diseases. Diseases are largely divided into acute and chronic, and care is provided according to the stage and speed of progression of the disease and the patient's health status.^{19,20} Care is divided into acute care, sub-acute or post-acute care, and LTC, and is provided on a continuum.²⁰ The acute care stage refers to the treatment of acute diseases where high-level medical treatment is provided intensively for a short period of time. In the sub-acute or post-acute care stage, the prognosis of acute treatment is observed, recurrence is prevented, and appropriate medical treatment is provided within a limited period. Lastly, the LTC stage involves coping with chronic and complex diseases, with medical and social services being provided for a long period with a focus on recuperation

rather than treatment. These characteristics are also reflected in the concept of LTC defined by the WHO, with the scope of LTC subjects and services being presented fairly comprehensively. The WHO defines LTC services as targeting “people who cannot take care of themselves” with “activities performed according to their preferences based on independence, autonomy, participation and human dignity.”²¹ At this time, the service encompasses not only “care provided by professionals such as medical and social welfare” but also “informal care provided by family, friends, and neighbors”. The OECD, which publishes health indicators and statistics on expenditure every year, defines “people with long-term dependence” as the target of LTC. It also defines “medical and social services that relieve pain and slow down the deterioration of health conditions” as LTC services.²² Furthermore, the OECD, like the WHO, have stated that LTC services include not only professional care provided by doctors or nurses in hospitals, but also informal care provided by family members at home. As such, LTC is at the heart of the welfare mix between the state, the market, and the family due to its unique characteristics.²³

2) Korea's long-term care insurance

(1) The History of LTCI in Korea

With the expected increase in life expectancy and the decrease in fertility rates, an aging population has rapidly progressed and social changes such as family structure, changes in values for supporting the elderly, and increased women's participation in economic activities have occurred. Accordingly, there is a growing movement to recognize responsibility for caring for the elderly as a social rather than an individual responsibility. Consequently, the need for public LTCI for the elderly has emerged.²⁴

In the case of South Korea, social interest in LTCI for the elderly began to emerge around 2000, when South Korea emerged as an aging society. Accordingly, the presidential congratulatory speech on August 15, 2001, proposed the introduction of LTCI for the elderly and included it as a presidential pledge in 2002, manifesting the government's interest. In 2003, the Roh Moo-Hyunn government formed a public LTCI security promotion planning team to develop a policy implementation model for the system operation method, financing and distribution plan, management operation system, benefit range, and care fee system.^{2,25} Since then, LTCI for the elderly has been implemented as a pilot project three times from July 2005 to June 2008, and in accordance with the LTCI Act for the Elderly, enacted in April 2007, it was introduced in earnest in July 2008.

In conclusion, LTCI for the elderly provides LTC services (such as support for physical activities or housework activities) for those who are unable to conduct their daily lives unaided, as suggested in Article 1 of the LTCI Act for the elderly. Consequently, it

is a social insurance system implemented for the purpose of improving the quality of life of elderly people by promoting health and stability in old age and further reducing the burden on their families.^{2,7}

(2) Eligibility and Assessment

Those aged ≥ 65 years who need care and support and persons < 65 years who have geriatric diseases are eligible for benefits through an assessment process certifying the presence of a physical or cognitive dysfunction, changes in behavior, and a need for rehabilitation.

In the LTCI recognition survey, a certified investigator belonging to the National Health Insurance Service (NHIS) visits the applicant's house in person to make an assessment using the National Nursing Needs Assessment Tool, a 52-item screening tool comprising five domains: physical function, cognitive problems, behavioral problems, demand for nursing, and demand for rehabilitation. The LTCI recognition score is thus calculated according to the applicant's level of ability in daily life according to each of the five domains. Thereafter, the rating committee reviews whether the applicant needs medical care, and where it is judged that medical care is necessary, the grade is determined according to the LTCI accreditation score.

The LTC grade was initially composed of three grades, from grade 3, the mildest, to grade 1 (95 points or more), which was judged to be the most difficult to perform in daily life. However, in the second half of 2014, LTCI recipients with grade 3 were deemed

to be too numerous and were sub-divided into grades 3 and 4. In addition, grade 5 was newly established to cover mild dementia, which has a high burden on the family. Furthermore, in 2018, as part of the national implementation of responsibility for dementia, the cognitive support grade was included as an LTCI recognition grade to strengthen social protection responsibility for dementia. The cognitive support grade is applicable to all cases of dementia regardless of the LTCI recognition score (Table 1).

(3) Benefit

In principle, LTCI allowances are in-kind benefits, and cash allowances are only allowed for family care expenses (150,000 won per month) in very exceptional cases. This prevents misuse of cash allowances and controls the allocation of resources directly for policy goals. Therefore, LTCI benefit in South Korea provides two types of benefit: HCBS and institutional care services (Table 2). First, HCBS include home-visit care, home-visit nursing, home-visit bathing, day and night care, short-term respite care, and welfare equipment such as wheelchairs and orthopedic mattresses. Second, institutional care services include services provided to beneficiaries who reside in a long-term care facilities (LTCFs), licensed nursing homes, retirement homes and licensed residential care facilities. Beneficiaries are free to choose their services and how long they will receive them for, negotiating contracts directly with providers without the intervention of an assistant such as a care manager. In South Korea, no one helps the recipient with their LTC service plan.

(4) Financing

South Korea's LTCI program is financed by subscribers' monthly premiums, government taxes, and OOPs of actual users of LTC under LTCI. Most LTCI financing comes from mandatory premiums for all adults registered with the NHIS. Actual users who receive HCBS care and institutional care services pay 15% and 20% of the total cost, respectively.²⁶⁻³⁰

(5) Expansion of the OOPs reduction on Long-term Care Insurance

The OOPs reduction of LTCI is a policy that reduces the OOPs for LTC services for those whose income and assets are below a certain amount (i.e. low-income population) based on Act 40 of the LTC Act for the Elderly. This policy reduces the burden of LTC services and promotes the use of LTC services for low-income groups. The LTCI OOPs reduction policy for the elderly was first implemented in 2009, and in 2015 was adjusted to the standard for reduction of health insurance premiums equivalent to 120% of the minimum cost of living according to the rules of the Ministry of Welfare. However, according to the revision of the Basic Act in 2016, the minimum cost of living was changed and implemented to the standard median income. Accordingly, the standard for reducing LTC OOPs was also revised to follow the criteria for determining the amount of health insurance premiums equivalent to 50% of the median income. Since 2018, the scope of OOPs reduction targets and reduction rates was expanded to improve the equity of users of LTC services.

Before August 2018, the group with a health insurance premium income rank of less than 25% for LTC services was receiving a 50% reduction in OOPs; however, after the expansion, OOPs were further reduced by 10% (before 50% > after 60%). In addition, the target group was expanded to provide a 40% reduction in OOPs for 26%–50% of premium income, which was not previously subject to reduction (before 0% > after 40%). The ratio of OOPs for each type of pay is shown in Table 3. In the case of HCBS, general recipients pay 15% of the total amount of LTC services as their OOPs, 40% reduction recipients pay 9%, and 60% reduction recipients pay 6%. Furthermore, in the case of institutional care services, general recipients pay 20% of the total amount LTC services as their OOPs, 40% reduction recipients pay 12%, and 60% reduction recipients pay 8% (Table 4).

Table 1. Changes in the standard for long-term care insurance

Period	Introduction of LTCI	1st expanded coverage	2nd expanded coverage	3rd expanded coverage	4th expanded coverage
	'08. 7. 1 ~'12. 6. 30.	'12. 7. 1 ~'13. 6. 30.	'13. 7. 1 ~'14. 6. 30.	'14. 7. 1 ~'17. 12. 31.	'18. 1. 1 ~ present
Grade 1 (very severe)	95 score				
Grade 2 (severe)	75~94 score				
Grade 3 (moderate)	55~74 score	53~74 score	51~74 score	60~74 score	60~74 score
Grade 4 (moderate)	-	-	-	51~59 score	51~59 score
Grade 5 (mild dementia)	-	-	-	45~50 score & dementia	
Grade for Cognitive support	-	-	-	-	Under 45 score & dementia

LTCI, Long-term care insurance.

Table 2. Types of long-term care benefits

Type	Content
1. Home- and community-based services(HCBS)	
1) Home-visit care	Long-term care benefit of in the support of physical activities or housework by visiting recipients' home
2) Home-visit nursing	Long-term care benefit in nursing, or providing administration of medication, injections skin care, pain management, laboratory examinations, or dental hygiene services by visiting recipients' home based on referral slips of physicians, doctors or oriental medicine doctors, or dentists
3) Home-visit bathing	Long-term care benefit in helping the bathing of recipients by visiting recipients' home
4) Day and night care	Long-term care benefit in providing recipients with long-term care for a number of hours during the day to support physical activity, and providing education and training to help maintain and improve recipients' mental and physical functions
5) Short-term respite care	Long-term care benefit in providing recipients with long-term care for a certain period within the scope of the law to support physical activity, and providing education and training to help maintain and improve recipients' mental and physical functions
6) Welfare equipment	Long-term care benefit in providing necessary equipment to support the daily life and physical activity, or supporting rehabilitation by visiting recipients' home
2. Institutional care services*	Long-term care benefit in providing recipients with training and education to help maintain and improve recipients physical and mental health for a long period in a welfare medical facility of long-term care providing institutes according to the act on long-term care insurance for elderly population
3. Cash allowance	Exceptional cases for elderly people who are unable to receive long-term care insurance benefits

* Institutional care services include LTC facilities (LTCFs), licensed nursing homes, retirement homes and licensed residential care facilities.

Table 3. Change of LTCI OOPs

Type		Before the implementation of the OOPs reduction policy	After the implementation of the OOPs reduction policy
Health insurance premium amount	0~25%	50%	60%
	26~50%	0%	40%
	51~100%	0%	0%

LTCI, Long-term care insurance; OOPs, Out-of-pocket expenses.

Table 4. OOPs ratio by type of LTC service

Type	General recipients	Subjects to OOPs reduction	
		Those eligible for a 40% reduction on OOPs	Those eligible for a 60% reduction on OOPs
HCBS	15%	9%	6%
Institutional care services	20%	12%	8%

OOPs, Out-of-pocket expenses; HCBS, Home- and community-based services.

2. Previous studies on the factors related to long-term care services utilization

1) Previous studies on the association between income level and LTC utilization

There are various factors that affect LTC services. According to previous studies, the most common variables present among characteristics that influence the use of LTC services are sociodemographic factors such as gender, age, presence/number of dependents, housing type, residential area, and education level.³¹⁻³⁴ Furthermore, from an economic point of view, income level, which indicates the ability to pay expenses, is used as the most decisive factor. This study examines the association between LTC service use by focusing on income level. This is because the target for reducing LTC service OOPs is determined by income level. According to international studies, the relationship between income level and LTC service use has mostly focused on service type, with inconsistent results.

With regard to income levels of the elderly, Dansky et al. (1998) found that Medicaid beneficiaries use institutional care services more than other elderly people.³⁵ Moreover, a study by Eustis N et al. (1984) found that income ability has a positive effect on the use of LTC care services, but in the case of protection of institutional care services supported by public finances, low-income group used it more.³⁶ In a study by Wallace et al. (1998), the lower the income of the elderly, the higher the use of official HCBS.³⁷ These results were consistent with those of Calsyn and Winter (2000).³⁸ The author interprets this being because the low-income group receives official HCBS not only through Medicaid

but also through various programs targeting those on low-incomes.^{38,37} However, conflicting results were also found. Two further studies reported that HCBS use increased as income increased.^{39,40} Conversely, Norgard et al. (1997) reported that the income of the elderly did not have a significant effect on HCBS.⁴¹ Furthermore, Bass & Noelker (1987) revealed that the income has a negative relationship with the choice of using official HCBS but has a positive relationship with the amount of use after making the choice.³¹ It is therefore confirmed that the relationship between income level and HCBS is inconsistent in international studies.

A study on the relationship between the type of LTC service use and income level reported that users of Medicaid programs targeting low-income group in the United States are more likely to use Institutional care services than HCBS.³² This result is interpreted as an argument that in the United States, Medicare covers short-term care after the acute phase. Finally, Tomassini et al. (2004) found that a higher level of education and financial resources promotes independent living of the elderly. Moreover, as their financial situation improves, there is a tendency to reduce institutional care services and increase the possibility of residential independence.⁴²

Most studies in South Korea on the relationship between income level and LTC services show that the higher the income, the higher the probability of using an LTCHs than an LTCFs. However, the association between income level and type of LTC service is not consistent, as in international studies. Kim (2017) found that the higher the income, the higher the probability of using instrumental care service HCBS, and the higher the

income, the higher the probability of being an LTCHs than an LTCFs. In a similar vein, Kim et al. (2008) reported that the lower the income level, the higher the intention to use home services.⁴³ By contrast, in a study of the general elderly, it was shown that the lower the monthly income,⁴⁴ the higher the intention to use institutional care services, and the higher the monthly income, the higher the intention to use HCBS.^{44,45} However, since these results were derived from a pilot project prior to the implementation of official LTC services, it is necessary to interpret them with caution.

After analyzing service usage patterns among LTC pilot project data, Lee et al. (2009) reported that the service use rate was high for the medical aid beneficiaries, general income, and low-income groups.¹⁰ It is of note here that the elderly in the low-income group showed a lower rate of service use compared to the general elderly despite the lower OOPs rate (reduced by 50% at the time). For this reason, the author inferred that even if the OOPs burden is reduced, non-coverage costs (such as food cost when using LTC services) limit access to the service.

By examining the findings of studies from South Korea and other countries, the use of LTC services is found to have either a negative or positive relationship depending on income level. This is due to the subjects included in the study, the design of the study, and other policies of each country. Nevertheless, the important point is not to change LTC service use depending on income level, but to examine whether appropriate LTC services are being used through appropriate financial support from the state.

2) Previous studies on the association between utilization of LTC or medical services due to OOPs reduction

The OOPs system is based on moral hazard theory, a traditional insurance theory developed mainly in the United States.⁴⁶ The effect of OOPs (such as coinsurance and copayment) on medical use is a traditional topic in the health economy field of which the RAND health insurance experiment is representative. Many such studies have been published since then.⁴⁷ According to previous studies, OOPs affect various medical needs such as doctor visits,⁴⁸ drug use,⁴⁹ and emergency room visits.⁵⁰ Studies also show that adequate OOPs can effectively control health care spending and contribute to health care financial health.⁵¹ However, there are also studies showing that adverse effects such as increased hospital admissions may occur due to deterioration of health resulting from diminishing patient access to medical care.⁵² For example, in two separate two studies, Tung (2006) and Chen et al. (2009) reviewed whether OOPs policies changed the use of outpatient and inpatient services.^{53,54} It was found that increasing OOPs by 71% among the general population reduced the number of outpatients in hospitals by 13.1%, while for the elderly population, even a 3.55% increase in OOPs reduced doctor visits by 17%. In addition, Chandra A et al. (2010) reported that the management of chronic diseases among the elderly may be limited due to high OOPs levels, which may lead to negative consequences such as increased hospitalization.⁵² The results of these studies show how difficult it is to achieve the health care policy goal of inducing rational use of medical care through OOPs whilst at the same time not impairing access to essential medical services.

In South Korea, there are several studies on the use of healthcare according to changes in OOPs. However, most of these studies have investigated differences in medical use according to OOPs reduction policies targeting various groups. Lee (2009) analyzed the effect of the OOPs reduction policy for cancer treatment on medical use, and found a positive correlation between the increase in total medical expenses, hospitalization expenses, and length of stay (LOS).⁵⁵ Furthermore, Ahn (2013) reported that the implementation of the outpatient OOPs reduction policy for children under the age of six contributed to increased numbers of outpatients.⁵⁶ Kim et al. (2021) investigated changes in the average number of hospitalizations, LOS, and average OOPs before and after the policy for reducing inpatient medical expenses for those under 15 years of age. It was found that the average number of hospitalizations, LOS, and average OOPs for this group decreased.^{57 57 57 57 57} However, the author mentioned the results of several previous studies, stating that the reduction OOPs reduced LOS, unlike the expected increase in medical use. Accordingly, the author pointed to the behavior of medical providers as an influencing factor. It was stated that there is a possibility that medical use may not have increased due to the behavior of medical providers increasing hospital profits by increasing bed turnovers within the limit that does not significantly affect the quality of treatment.⁵⁷ Kim et al. (2010) comprehensively evaluated the policy of increasing and decreasing OOPs for those under 65 years of age or older.¹⁷ As a result, the number of outpatient visits decreased when OOPs increased, and the number of outpatient visits increased when OOPs decreased.¹⁷ These results were consistent with the research of Na (2020), who evaluated the policy of

changing outpatient OOPs for the elderly in 2018 for those aged 65 and over. As with previous studies, it was concluded that medical use increased when OOPs decreased.⁵⁸

A number of studies have examined the relationship between OOPs reduction and medical service use under various systems, but few studies examine the relationship between reduced OOPs and LTC service use. In particular, there are few studies examining the effect of using LTC services according to the “expansion of OOPs reduction of LTCI” conducted in 2018. Chae et al. (2022) investigated the effect of the expansion of OOPs reduction of LTCI in 2018 in terms of equity using the Horizontal Inequity (HIwv) Index.⁷ Consequently, the total number of services and total OOPs improved equity for both low- and high-income groups alike. Nevertheless, the LTCI OOPs reduction policy has been studied only from an equity perspective to evaluate the effectiveness of a policy, it is important to apply various criteria other than equity.

3) Previous studies on the relationship between long-term care and medical utilization

The elderly are intensive users of healthcare—particularly hospital care—but are also intensive users of LTC. The relationship between these services can be described as reciprocal, suggesting that LTC utilization will affect medical utilization needs, and vice versa.^{59,60} LTC can be discharged from hospitals in a timely manner, and hospitalization rates can be reduced through better management of health conditions. Above all, it is important to understand the relationship between LTC utilization and medical utilization in that the health outcomes for the elderly vary depending on appropriate medical and care use and can reduce waste of resources, including medical expenses.⁶¹ Some studies describe LTC as a substitute for or complement to medical care.

Spiers et al. (2018) reported that adequate availability of social care has the potential to reduce demand for secondary healthcare services.⁶² Furthermore, a systematic literature review was conducted by Spiers et al. (2018) on the relationship between social care and medical use for those over the age of 60 in high-income countries. It was reported that higher social care expenditure and availability of nursing and home services resulted in fewer readmissions, delays in discharge, and LOS and reduced expenditure on secondary health care services.⁶² Forder et al. (2019) reported that the use of LTC services can replace medical utilization.⁶³ The study revealed that HCBS has the effect of replacing General practitioners (GP) visits for senior citizens aged 75 or older, and using HCBS reduces GP visits by approximately five per year. This substitution effect was also found to decrease the cost of doctor visits by £0.03 for each additional £1 for LTC. Therefore, the author

argued that additional medical costs could be further reduced considering that GP visits lead to the results of requests and prescription costs from secondary medical institutions.⁶³ A study by Gonçalves and Weaver (2017) on the effect of formal home care on hospitalization and doctor visits in Switzerland found the availability of hospitalization and doctor visits significantly increased, and the LOS was reduced by as much as 30 days.⁶⁴ However, it did not affect the number of doctor visits. In this study, the authors argued that home care increased the availability of hospitalization and doctor visits by observing patients' health status and recommending either hospitalization or doctor visits. Furthermore, it was argued that for the reduction in the LOS in the acute stage, home care has the potential to replace inpatient treatment or to reduce the acute stage treatment period by monitoring the health status at an early stage.⁶⁴ According to a study by Costa-Font et al. (2018), the use of LTC services increases the number of hospital visits and primary health care costs for outpatient services, a potential positive correlation between LTC services and outpatient services was found.⁶⁵ These results suggest that the introduction of LTC services improves access to treatment for patients with reduced mobility and increases the use of medical care as patients who are not yet aware of their disease state become conscious of their medical care.^{65,66} Feng et al. (2020) investigated the impact of public LTCI adoption on hospital admissions and expenditure of the elderly in Shanghai, China.⁶⁷ The results showed that LOS at the tertiary hospital decreased by 41.0%, OOPs decreased by 17.7%, and the total cost expenditure fell by 11.4%. These results show that LTC

services replace hospitalization. In addition, the author argued that for every additional 1(元) yuan spent on LTC services, medical costs decreased by 8.6(元) yuan.⁶⁷

According to studies examining the relationship between LTC services and medical utilization in South Korea, results are reported inconsistently. Hyun et al. (2014) studied the effect of LTC service use on LOS, focusing on grade 1, 2, and 3 LTCI beneficiaries in South Korea. As a result, it was found that LTC service users had 1.27 days more LOS than non-users. However, when analyzed according to stratification by grade, compared to non-users, LOS decreased by 8.35 days for first-grade users and 2.84 days for second-grade users.⁶⁸ However, LOS did not decrease for third-grade users. For this reason, the authors interpret that for grade 1 and 2 beneficiaries, institutional services can be selected within LTC, but for grade 3 beneficiaries, the LOS reduction was not affected because institutional services were not available in the Korean LTCI system.⁶⁸ In the study by Choi et al. (2018), medical use and medical expense burden were studied for those who used LTC services for the elderly and those who did not.⁶⁹ The results showed that the number of hospitalizations and the LOS in the group using the service decreased compared to the group that did not use the LTC service. Moreover, the burden of medical expenses was also significantly reduced.⁶⁹ Cho et al. (2020) reported a decrease in the hospitalization rate, LOS, and inpatient expenses of medical service users was reported as a result of evaluating the impact of introducing LTCI on medical use.⁷⁰ Furthermore, according to the results of this study, there was no effect on the availability of outpatient use and the number of outpatient visits, with the effect reported on the average reduction in expenditure per

outpatient visit. In addition, it was found that the introduction of LTCI reduced hospitalization with longer stays (more than 181 days) being a noted problem in South Korea.⁷⁰ Lee et al. (2015) analyzed the effect of introducing LTCI on medical expenses for the elderly.¹² It was found that LTC users had lower total medical and hospitalization costs than non-users. However, it was also reported that outpatient and drug costs were higher among users compared with non-users. Nevertheless, the authors concluded that the use of LTC had a positive effect because it reduced total medical costs.¹² In the same vein, Han (2010) investigated changes in medical expenses for the elderly before and after the introduction of LTCI and found that the total cost of treatment including inpatient treatment (nursing home, general hospital) decreased, but the cost of drug and outpatient treatment increased. Lee (2022) examined groups using institutional services or using HCBS and studied the relationship between them and medical use.⁷¹ As a result of the study, both groups experienced an increase in acute hospital use experience and outpatient service use experience, while the use of LTCHs experience decreased. Furthermore, in this study, despite the increase in acute hospital use experience and outpatient service experience, there was a decrease in total medical expenses, LOS for acute care and costs, and number of outpatient visits and costs. The author argued that these results could be interpreted as a more use of acute hospitals experience to fulfil medical services such as disease treatment, even when LTC services are used and there is improved accessibility when using outpatient services.⁷¹ In addition, the decrease in medical expenses, hospitalization days, and number of visits were interpreted as the effect of using hospital services before the health condition

deteriorated due to use of LTC services, or the effects of care in LTCFs after treatment. It is important to examine the relationship between medical care and LTC because improper resource allocation or transfer can lead to inefficiencies in social security systems, including health insurance and LTCI.⁷² Considering substitution or the complementarity effect between these services, the well-defined roles and functions of these two sectors will be essential for achieving a sustainable health care system.

3. Theoretical model

Although the intensity and type of care needs of older adults will be assessed by health care providers, there are many other determinants that influence the choices that older adults and their caregivers make.⁷³⁻⁷⁵ This study focuses on the increase in accessibility and economic feasibility of LTC following the introduction of the new policy and the effect of its use. Therefore, this study is relevant to the literature describing individuals' behaviors or determinants related to their decision-making preferences for the use of health-related services.

The Anderson healthcare utilization model, developed in the late 1960s, is most often used to describe healthcare utilization in many studies by describing the “how” and “why” of healthcare utilization.^{76,77} This model divides the factors that determine service use into three categories (Figure 1).

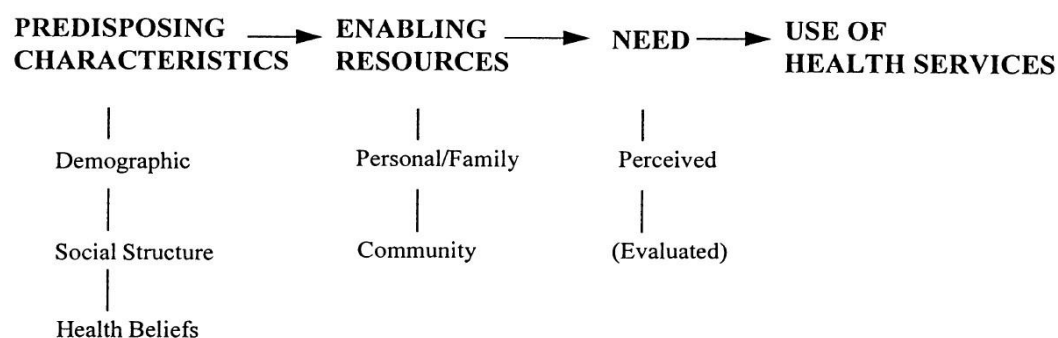


Figure 1. The initial Andersen behavioral model (1960s)

Predisposing characteristics are characteristics that an individual already possesses prior to a specific disease, and refer to individual characteristics that are more likely to make them use health services than others.¹⁰ Individual predisposing characteristics related to the use of medical services consist of demographic characteristics, social structural characteristics, and health beliefs. Demographic characteristics refer to individual biological characteristics that indicate the likelihood of requiring health services, such as age, gender, and marital status.⁷⁸ Social structures are representative factors such as education, occupation, and religion, and these indirectly indicate an individual's lifestyle and their physical and social environment related to the use of health services.⁷⁸ Health beliefs refer to factors such as attitudes, values, and knowledge of health and health services. Enabling factors are factors related to the means and capabilities of making health services available and are divided into personal/family and community levels. At personal/family levels, income, health insurance, presence or absence of a primary care physician, distance from medical institutions, and waiting time are contributory factors. Furthermore, community levels refer to the supply status of medical personnel and facilities, characteristics of the medical insurance delivery system, the price of services, and the characteristics of the region in which an individual lives.⁷⁸ Need factor is a variable related to the level of an individual's disability or disease and is the most direct cause of using health services. Need factor refers to a perceived need for general health and functional status recognized by an individual, and an evaluated need measured by expert diagnosis and judgment on the health status of the individual and the need for medical services.

The Andersen model is used in research related to the use of LTC services as well as healthcare utilization. However, this model is not suitable for application to LTCI recipients at the end of their life as it was developed for hospital patients. Nevertheless, because it provides a useful framework for either predicting the use of medical services for the elderly or their health status in old age, many studies have either referenced or applied this model in both international studies⁷⁹⁻⁸¹ and those in South Korea.^{10,71,82} In particular, Borrayo et al. (2002) applied the Andersen model to the use of nursing facilities (NFs) and HCBS under Medicaid in the United States. It was emphasized that it is important for prediction, demonstrating that the three characteristics of the Andersen model are practically related to the use of LTC services.³²

The model was recently newly developed by Anderson and Davidson (Figure 2). In this model, healthcare utilization is described as both contextual and individual determinants.⁸³ The model explains the healthcare utilization use situation and environment through contextual factors. The context indicates health organization, provider-related factors and community characteristics.⁸⁴ Contextual factors are measured at a holistic level, from family size to national health systems.⁸³ Contextual factors are divided into predisposing characteristics, enabling characteristics, and need characteristics together with individual determinants. Contextual predisposing characteristics refer to people's predisposition for using healthcare services. Enabling characteristics are factors that make it possible to receive healthcare services, and need characteristics are the needs or conditions that a people or provider recognizes as a need for healthcare services.

To explain the process of the expansion of the OOPs reduction policy using Anderson and Davidson's model, a change in the contextual enabling factors was required. This had an impact on OOPs for LTC services in terms of financing contextual enabling factors. As a result, this has affected individual enabling characteristics, i.e., service utilization. Therefore, changes in these factors will lead to changes in LTC services, including healthcare services.

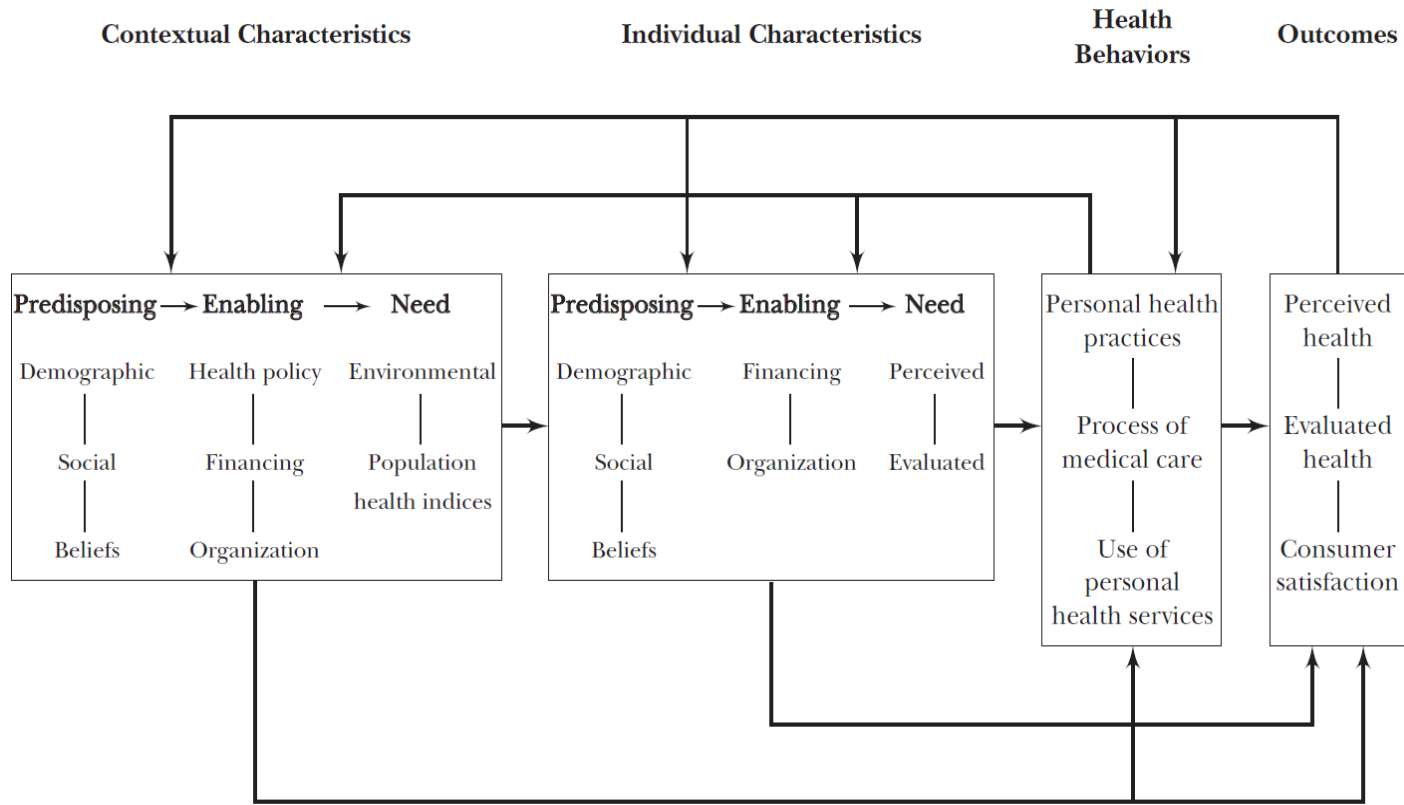


Figure 2. A behavioral model of health services use
 Source: Andersen and Davidson (2007)

III. Material and Methods

1. Framework of the Study Design

The study design was based on the Anderson and Davidson model (2007), through which the change in LTCI OOPs were examined to determine how these changes might affect LTC and medical services utilization for LTCI beneficiaries and users. The framework of this study is presented in Figure 3.

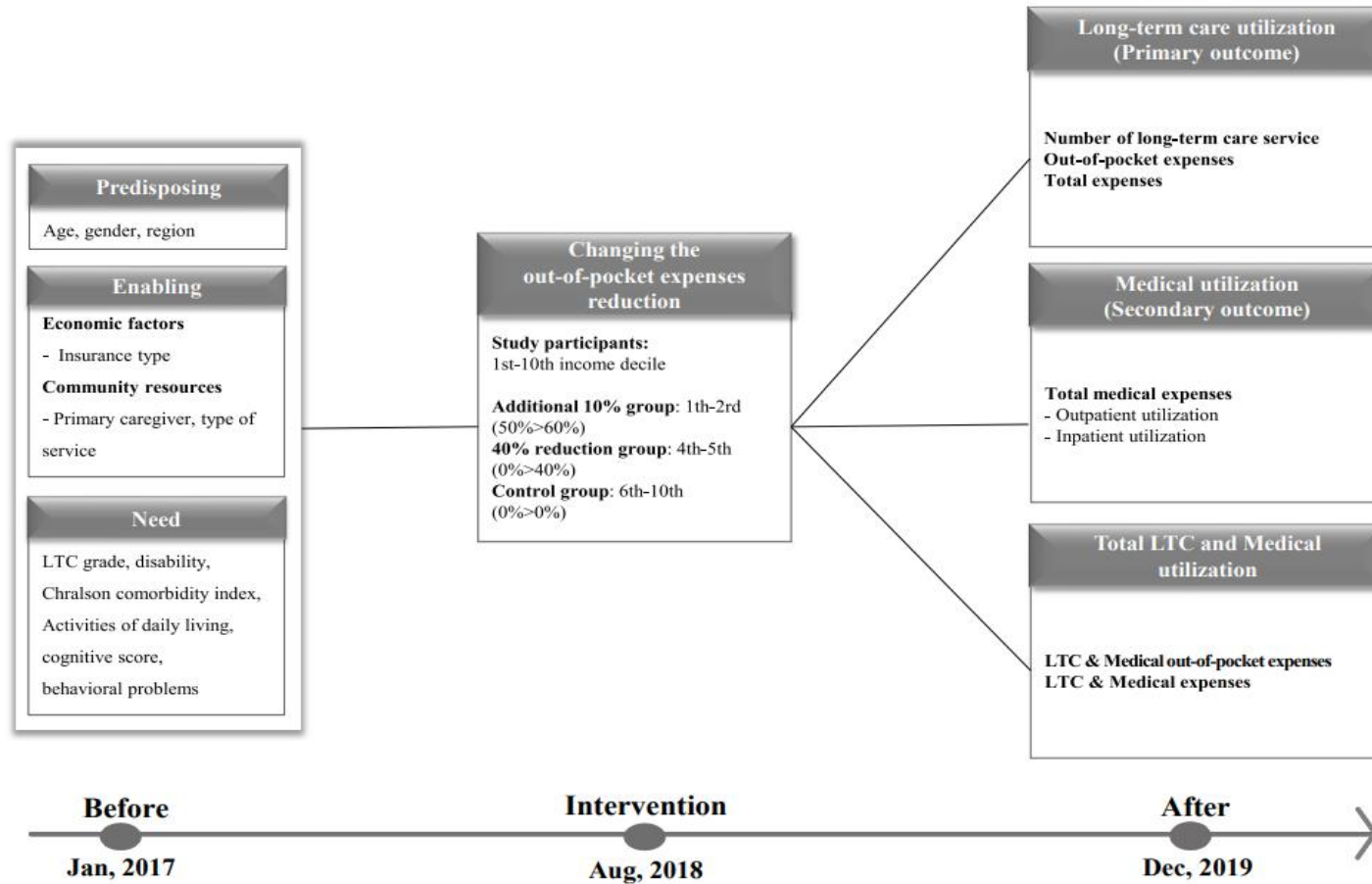


Figure 3. Conceptual framework of the study design

2. Data sources and study population

1) Data source

In this study, the National Health Insurance Service-Elderly Cohort (NHIS-EC) database from 2014–2019 was used. Specifically, the data period actually used for analysis in this study was one year before and after 2018, when the policy was changed, that is, data from 2017 and 2019. This enabled examination of the impact of the change in the expansion of the LTCI OOPs reduction policy implemented in 2018.

The NHIS-EC was established to support research that examines various aspects of changes in the socio-economic and health status of the elderly by analyzing risk factors. Moreover, this database has been de-identified so that individuals cannot be identified. As for the sample composition, at the end of December 2002, 558,147 people were selected through simple random extraction whereby 10% of the 5.5 million elderly people aged 60 or older who maintain health insurance and medical benefits qualifications are selected. The total database is configured into five sub-division databases, as follows: 1) the qualification database, comprising health insurance eligibility information of health insurance subscribers and medical aid beneficiaries; 2) the medical treatment database, comprising medical use and medical expenses on the statement of cost of medical care; 3) the health checkup database that comprises the main results of health checkups and questionnaire response data; 4) the health care institution information database; 5) the LTCI database with information related to application for and use of LTC services for the elderly.

The database contains information about reimbursement for each medical service and includes basic patient demographics. Details include diagnostic codes according to the International Classification of Diseases 10th Revision (ICD-10), medication prescriptions, procedures/surgical operations, and other treatments described. A feature of the geriatric cohort is that if a person loses health insurance eligibility due to death or other reasons within the follow-up period (after establishment to 2019), they are excluded from the cohort data and are not added or replaced by another person.⁸⁵

2) Study population

Participants were selected and organized into two different case groups and each control group (four groups in total) according to the expansion of OOPs reduction of LTCI.

First, because the expansion of the LTCI OOPs reduction policy (implemented in August 2018) is determined by income decile, the subjects included in this study were selected with the same income decile in 2017 and 2019 (the study period). Furthermore, in 2017 and 2019, LTCI beneficiaries and LTC users were selected. NHIS-EC data are expressed by defining income as a decile, and the beneficiaries of the policy fall into the 0%–25% and 26%–50% health insurance premium brackets. Accordingly, I excluded those in the third decile of income (approximately 21%–30% health insurance premium) to select those who benefit from the policy more accurately. There were no missing values in the other variables. The case group includes an additional 10% group and a 40% reduction group, with the 6th income quintile or higher as a control group. Furthermore, the control group was selected with the same gender, age, LTC grade, Charlson comorbidity index (CCI), and disability, matching those of the additional 10% group and 40% reduction group.

The detailed exclusion criteria were as follows: 1) Medical aid beneficiaries were excluded because they did not pay their OOPs when using LTC services; 2) As previously mentioned, those in the third income decile were excluded; 3) Because this is a study conducted with users of LTC services, those who have never used LTC services either before or after the expansion of the LTCI OOPs reduction policy was implemented were excluded.

Finally, after applying the exclusion criteria, the sample comprised 2,383 participants in the additional 10% group and 1,019 participants in the 40% reduction group. Further, for control groups included 7,149 (10% group) and 3,057 (40% group) participants, respectively (Figure 4).

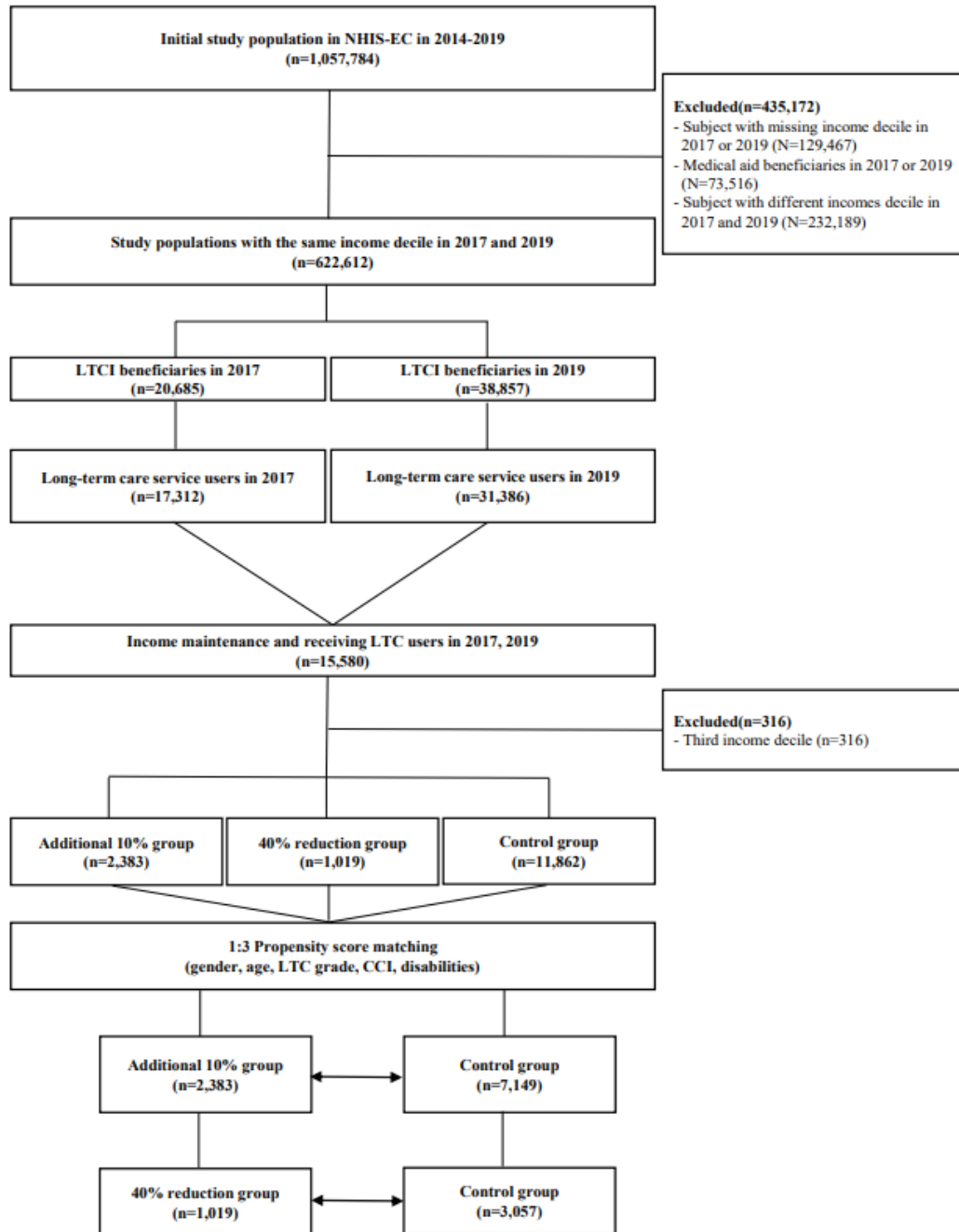


Figure 4. Flowchart of the Study Participants

3. Definition of variables

1) Dependent variable

This study explores the impact of the expansion of the LTCI OOPs reduction policy on LTC utilization, medical utilization, and total LTC and medical expenses. With regard to the wide range of outcome variables, three main outcomes of interest were selected: annual LTC utilization and expenses, annual medical expenses, and annual total LTC and medical expenses.

The primary dependent variable was annual total number of LTC services and expenses. The primary dependent variable was set by summing HCBS and institutional service use because the reduction in LTCI OOPs applies equally to all services. In addition, the annual LTC service expenses were set by dividing annual OOPs and total cost. The secondary dependent variable was annual total medical utilization. This was divided into annual total medical OOPs and total medical expenses. Furthermore, LOS, number of outpatient visits, each OOPs, and total expenses were analyzed as subgroups by dividing inpatient and outpatient services. Finally, this study analyzed annual total LTC and medical OOPs together with total LTC and medical expenses by summing LTC and medical utilization as a broad outcome variable for medical expenses.

Table 5. Definition of Dependent Variables

	Category	Definition	
LTC utilization	No. of LTC services	Sum of long-term care utilization(HCBS, Institutional services) in a year	
	OOPs	Sum of OOPs long-term care expenses (HCBS, Institutional services) in a year	
	Total expenses	Sum of total long-term care expenses (HCBS, Institutional services) in a year	
Medical utilization	Total medical OOPs	Medical OOPs for all inpatient and outpatient care in a year	
	Total medical expenses	Medical expenses for all inpatient and outpatient care in a year	
	Outpatient services	No. of outpatient visit	Sum of number of outpatient visits during each admission in a year
		Outpatient OOPs	Sum of OOPs expenses for outpatient care in a year
		Outpatient total expenses	Sum of expenses for outpatient in a year
	Inpatient services	LOS	Sum of length of stay during each admission in a year
		Inpatient OOPs	Sum of OOPs expenses for inpatient care in a year
		Inpatient total expenses	Sum of expenses for inpatient in a year
	Total LTC and Medical utilization	Total LTC & medical OOPs	Sum of LTC and medical OOPs in a year
Total LTC & medical expenses		Sum of LTC and medical expenses in a year	

LTC, Long-term care; OOPs: Out-of-pocket expenses; HCBS, Home- and community-based services; LOS: Length of stay.

2) The variable of Interest

To evaluate the effect of the expansion of the LTCI OOPs reduction policy, this study included an interaction term between the case variables and policy variables as the variable of interest. The groups defined as cases are the additional 10% group (1st and 2nd income decile) and the 40% reduction group (4th and 5th income decile). For the additional 10% group, there was a 50% OOPs reduction before the LTCI OOPs reduction policy was expanded; however, this was changed to a 60% OOPs reduction as a result of the policy. In the case of the 40% reduction group, OOPs were reduced by 40% as a result of the policy. The control group (6th or higher income decile) had the LTC services OOPs maintained regardless of the policy.

Because expansion of the LTCI OOPs reduction policy was implemented on August 1, 2018, I set the study period before policy intervention from January 1 to December 31, 2017, and the period after policy intervention was set from January 1 to December 31, 2019 (Figure 5).

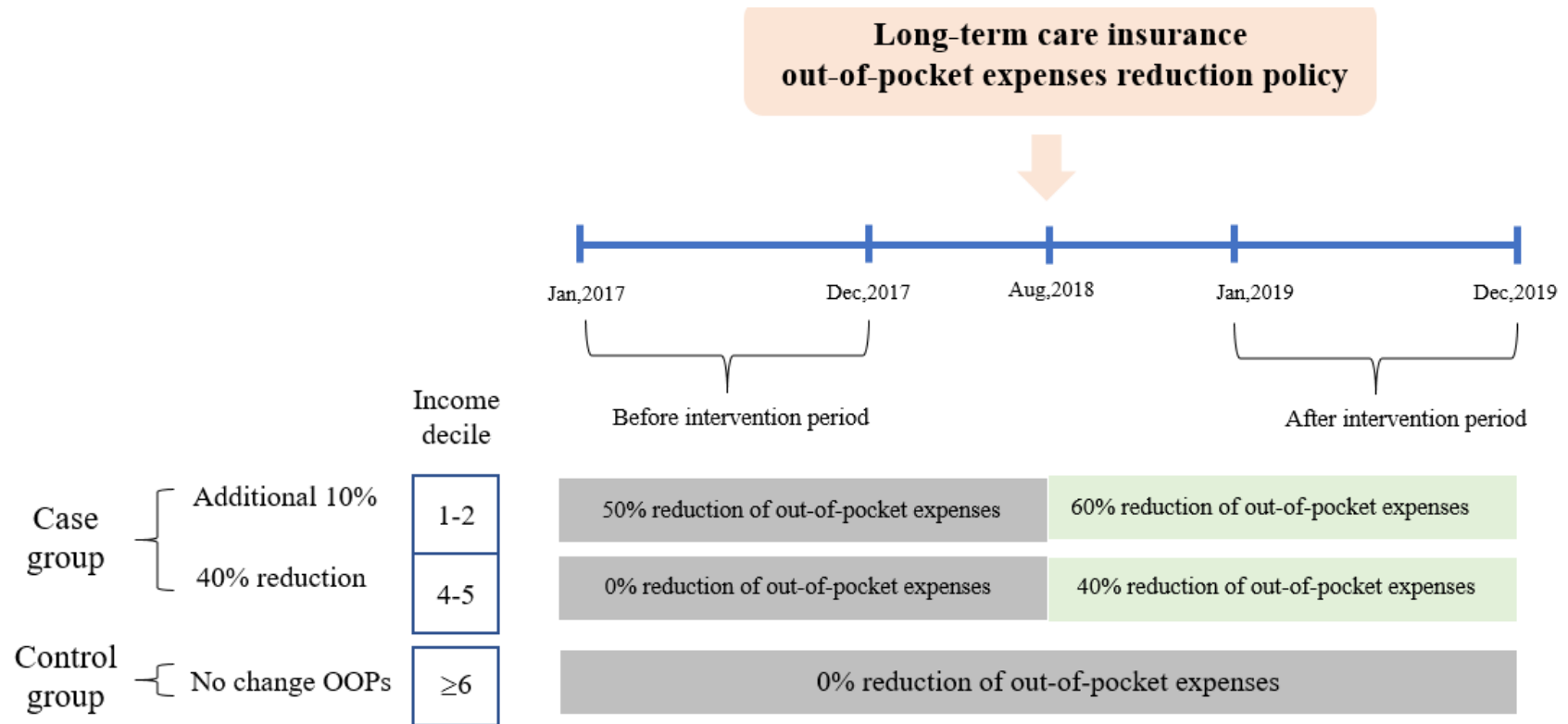


Figure 5. Changes of OOPs rate for LTC service by income decile among LTCI beneficiaries population

3) Covariates

The covariates variables of this study were gender, age, insurance type, region, primary caregiver, LTC grade, type of service, CCI, disability, activities of daily living (ADL), cognitive score, and behavioral problem score. The CCI was measured as a diagnostic code using the International Statistical Classification of Disease and Related Health Problems-10 coding algorithm of the CCI score for the two years that the year treatment occurred (Table 6).^{86,87}

Table 6. Definition of Covariates

Variable	Definition
Gender	male, female
Age	≤74, 75-79, 80-84, ≥85
Insurance type	self-employed insured, employee insured
Region	metropolitan, city, rural
Primary caregiver	child / married partner, paid caregiver, other ^a , none
LTC grade	1-2, 3-4, 5
Type of service	institutional care, HCBS, both
CCI	0, 1, ≥2
Disability	yes, no
ADL*	13 items, total 0-39 points
Cognitive score*	7 items, total 0~14 points
Behavioral problems*	14 items, total 0~28 points

^aOther includes grandchild, relative, neighborhood and parent.

*ADL, Cognitive score, Behavioral problems are continuous variable.

LTC, Long-term care; CCI, Charlson comorbidity index; ADL, Activities of daily living; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

4. Statistical Methods

This study is a quasi-experimental design, which is an experimental method that does not go through the process of randomization, meaning that selection bias cannot be avoided in the selection of study subjects.⁸⁸ To overcome this limitation, propensity score matching (PSM) was therefore applied. While various methods can be used to match individuals, in this study a 1:3 nearest-neighbor method was used that matches case and control individuals who have a similar propensity score value.⁸⁹ Further, a constraint was added that the difference between propensity scores (caliper width) must be 0.1 at most, to avoid pairing dissimilar individuals. Specifically, for the baseline period (2017), for each case group (additional 10% group and 40% reduction group), a control group matched in gender, age, LTC grade, CCI, and disabilities was selected.

Then, descriptive analysis was first performed to evaluate the difference in proportion or mean between the case group (additional 10% group, 40% reduction group) and the control group for each factor. Furthermore, the difference between the general characteristics of the case group and the control group and the dependent variable during 2017 (before the expansion of the LTCI OOPs reduction policy) and 2019 (after the expansion of the LTCI OOPs reduction policy) was analyzed using a T-test.

To investigate the effect of the expansion of the OOPs reduction policy for LTC service users, the difference-in-differences method (DID) of analysis was used to examine any changes in LTC and healthcare utilization among the case groups for the before-

intervention (2017) and after-intervention (2019) periods, relative to changes in the control group.

The DID method is commonly used to evaluate policy effectiveness in the health care sector and has been widely used in similar previous studies.^{90,91} Therefore, the effect of the OOPs reduction policy was evaluated by comparing the difference before and after policy change between the case group and the control group using DID method.

The generalized estimating equation (GEE) was used for the DID analysis and to evaluate the effectiveness of the OOPs reduction using the following equation:^{92,93}

$$g(E[Y_{it}]) = \beta_0 + \beta_1(\text{Intervention}_t) + \beta_2(\text{Case}_{it}) + \beta_3(\text{Case}_{it} \times \text{Intervention}_t) + \gamma' X_{it}$$

g: link function

E: Expectation

Y: dependent variables

i: individual ($i=1,2,\dots, n$)

t: time period (year)

Case: dummy variable which assigns 1 if the case group

(additional 10% group or 40% reduction group after intervention, additional 10% group or 40% reduction group = 1: case group, case= 0: control group)

Intervention: dummy variable which assigns 1 if time is after the changing out-of-pocket expenses reduction intervention period.

(policy = 1: after intervention, policy = 0: before intervention)

X_{it} : Covariates (gender, age, region, insurance type, primary caregiver, LTC grade, Type of services, CCI, disability, ADL score, cognitive score, and behavioral problem)

The difference between the primary (LTC utilization), secondary dependent (Medical utilization), and total LTC and medical utilization variables before and after the intervention was compared using the DID model together with the above formula. Subgroup analysis was also performed for each of the primary and secondary dependent variables. In the subgroup analysis of the primary dependent variable, since HCBS and institutional service use may differ due to the OOPs reduction policy expansion, each was analyzed separately.^{38,37,39} Furthermore, the LTC grade is a measure that indirectly shows health status and need for LTC. Therefore, the differences in LTC service use were analyzed by dividing the LTC grade.¹⁰ Then, subgroup analysis was performed by dividing inpatients among secondary dependent variables into acute care hospitals and LTCHs, reflecting the previous study in that there may be differences between the use of acute care hospitals and LTCHs depending on the use of LTC services.⁶⁶

To investigate LTC expenses, medical expenses, and total LTC and medical expenses, GENMOD procedure with *log link*, *gamma distribution*, and *Autoregressive (1) Correlation Matrix Type* was used. In addition, to apply the log-link function in the statistical analysis, the value of 0 was adjusted by adding 1 to all observations. To investigate the number of LTC services, the number of outpatient visits, and LOS,

GENMOD procedure with *log link*, *negative binomial distribution*, and *Autoregressive (1) Correlation Matrix Type* were used.⁹²

All analysis was performed using SAS software (version 9.4; SAS Institute, Care, NC) and differences were considered statistically significant at a p-value of <0.05.

5. Ethics Statement

This study was reviewed and approved by the Institutional Review Board of Yonsei University's Health System in accordance with the principles of the Declaration of Helsinki (IRB no. 4-2022-0790). Furthermore, as the NHIS- EC data we used for analysis does not contain personally identifiable information, the informed consent requirement was exempted.

IV. Results

1. General Characteristics of the Study Population

1) Distribution by characteristics

A total of 15,264 people were included in this study, with 11,862 (77.7%) not receiving OOPs reductions and 3,402 (22.3%) receiving OOPs reductions (Appendix 1). Among the total sample, through 1:3 PSM matching, the main analyses included 2,383 participants within the additional 10% group, 1,019 participants within the 40% reduction group, and 7,149 and 3,057 participants were included in each control group, respectively. In addition, at the baseline there were more females than males, more LTC Grades 3–4 (most of whom used HBCS), and more without disabilities in all groups. Furthermore, the group with 0 CCI was the smallest (Table 7).

Table 7. General characteristics and distribution of study population

Variables	Matching separate(1:3)								p-value	p-value
	Control group		Additional 10%		Control group		40% reduction			
	N	%	N	%	N	%	N	%		
Total	7,149	100	2,383	100	3,057	100	1,019	100		
Gender										
Male	1,335	18.7	445	18.7	756	24.7	252	24.7	1.0000	1.0000
Female	5,814	81.3	1,938	81.3	2,301	75.3	767	75.3		
Age										
≤74	1,086	15.2	362	15.2	600	19.6	200	19.6	1.0000	1.0000
75-79	1,323	18.5	441	18.5	648	21.2	216	21.2		
80-84	2,480	34.7	827	34.7	1,026	33.6	342	33.6		
≥85	2,260	31.6	753	31.6	783	25.6	261	25.6		
Insurance type										
Self-employed insured	1,388	19.4	1,458	61.2	597	19.5	339	33.3	<.0001	<.0001
Employee insured	5,761	80.6	925	38.8	2,460	80.5	680	66.7		
Region										
Metropolitan	2,668	37.3	787	33.0	1,137	37.2	395	38.8	<.0001	0.0560
City	1,626	22.7	418	17.5	701	22.9	197	19.3		
Rural	2,855	39.9	1,178	49.4	1,219	39.9	427	41.9		
Primary caregiver										
Child	2,847	39.8	898	37.7	1,187	38.8	380	37.3	<.0001	0.1460
Married partner	1,769	24.7	407	17.1	858	28.1	259	25.4		
Paid caregiver	1,256	17.6	522	21.9	507	16.6	184	18.1		
Other ^a	921	12.9	388	16.3	360	11.8	137	13.4		
None	356	5.0	168	7.0	145	4.7	59	5.8		
LTC grade										
1-2	1,188	16.6	407	17.1	495	16.2	165	16.2	0.8706	1.0000
3-4	5,511	77.1	1,826	76.6	2,346	76.7	782	76.7		
5	450	6.3	150	6.3	216	7.1	72	7.1		
Type of service										
Institutional care	1,473	20.6	755	31.7	583	19.1	223	21.9	<.0001	0.1210
HCBS	5,313	74.3	1,500	62.9	2,334	76.3	746	73.2		
Both	363	5.1	128	5.4	140	4.6	50	4.9		
CCI										
0	473	6.6	158	6.6	171	5.6	60	5.9	0.9997	0.4181
1	3,343	46.8	1,114	46.7	1,340	43.8	468	45.9		
≥2	3,333	46.6	1,111	46.6	1,546	50.6	491	48.2		
Disability										
No	4,379	61.3	1,460	61.3	1,950	63.8	650	63.8	0.9903	1.0000
Yes	2,770	38.7	923	38.7	1,107	36.2	369	36.2		
ADL	19.3±5.7		19.3±5.7		19.2±5.7		19.2±5.7		0.9706	0.7460
Cognitive score	3.7±1.7		3.8±1.7		3.6±1.7		3.6±1.7		0.0002	0.3398
Behavioral problems	0.8±1.3		0.9±1.3		0.8±1.2		0.8±1.3		0.0091	0.8600

^aOther includes grandchild, relative, neighborhood and parent.

CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

2. Effect of LTCI OOPs reduction policy expansion on LTC utilization

1) Changes in long-term care utilization according to the expansion of the LTCI OOPs reduction policy

Table 8 showed the changes in the primary dependent variables before and after the intervention for the additional 10% and 40% reduction groups and each control group.

For the additional 10% group, the number of LTC services, OOPs, and total expenses increased before and after the intervention and the findings were statistically significant (number of long-term care services, $p < .0001$; OOPs, $p < .0001$; total expenses, $p < .0001$).

For the 40% reduction group, the number of long-term care services, OOPs and total expenses increased before and after the intervention and the findings were statistically significant (number of long-term care service, $p < .0001$; OOPs, $p < .0001$; total expenses, $p < .0001$).

Finally, in each control group for the additional 10% group and 40% reduction group, the number of LTC services, OOPs, and total expenses all increased before and after the intervention and were statistically significant.

The difference in primary dependent variables for each independent variable before and after intervention is presented in Appendices 2–7.

Table 8. Changes of primary dependent variables in the study population to evaluate the effect of LTCI OOPs reduction policy expansion

Variables	Case					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)	
No. of long-term care services										
Additional 10%	346.7	(203.6)	400.0	(222.1)	<.0001	349.7	(230.1)	399.8	(242.6)	<.0001
40% reduction	323.3	(203.1)	396.9	(225.5)	<.0001	345.9	(235.6)	401.4	(248.1)	<.0001
OOPs										
additional 10%	1,112,367	(745,663)	1,177,115	(712,155)	<.0001	1,657,753	(1,171,632)	2,107,186	(1,359,665)	<.0001
40% reduction	1,424,171	(1,064,478)	1,543,908	(1,030,154)	<.0001	1,593,117	(1,147,686)	2,024,072	(1,331,426)	0.0099
Total expenses										
additional 10%	11,894,765	(6,403,401)	16,109,520	(7,178,664)	<.0001	10,542,149	(6,201,924)	14,271,625	(7,510,595)	<.0001
40% reduction	10,515,344	(6,144,544)	15,092,585	(7,139,917)	<.0001	10,211,428	(6,139,481)	13,869,304	(7,460,127)	<.0001

Notes: Case groups included the additional 10% group and the 40% reduction group.
 SD, Standard deviation; OOPs, Out-of-pocket expenses.

2) Assumptions of study design for Primary dependent variables

Figures 6 and 7 show how the primary dependent variables changed by year for the two case groups (additional 10% group, 40% reduction group) and each control group. The results of the parallel trend test before intervention for difference analysis are presented in Appendix 8.

For the additional 10% group, the number of LTC services and total expenses before the intervention period showed a parallel trend to the control group, and there was no statistically significant difference (number of LTC services, $p=0.0798$; total expenses, $p=0.7485$). However, for OOPs, there was no parallel trend with the control group before the intervention and there was a statistically significant difference (OOPs, $p<.0001$).

For the 40% reduction group, the number of LTC services, OOPs, and total expenses all showed a parallel trend to the control group before the intervention period, and there was no statistically significant difference (number of LTC services, $p=0.4884$; OOPs, $p=0.9467$; total expenses, $p=0.7448$).

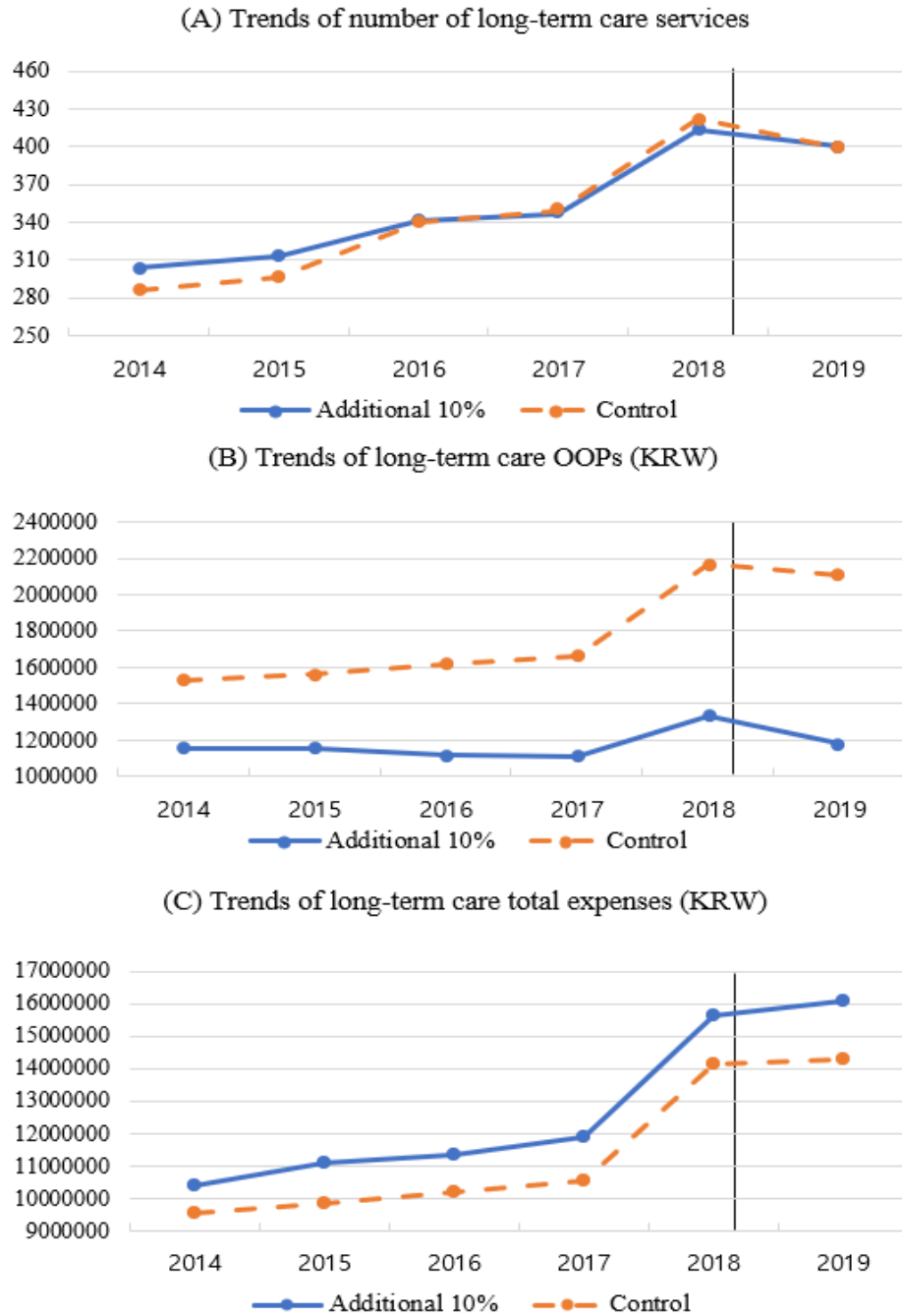


Figure 6. Trends of annual mean of primary dependent variables by additional 10% group and control group

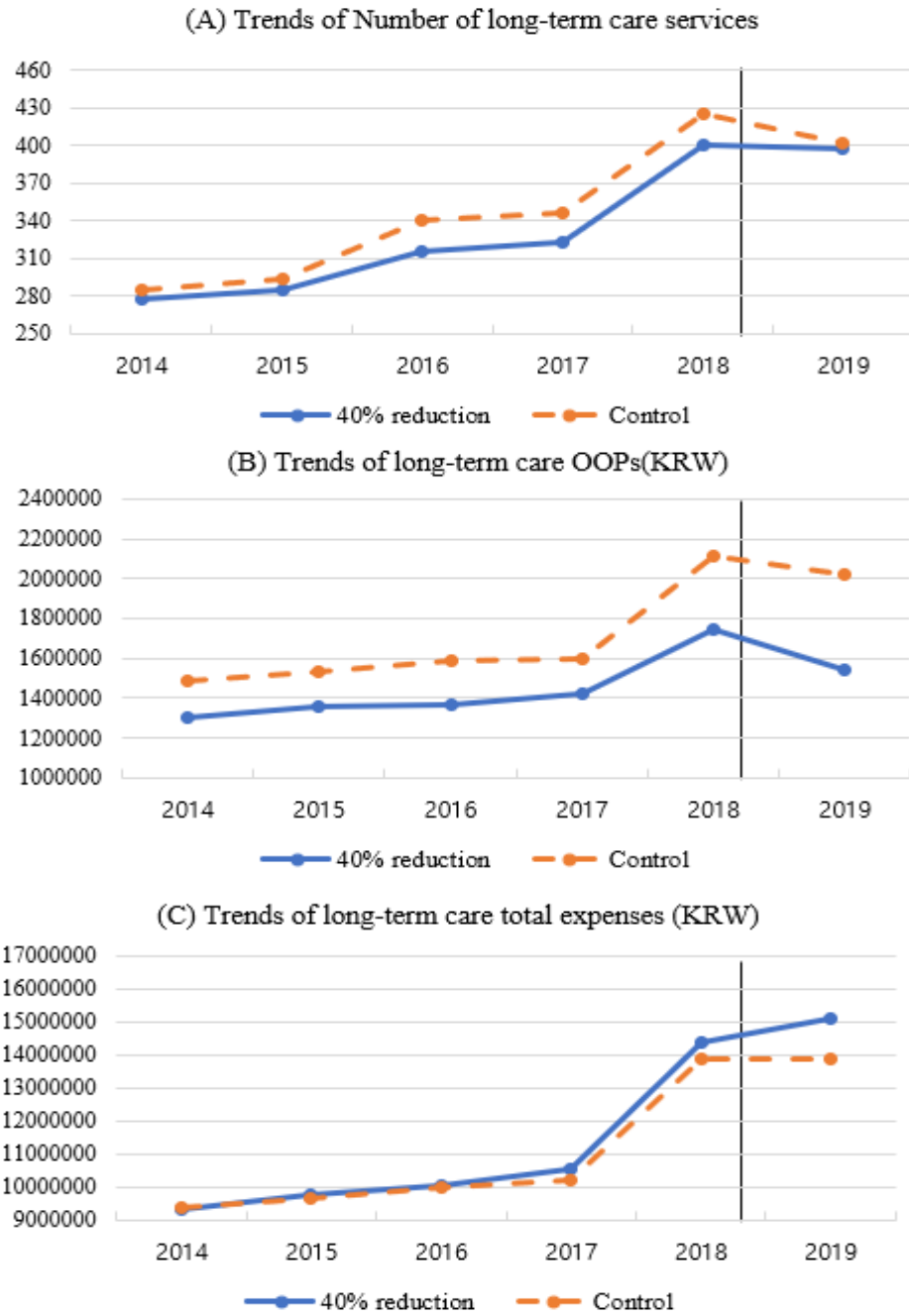


Figure 7. Trends of annual mean of primary dependent variables by 40% reduction group and control group

3) Difference-in-Differences analysis on LTC utilization

Table 9 showed the results of the primary analysis using the DID method. These results represent the differential changes in LTC utilization between the additional 10% and 40% reduction groups and each control group due to the expansion of LTCI OOPs reduction policy (Appendix 9 and 10).

Analysis to assess the effectiveness of the expansion of LTCI OOPs reduction policy showed that the 10% additional group had a smaller increase of LTC OOPs compared to the control group (5.5% vs 21.3%). The adjusted differential change between the additional 10% group and control group for LTC OOPs was -15.7% and was statistically significant ($p < .0001$). However, there were no significant differences in the number of long-term care services and LTC total expenses.

The 40% reduction group had the more increased number of LTC services and LTC total expenses (number of LTC services, 18.5% vs 13.8%; total expenses, 30.3% vs 26.4%) and a smaller increase of LTC OOPs compared to the control group (OOPs, 7.8% vs 21.3%). The adjusted differential change between the 40% group and the control group was 5.8% for the number of LTC services, -14.6% for OOPs, and 5.5% for total expenses, which was statistically significant (number of long-term care service, $p = 0.0084$; OOPs, $p < .0001$; Total expenses, $p = 0.0077$).

Table 9. Differential change over time in primary dependent variables for the additional 10% and 40% reduction group versus each of the control group

Variables	Case	Control	Adjusted change ^a , DID estimates, % (95% CI)		p-value
	Unadjusted change, %	Unadjusted change, %			
No. of long-term care services					
Additional 10%	13.3	12.5	0.9	(-0.02 to 0.04)	0.4773
40% reduction	18.5	13.8	5.8	(0.01 to 0.10)	0.0084
OOPs					
Additional 10%	5.5	21.3	-15.7	(-0.20 to -0.14)	<.0001
40% reduction	7.8	21.3	-14.6	(-0.21 to -0.11)	<.0001
Total expenses					
Additional 10%	26.2	26.1	1.2	(-0.01 to 0.04)	0.3299
40% reduction	30.3	26.4	5.5	(0.01 to 0.09)	0.0077

Notes: Case groups included the additional 10% group and the 40% reduction group.
 CI, Confidence interval; OOP, Out-of-pocket expenses.

^a All covariates are included in the regression

4) Results of Subgroup Analysis

(1) Result of subgroup analysis according to long-term care services type

Table 10 showed the results of the subgroup analysis performed by dividing long-term care services into HCBS and institutional services using the DID method.

Analysis to assess the effectiveness of the expansion of LTCI OOPs reduction policy showed that the additional 10% group had a smaller increase of OOPs in institutional services compared to the control group (12.0% vs 31.0%). Furthermore, for HCBS, the additional 10% group had the decreased OOPs (-5.5%) while for the control group it increased (10.0%). The adjusted differential change between additional 10% group and the control group for OOPs was -17.3% for institutional services and -13.5% for HCBS, which were statistically significant (institutional services, $p < .0001$; HCBS, $p < .0001$). However, there was no significant differential change between the additional 10% group and the control group in terms of the number of LTC services and total expenses for both institutional services and HCBS.

The 40% reduction group had a smaller increase in OOPs in institutional services than the control group (22.6% vs 29.9%). In addition, OOPs in HCBS decreased in the 40% case group (-11.8%) and increased in the control group (12.4%). The adjusted differential change between the additional 40% reduction group and the control group for OOPs was -10.8% for institutional services and -18.4% for HCBS, which were statistically significant (institutional services, $p = 0.0452$; HCBS, $p < .0001$). As with the 10% addition

group, there was no significant differential change between the 40% reduction group and the control group in terms of the number of LTC services and total expenses for both institutional services and HCBS.

Table 10. Results of subgroup analysis according to LTC services type

Variables	Type of LTC service									
	Institutional care service					HCBS				
	Case	Control	Adjusted change ^a , DID estimates, % p-value (95%CI)			Case	Control	Adjusted change ^a , DID estimates, % p-value (95%CI)		
Unadjusted change, %	Unadjusted Change, %				Unadjusted change, %	Unadjusted change, %				
No. of long-term care services										
Additional 10%	18.5	24.9	-2.6	(-0.09 to 0.03)	0.3736	10.5	8.3	4.5	(-0.02 to 0.11)	0.1811
40% reduction	31.1	23.6	8.6	(-0.02 to 0.19)	0.1282	13.4	10.9	5.6	(-0.04 to 0.15)	0.2651
OOPs										
Additional 10%	12.0	31.0	-17.3	(-0.25 to -0.13)	<.0001	-5.5	10.0	-13.5	(-0.21 to -0.08)	<.0001
40% reduction	22.6	29.9	-10.8	(-0.23 to -0.01)	0.0452	-11.8	12.4	-18.4	(-0.30 to -0.11)	<.0001
Total expenses										
Additional 10%	32.3	37.5	-2.5	(-0.09 to 0.04)	0.4222	17.8	16.2	3.9	(-0.03 to 0.11)	0.2563
40% reduction	42.7	36.5	8.7	(-0.03 to 0.20)	0.1463	18.1	18.7	3.6	(-0.06 to 0.13)	0.4778

Notes: Case groups included the additional 10% group and the 40% reduction group; Institutional care services includes LTC facilities, licensed nursing homes, retirement Homes, and licensed residential care facilities, and HCBS includes home-visit care, home-visit nursing, home-visit bathing, day and night care, short-term respite care, and welfare equipment.

LTC, Long-term care; CI, Confidence interval; OOPs, Out-of-pocket expenses; HCBS : Home- and community-based services.

^a All covariates are included in the regression.

(2) Result of subgroup analysis according to LTC grade

Table 11 showed the results of the subgroup analysis of LTC service use according to LTC grade using the DID method.

Analysis to assess the effectiveness of the expansion of LTCI OOPs reduction policy showed that for grade 1–2 in the additional 10% group, OOPs decreased (–8.6%), while the control group increased (8.6%). Furthermore, the additional 10% group of grade 3–4 and grade 5 had a smaller increase in OOPs than the control group (grade 3–4, 22.8% vs 27.0%; grade 5, 37.6% vs 48.6%). The adjusted differential change for OOPs between the additional 10% group and the control group was statistically significant at –16.4% for grade 1–2, –15.8% for grade 3–4, and –15.4% for grade 5 (grade 1–2, $p < .0001$; grade 3–4, $p < .0001$; grade 5, $p = 0.0192$). However, there was no significant difference in the change between the additional 10% and control groups in terms of the number of LTC services and total expenses in all LTC grade groups.

The 40% reduction group of grade 1–2 and grade 3–4 had a greater increase in the number of LTC services than the control group (grade 1–2, 12.5% vs 0.1%; grade 3–4, 19.2% vs 14.2%). The adjusted differential change for the number of long-term care services between the 40% reduction group and the control group was 12.5% for grade 1–2 and 6.2% for grade 3–4, which was statistically significant (grade 1–2, $p = 0.0095$; grade 3–4, $p = 0.0143$). However, for grade 5, there was no significant difference in the change in the number of LTC services between the 40% reduction group and the control group.

In addition, the 40% reduction group of grade 1–2 showed a decrease in OOPs (–3.5%), and the control group had an increase in OOPs (11.4%). Furthermore, the 40% reduction group of LTC grade 3–4 and grade 5 had a smaller increase in OOPs than the control group (grade 3–4, 9.0% vs 21.7%; grade 5, 31.6% vs 49.0%). The adjusted differential change for OOPs between the 40% reduction group and the control group was statistically significant at –12.7% for grade 1–2, –13.9% for grade 3–4, and –25.0% for grade 5 (grade 1–2, $p=0.0292$; grade 3–4, $p<.0001$; grade 5, $p=0.0305$).

Total expenses increased more for the 40% reduction group in grade 1–2 and grade 3–4 compared to the control group (grade 1–2, 24.0% vs 17.4%; grade 3–4, 30.8% vs 26.3%). The adjusted differential change for total expenses between the 40% reduction group and the control group was 11.4% for grade 1–2 and 6.2% for grade 3–4, which was statistically significant (grade 1–2, $p=0.0337$; grade 3–4, $p=0.0074$). However, in the grade 5 group, there was no significant difference in the change in total expenses between the 40% reduction group and the control group.

Table 11. Results of subgroup analysis according to LTC grade

Variables	LTC Grade											
	Grade 1,2				Grade 3,4				Grade 5			
	Case	Control			Case	Control			Case	Control		
	Unadjusted change, %	Unadjusted change, %	Adjusted change ^a , DID estimates, % (95%CI)	p-value	Unadjusted change, %	Unadjusted change, %	Adjusted change ^a , DID estimates, % (95%CI)	p-value	Unadjusted change, %	Unadjusted change, %	Adjusted change ^a , DID estimates, % (95%CI)	p-value
No. of long term care services												
Additional 10%	-1.5	-2.2	0.7 (-0.05 to 0.05)	0.8781	14.6	13.7	0.9 (-0.02 to 0.04)	0.5559	33.1	33.7	-0.9 (-0.14 to 0.10)	0.7481
40% reduction	12.5	0.1	12.5 (0.03 to 0.21)	0.0095	19.2	14.2	6.2 (0.01 to 0.11)	0.0143	26.1	37.9	-15.8 (-0.37 to 0.03)	0.0870
OOPs												
Additional 10%	-8.6	8.6	-16.4 (-0.25 to -0.11)	<.0001	22.8	27.0	-15.8 (-0.21 to 0.14)	<.0001	37.6	48.6	-15.4 (-0.31 to -0.03)	0.0192
40% reduction	-3.5	11.4	-12.7 (-0.26 to -0.01)	0.0292	9.0	21.7	-13.9 (-0.21 to 0.09)	<.0001	31.6	49.0	-25.0 (-0.55 to -0.03)	0.0305
Total expenses												
Additional 10%	14.7	15.0	0.7 (-0.06 to 0.05)	0.8706	27.3	18.7	1.5 (-0.01 to 0.04)	0.2776	49.6	49.1	1.7 (-0.10 to 0.14)	0.7858
40% reduction	24.0	17.4	11.4 (0.01 to 0.21)	0.0337	30.8	26.3	6.2 (0.02 to 0.10)	0.0074	43.9	50.3	-10.7 (-0.32 to 0.09)	0.2807

Notes: Case groups included the additional 10% group and the 40% reduction group.
 LTC, Long-term care; LTCL, Long-term care insurance; CI, Confidence interval; OOP, Out-of-pocket expenses.
^aAll covariates are included in the regression.

3. Effect of LTCI OOPs reduction policy expansion on medical utilization

1) Changes in medical utilization according to the expansion of the LTCI OOPs reduction policy

Table 12 showed the changes in the secondary dependent variables before and after the intervention for the additional 10% and 40% reduction groups and each control group.

(1) Total medical utilization expenses

For the additional 10% group, total medical OOPs and total medical expenses increased before and after the intervention, all of which were statistically significant (total medical OOPs, $p=0.0019$; total medical expense, $p<.0001$).

For the 40% reduction group, total medical OOPs decreased before and after the intervention, and total medical expenses increased, but the findings were not statistically significant.

For each control group for the additional 10% and 40% reduction groups, total medical OOPs and total medical expenses increased before and after the intervention, all of which were statistically significant.

(2) Outpatient services

For the additional 10% group, the number of outpatient visits decreased before and after the intervention, and were statistically significant (number of outpatient visits, $p=0.0001$). By contrast, OOPs due to outpatient utilization decreased and the total expenses due to outpatient utilization increased but the results were not statistically significant.

The 40% reduction group also showed a decrease in number of outpatient visits before and after the intervention, which was statistically significant (number of outpatient visits, $p=0.0218$). Furthermore, as with the additional 10% group, OOPs decreased due to outpatient utilization, while total expenses increased but it was not statistically significant.

For each control group and for the additional 10% and 40% reduction groups, the number of outpatient visits and OOPs both decreased due to outpatient utilization before and after the intervention and the findings were statistically significant. However, due to outpatient utilization the total expenses decreased in the control group of the additional 10% reduction group and increased in the control group of the 40% reduction group, but it was not statistically significant.

(3) Inpatient services

For the additional 10% group, due to inpatient utilization, LOS, OOPs, and total expenses, all increased before and after the intervention and were all statistically significant (LOS, $p=0.0188$; OOPs, $p=0.0004$; total expenses, $p<.0001$).

For the 40% reduction group, due to inpatient utilization, LOS decreased before and after the intervention, while OOPs and total expenses increased but the findings were not statistically significant.

Finally, in each control group for the additional 10% and 40% reduction groups, due to inpatient utilization, LOS, OOPs, and total expenses increased before and after the intervention and were also statistically significant.

The difference in secondary dependent variables for each independent variable before and after intervention is presented in Appendix 11–26.

Table 12. Changes of secondary dependent variables in the study population to evaluate the effect of LTCI OOPs reduction policy expansion.

Variables	Case					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)	
Medical utilization expenses										
Total medical OOPs										
Additional 10%	796,084	(1,491,983)	946,342	(1,828,350)	0.0019	1,045,037	(1,879,079)	1,310,955	(2,240,648)	<.0001
40% reduction	1,027,567	(1,932,213)	1,013,638	(1,759,596)	0.5054	1,123,268	(1,982,770)	1,418,854	(2,400,261)	<.0001
Total medical expenses										
Additional 10%	3,776,436	(7,526,940)	4,954,269	(10,102,204)	<.0001	4,590,415	(9,218,605)	6,290,547	(12,016,921)	<.0001
40% reduction	4,761,642	(9,560,459)	5,081,446	(9,507,320)	0.4490	5,026,132	(9,844,145)	6,902,170	(12,836,649)	<.0001
Outpatient services										
No. of outpatient visits										
Additional 10%	29.9	(31.8)	26.4	(30.1)	0.0001	30.6	(32.7)	26.2	(30.7)	<.0001
40% reduction	31.5	(34.7)	28.2	(30.4)	0.0218	31.9	(34.2)	26.9	(31.9)	<.0001
OOPs										
Additional 10%	268,090	(395,924)	251,449	(398,642)	0.1483	333,262	(473,876)	300,892	(468,100)	<.0001
40% reduction	304,090	(433,433)	289,942	(427,539)	0.4583	353,859	(496,614)	316,092	(479,505)	0.0025
Total expenses										
Additional 10%	1,137,631	(2,994,290)	1,157,184	(3,031,412)	0.8228	1,236,899	(3,198,181)	1,219,666	(3,206,631)	0.7477
40% reduction	1,287,850	(3,307,801)	1,345,459	(3,298,282)	0.6939	1,333,962	(3,197,583)	1,342,394	(3,576,851)	0.9226

Notes: Case groups included the additional 10% group and the 40% reduction group.
 SD, Standard deviation; OOPs, Out-of-pocket expenses.

Table 12. (Continued)

Variables	Case					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)	
Inpatient services										
LOS										
Additional 10%	18.1	(56.0)	22.2	(64.6)	0.0188	23.0	(65.7)	32.8	(82.4)	<.0001
40% reduction	22.9	(63.9)	21.8	(61.4)	0.7021	24.5	(67.2)	35.5	(85.9)	<.0001
OOPs										
Additional 10%	527,994	(1,428,835)	694,893	(1,780,164)	0.0004	711,775	(1,805,131)	1,010,063	(2,204,753)	<.0001
40% reduction	723,477	(1,865,298)	723,696	(1,711,111)	0.9978	769,409	(1,904,559)	1,102,762	(2,364,937)	<.0001
Total expenses										
Additional 10%	2,638,805	(6,774,793)	3,797,085	(9,447,075)	<.0001	3,353,516	(8,526,531)	5,070,881	(11,525,460)	<.0001
40% reduction	3,473,792	(8,964,898)	3,735,987	(8,805,354)	0.5054	3,692,170	(9,172,241)	5,559,776	(12,243,278)	<.0001

Notes: Case groups included the additional 10% group and the 40% reduction group.
 SD, Standard deviation; OOPs, Out-of-pocket expenses; LOS, Length of stay.

2) Assumptions of Study Design for Secondary dependent variables.

Figures 8 and 11 show the changes in the secondary dependent variables by year for the two case groups (10% addition group, 40% reduction group) and each control group. The results of the parallel trend test before intervention for difference analysis are presented in Appendix 8.

(1) Total medical utilization expenses

For the additional 10% group, total medical expenses before the intervention period showed a parallel trend to the control group, and there was no statistically significant difference ($p=0.1094$). However, in the case of total medical OOPs, there was no parallel trend between the additional 10% group and the control group before the intervention period and there was a statistically significant difference ($p=0.0148$).

For the 40% reduction group, total medical expenses and total medical OOPs showed parallel trends to the control group before the intervention period and there was no statistically significant difference (total medical expenses, $p=0.4548$; total medical OOPs, $p=0.1718$).

(2) Outpatient services

For the additional 10% group, the number of outpatients visit, OOPs, and total expenses showed parallel trends to the control group before the intervention period with no

statistically significant difference (number of outpatient visits, $p=0.7666$; OOPs, $p=0.6713$; total expenses, $p=0.3143$).

For the 40% reduction group, the number of outpatients visit, OOPs, and total expenses showed parallel trends to the control group before the intervention period with no statistically significant difference (number of outpatient visits, $p=0.9996$; OOPs, $p=0.8039$; total expenses, $p=0.7687$).

(3) Inpatient services

For the additional 10% group, total expenses showed a parallel trend to the control group before the intervention period with no statistically significant difference ($p=0.1476$). However, in the case of LOS and OOPs, there was no parallel trend between the additional 10% group and the control group before the intervention period and there was a statistically significant difference (LOS, $p<.0001$; OOPs, $p=0.0032$).

For the 40% reduction group, the LOS, OOPs, and total expenses showed a parallel trend to the control group before the intervention period, with no statistically significant difference (LOS, $p=0.0781$; OOPs, $p=0.2919$; total expenses, $p=0.2391$).

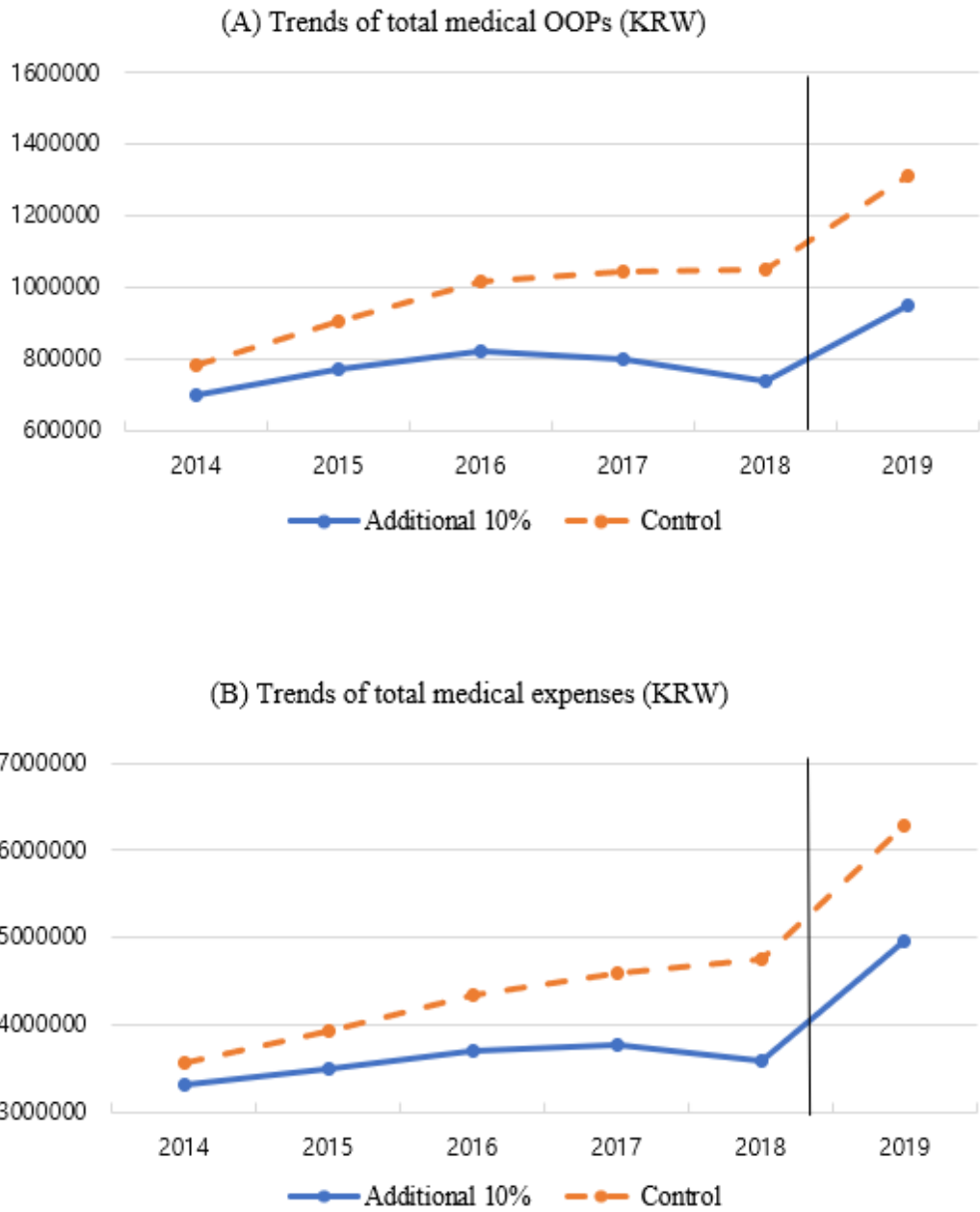


Figure 8. Trends of annual mean of secondary dependent variables by additional 10% group and control group

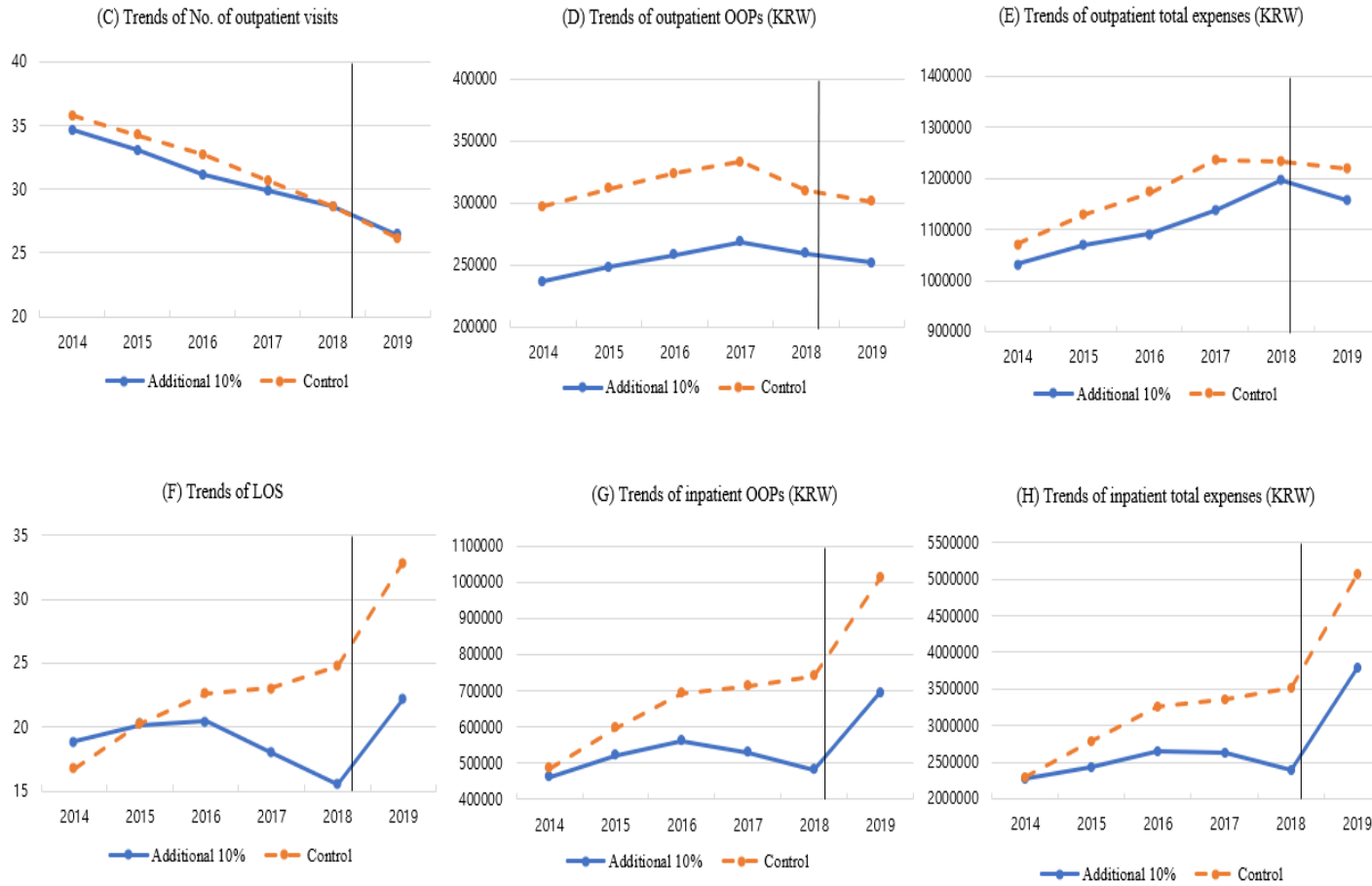


Figure 9. Trends of annual mean of secondary dependent variables by additional 10% group and control group(continued)

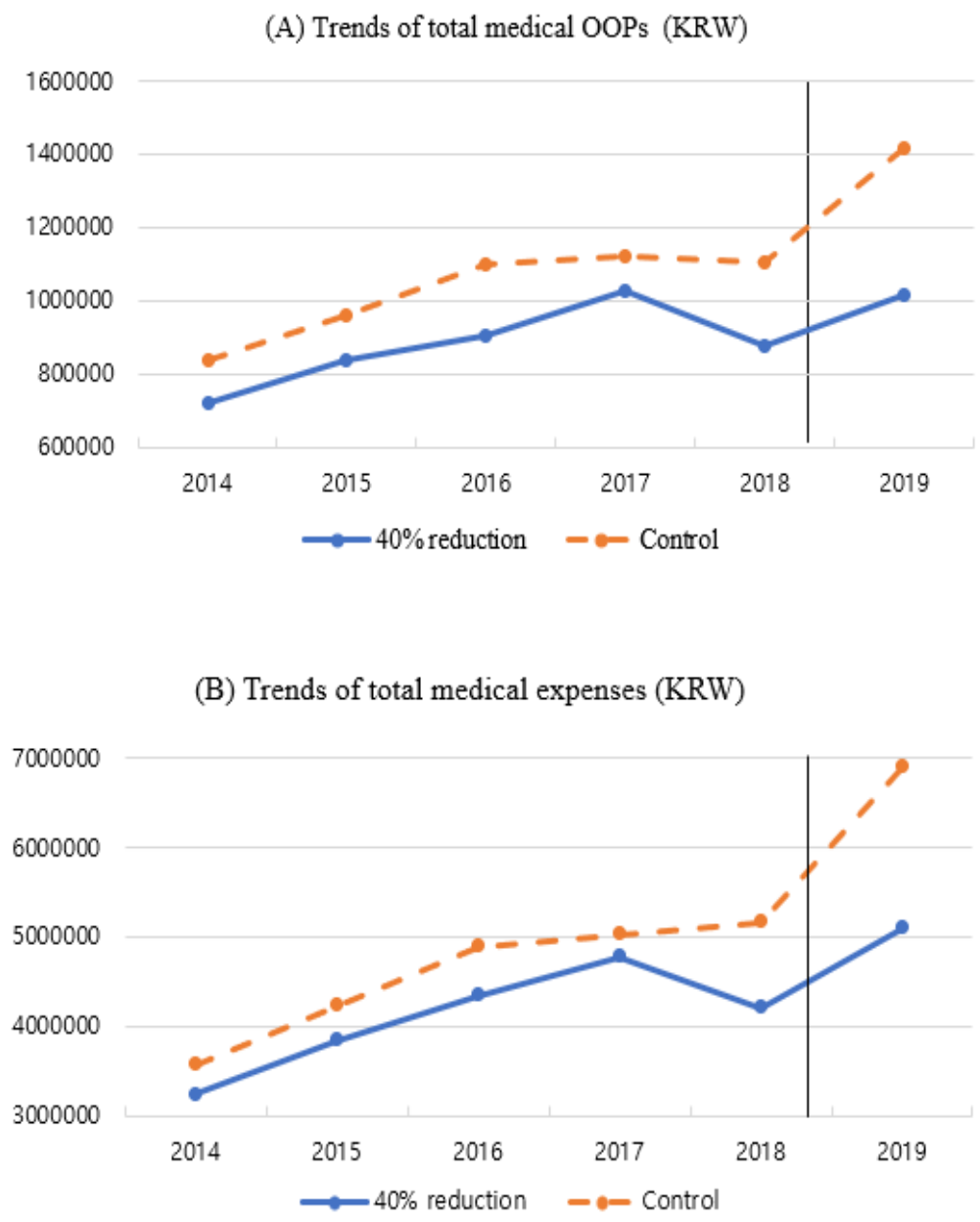


Figure 10. Trends of annual mean of secondary dependent variables by 40% reduction group and control group

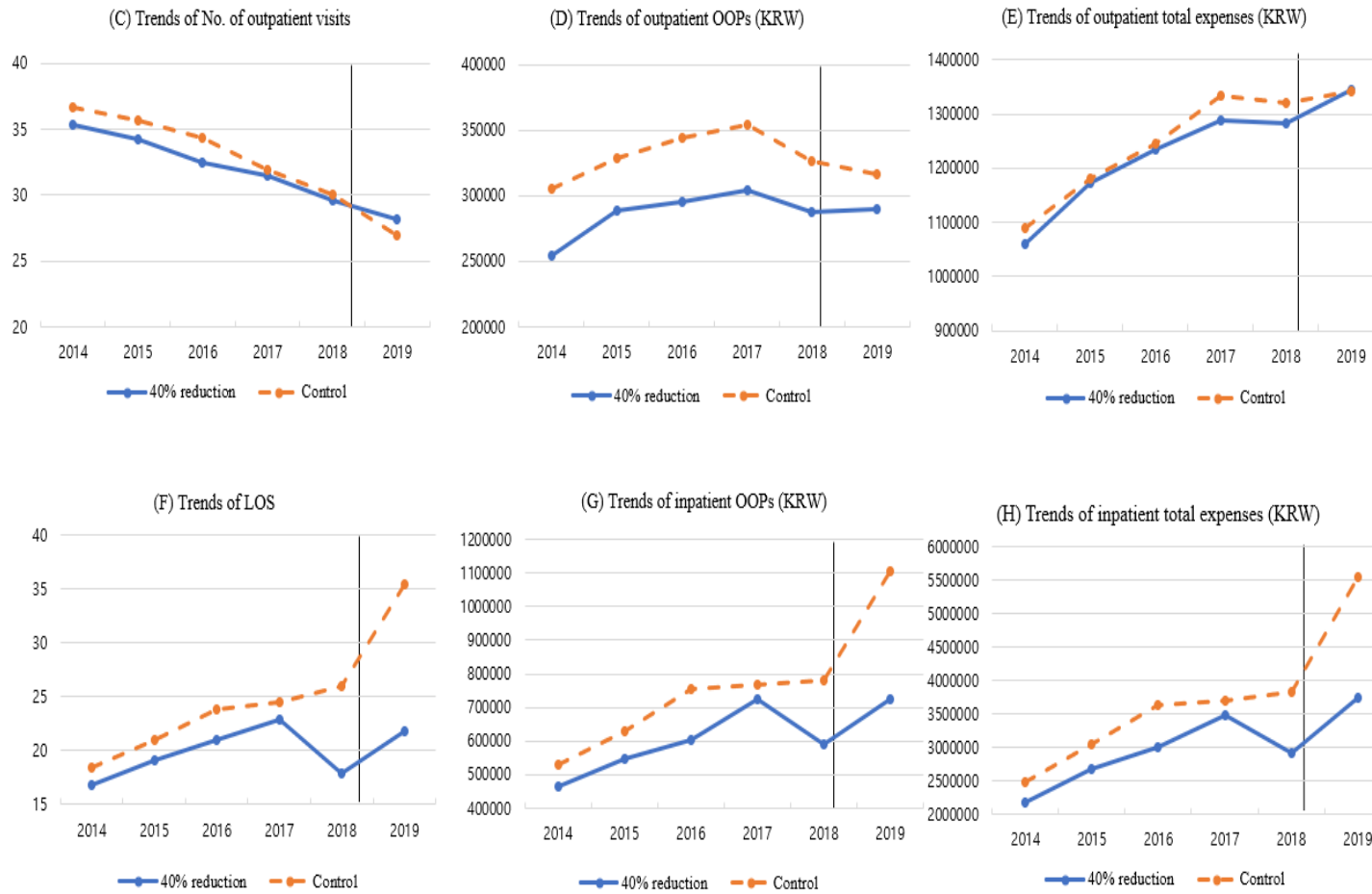


Figure 11. Trends of annual mean of secondary dependent variables by 40% reduction group and control group(continued)

3) Difference-in-Differences analysis on medical utilization

Table 13 showed the DID analysis results for the secondary dependent variable. These results represent the differential changes in medical utilization between the additional 10% and 40% reduction groups and each control group due to the expansion of LTCI OOPs reduction policy (Appendix 27–32).

(1) Total medical utilization expenses

Analysis to assess the effectiveness of the expansion of LTCI OOPs reduction showed that there was no significant difference between the additional 10% group and the control group in terms of changes in total medical OOPs and total medical expenses.

The 40% reduction group had the decrease in total medical OOPs (−1.4%) and the increase for the control group (20.8%). Furthermore, total medical expenses showed a smaller increase in the 40% reduction group compared to the control group (6.3% vs 27.2%). The adjusted differential change between the 40% reduction group and the control group was −20.5% for total medical OOPs and −21.4% for total medical expenses, which was statistically significant (total medical OOPs, $p=0.0021$; total medical expenses, $p=0.0028$).

(2) Outpatient services

Analysis to assess the effectiveness of the expansion of the LTCI OOPs reduction policy showed that there was no significant difference in the change between the 10% addition group and the control group for changes in the number of outpatient visits, OOPs, and total expenses.

Conversely, in the 40% reduction group, the number of outpatient visits and OOPs showed a smaller decrease than for the control group (number of outpatient visits, -11.8% vs -18.6%; OOPs, -4.9% vs -11.9%) and total expenses showed a greater increase than the control group (4.3% vs 0.6%). The adjusted differential change between the 40% reduction group and the control group was 9.6% for the number of outpatient visits and 11.6% for OOPs, and 10.9% for total expenses, which were statistically significant (number of outpatient visits, $p=0.0044$; OOPs, $p=0.0163$; total expenses, $p=0.0491$).

(3) Inpatient services

Analysis to assess the effectiveness of the expansion of LTCI OOPs reduction showed that the additional 10% group had a smaller increase in LOS than the control group (18.8% vs 29.9%). The adjusted difference for LOS between the additional 10% group and the control group was -18.9%, which was statistically significant ($p=0.0217$). However, there was no significant difference in the change in OOPs and total expenses.

The 40% reduction group had the decrease in LOS (-4.9%) and the increase for the control group (31.0%). Furthermore, OOPs and total expenses had a smaller increase

in the 40% reduction group compared to the control group (OOPs, 0.1% vs 30.2%; total expenses, 7.0% vs 33.6%). The adjusted differential change between the 40% reduction group and the control group was -35.3% for LOS, -29.3% for OOPs, -27.9% for total expenses, which was statistically significant (LOS, $p=0.0009$; OOPs, $p=0.0025$; total expenses, $p=0.0043$).

Table 13. Differential change over time in secondary dependent variables for the additional 10% and 40% reduction groups versus each of the control group

Variables	Case	Control	Adjusted change ^a , DID estimates, % (95% CI)		<i>p</i> -value
	Unadjusted change, %	Unadjusted change, %			
Medical utilization expenses					
Total medical OOPs					
Additional 10%	15.9	20.3	-7.7	(-0.18 to 0.02)	0.1298
40% reduction	-1.4	20.8	-20.5	(-0.38 to -0.08)	0.0021
Total medical expenses					
Additional 10%	23.8	27.0	-8.2	(-0.19 to 0.02)	0.1188
40% reduction	6.3	27.2	-21.4	(-0.40 to -0.08)	0.0028
Outpatient services					
No. of outpatient visits					
Additional 10%	-13.0	-17.0	3.8	(-0.01 to 0.08)	0.0552
40% reduction	-11.8	-18.6	9.6	(0.03 to 0.15)	0.0044
OOPs					
Additional 10%	-6.6	-10.8	4.0	(-0.02 to 0.10)	0.1643
40% reduction	-4.9	-11.9	11.6	(0.02 to 0.20)	0.0163
Total expenses					
Additional 10%	1.7	-1.4	4.1	(-0.02 to 0.10)	0.1921
40% reduction	4.3	0.6	10.9	(0.01 to 0.21)	0.0491
Inpatient services					
LOS					
Additional 10%	18.8	29.9	-18.9	(-0.39 to -0.03)	0.0217
40% reduction	-4.9	31.0	-35.3	(-0.69 to -0.18)	0.0009
OOPs					
Additional 10%	24.0	29.5	-11.3	(-0.27 to -0.03)	0.1177
40% reduction	0.1	30.2	-29.3	(-0.57 to -0.12)	0.0025
Total expenses					
Additional 10%	30.5	33.9	-10.7	(-0.23 to 0.01)	0.1290
40% reduction	7.0	33.6	-27.9	(-0.55 to -0.10)	0.0043

Notes: Case groups included the additional 10% group and the 40% reduction group.

LOS : Length of stay; CI, Confidence interval; OOPs, Out-of-pocket expenses.

^a All covariates are included in the regression.

4) Result of subgroup analysis according to type of hospitalization

Table 14 showed the results of subgroup analysis performed by dividing hospitalization into acute care hospitals and LTCHs using the DID method.

(1) Acute care hospital

Analysis to assess the effectiveness of the expansion of LTCI OOPs reduction showed that there was no significant differential change between the additional 10% group and the 40% reduction group in terms of change in LOS, OOPs, and total expenses compared to each control group.

(2) Long-term care hospitals

Analysis showed that the additional 10% group had a smaller increase in LOS, OOPs, and total expenses compared to the control group (LOS, 25.5% vs 42.9%; OOPs, 21.1% vs 39.7%; total expenses, 27.5% vs 43.1%). The adjusted differential change between the additional 10% group and the control group was -30.2% for LOS, -19.9% for OOPs, and -27.4% for total expenses, which was statistically significant (LOS, $p=0.0182$; OOPs, $p=0.0222$; total expenses, $p=0.0358$).

The 40% reduction group had a smaller increase in LOS, OOPs, and total expenses compared to the control group (LOS, 7.9% vs 46.9%; OOPs, 7.6% vs 43.5%; total expenses, 10.3% vs 46.4%). The adjusted differential change between the additional 40% reduction group and the control group was -45.8% for LOS, -40.7% for OOPs, -42.9% in total

expenses, which was statistically significant (LOS, $p=0.0053$; OOPs, $p=0.0212$, total expenses, $p=0.0138$).

Table 14. Results of subgroup analysis according to type of hospitalization

Variables	Acute Care hospital					LTCHs				
	Case	Control	Adjusted change ^a , DID estimates, % (95% CI)		<i>p</i> -value	Case	Control	Adjusted change ^a , DID estimates, % (95% CI)		<i>p</i> -value
	Unadjusted change, %	Unadjusted change, %	Unadjusted change, %	Unadjusted change, %		Unadjusted change, %	Unadjusted change, %			
LOS										
Additional 10%	5.9	-6.4	7.9	(-0.10 to 0.25)	0.4001	25.5	42.9	-30.2	(-0.66 to -0.06)	0.0182
40% reduction	-27.7	-12.7	-8.1	(-0.33 to 0.16)	0.5050	7.9	46.9	-45.8	(-1.04 to -0.18)	0.0053
OOPs										
Additional 10%	25.9	19.8	3.6	(-0.13 to 0.20)	0.6781	21.1	39.7	-19.9	(-0.60 to -0.05)	0.0222
40% reduction	-4.9	17.6	-18.7	(-0.46 to 0.04)	0.1053	7.6	43.5	-40.7	(-0.97 to -0.08)	0.0212
Total expenses										
Additional 10%	32.0	27.0	1.1	(-0.16 to 0.18)	0.9008	27.5	43.1	-27.4	(-0.62 to -0.02)	0.0358
40% reduction	5.3	24.2	-18.1	(-0.45 to -0.05)	0.1219	10.3	46.4	-42.9	(-1.00 to -0.11)	0.0138

Notes: Case groups included the additional 10% group and the 40% reduction group.

LOS : Length of stay; CI, Confidence interval; OOPs, Out-of-pocket expenses; LTCHs, Long-term care hospitals.

^a All covariates are included in the regression.

4. Effect of LTCI OOPs reduction policy expansion on total LTC and medical utilization

1) Changes in total LTC and medical utilization according to the expansion of the LTCI OOPs reduction policy

OOPs and total expenses of LTC and medical utilization were calculated and Table 15 showed the changes in total LTC and medical OOPs and total LTC and medical expenses before and after the intervention for the additional 10% and 40% reduction groups and each control group.

For the additional 10% group, total LTC and medical expenses with total LTC and medical OOPs increased before and after the intervention, which was statistically significant (total LTC and medical OOPs, $p<.0001$; total LTC and medical expenses, $p<.0001$)

For the 40% reduction group, total LTC and medical expenses and total LTC and medical OOP increased before and after the intervention, which was statistically significant only for total LTC and medical expenses (total LTC and medical OOPs, $p=0.2044$; total LTC and medical expenses, $p<.0001$).

Finally, both total LTC and medical expenses with total LTC and medical OOPs increased before and after the intervention with each control group for the additional 10% group and 40% reduction group and were also statistically significant.

The difference before and after intervention for each independent variable is presented in Appendices 33–36.

Table 15. Changes of total LTC and medical utilization in the study population to evaluate the effect of LTCI OOPs reduction policy expansion

Variables	Case					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)	
Total LTC & Medical OOPs										
Additional 10%	1,908,451	(1,493,771)	2,123,457	(1,774,174)	<.0001	2,702,790	(1,898,073)	3,418,141	(2,165,721)	<.0001
40% reduction	2,451,738	(1,941,383)	2,557,546	(1,818,908)	0.2044	2,716,385	(1,982,613)	3,442,926	(2,280,329)	<.0001
Total LTC & Medical expenses										
Additional 10%	15,671,201	(8,188,912)	21,063,789	(9,922,535)	<.0001	15,132,564	(9,308,043)	20,562,172	(11,324,811)	<.0001
40% reduction	15,276,986	(9,562,541)	20,174,031	(9,671,210)	<.0001	15,237,560	(9,787,353)	20,771,474	(11,841,729)	<.0001

Notes: Case groups included the additional 10% group and the 40% reduction group.
 LTC, long-term care; LTCI, Long-term care insurance; SD, Standard deviation; OOPs, Out-of-pocket expenses.

2) Assumptions of Study Design for total LTC and medical utilization

Figures 12 and 13 show the changes in total LTC and medical utilization dependent variables by year for the two case groups (additional 10% group, 40% reduction group) and each control group. The results of the parallel trend test for difference analysis before intervention are presented in Appendix 8.

For the additional 10% group, total LTC and medical expenses before the intervention period showed a parallel trend with the control group and no statistically significant difference (total LTC and medical expenses, $p=0.9054$). However, in the case of total LTC and medical OOPs, there was no parallel trend with the control group before the intervention and there was a statistically significant difference (total LTC and medical OOPs, $p=0.0041$).

For the 40% reduction group, total LTC and medical expenses and total LTC and medical OOPs showed a parallel trend with the control group before the intervention period, and there was no statistically significant difference (total LTC and medical expenses, $p=0.6250$; total LTC and medical OOPs, $p=0.6636$).

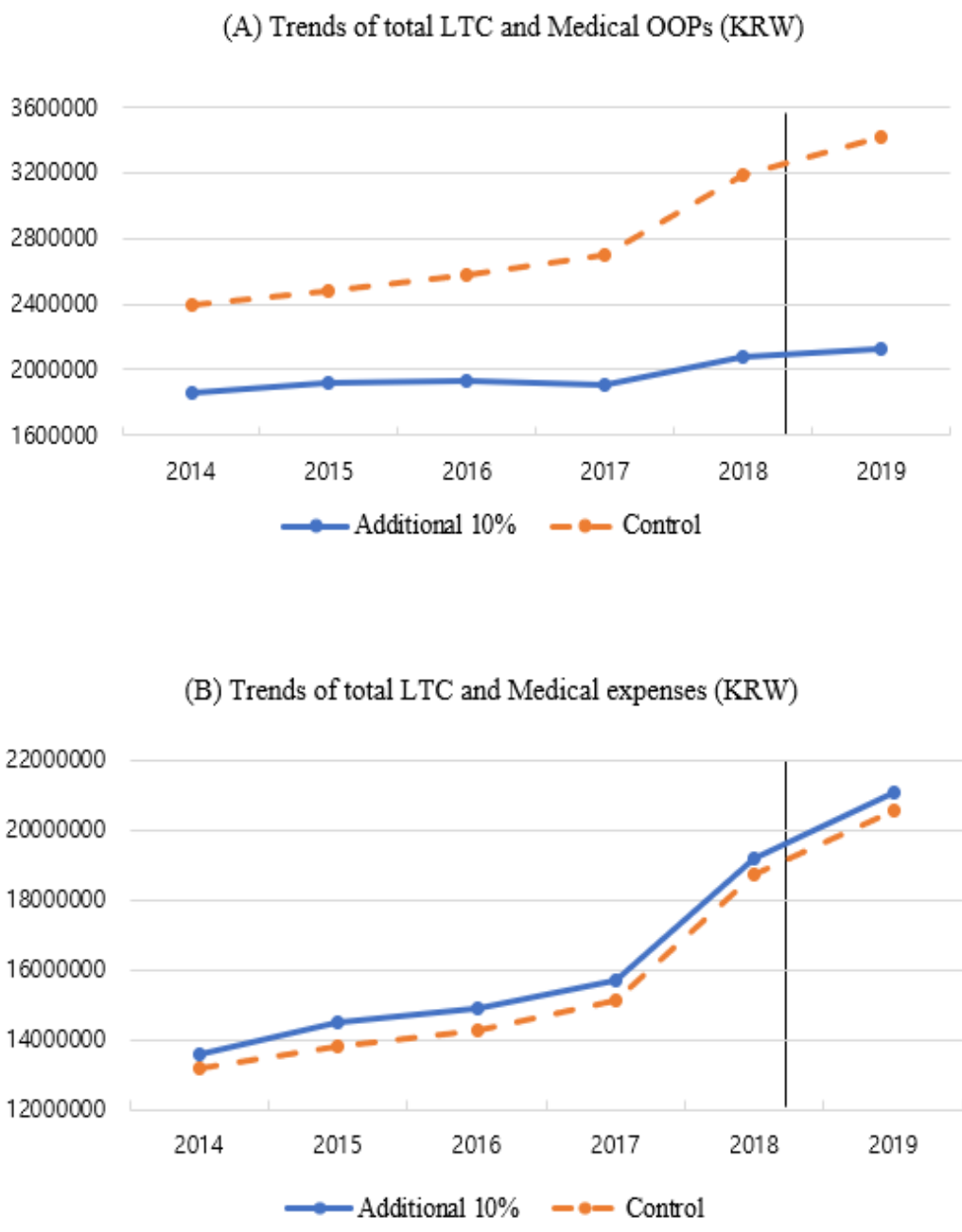


Figure 12. Trends of annual mean of LTC and medical utilization dependent variables by additional 10% group and control group

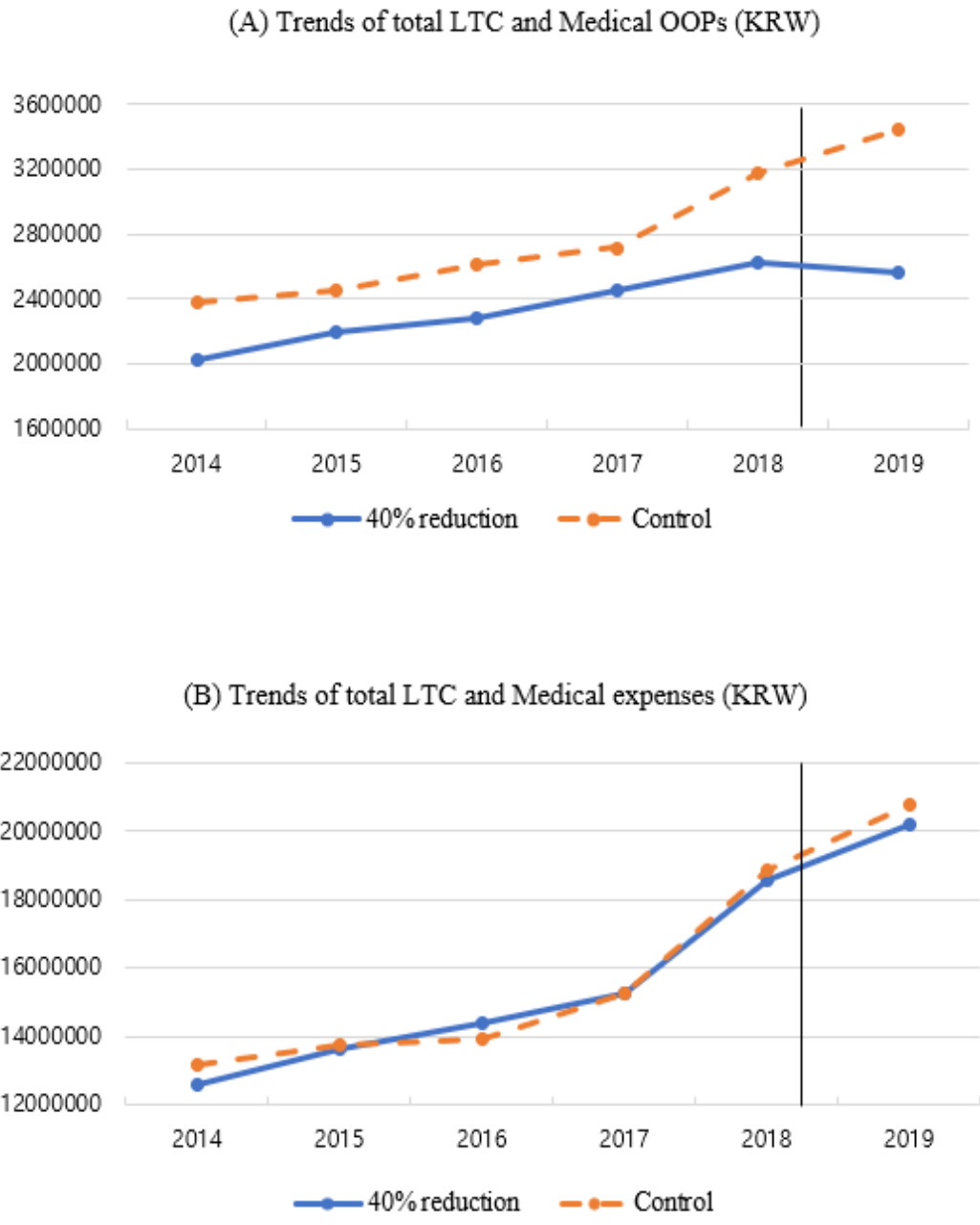


Figure 13. Trends of annual mean of LTC and medical utilization dependent variables by 40% reduction group and control group

3) Difference-in-Differences Analysis on total LTC and medical utilization

Table 16 showed the results of the total LTC and medical utilization analysis using the DID method. These results represent the difference in total LTC and medical utilization between the additional 10% and 40% reduction groups and each control group due to the reduction in LTCI OOPs (Appendix 37 and 38).

Analysis to assess the effectiveness of the expansion of the LTCI OOPs reduction policy showed that the 10% additional group had a smaller increase in total LTC and medical OOPs than the control group (10.1% vs 20.9%). The adjusted differential change between the additional 10% group and control group for total LTC and medical OOPs was -11.8%, which was statistically significant ($p < .0001$). However, there was no significant difference in the change for total LTC and medical expenses.

The 40% reduction group had a smaller increase in total LTC and medical OOPs than the control group (4.1% vs 21.1%). The adjusted differential change between the 40% reduction group and control group for total LTC and medical OOPs was -17.7%, which was statistically significant ($p < .0001$). However, there was no significant difference in the change in total LTC and medical expenses.

Table 16. Differential change over time in LTC and Medical utilization for the additional 10% and 40% reduction groups versus each control group

Variables	Case	Control	Adjusted change ^a , DID estimates, % (95% CI)		<i>p</i> -value
	Unadjusted change, %	Unadjusted change, %			
Total LTC & Medical OOPs					
Additional 10%	10.1	20.9	-11.8	(-0.17 to -0.09)	<.0001
40% reduction	4.1	21.1	-17.7	(-0.25 to -0.14)	<.0001
Total LTC & Medical expenses					
Additional 10%	25.6	26.4	-1.2	(-0.04 to 0.01)	0.3683
40% reduction	24.3	26.6	-3.2	(-0.76 to 0.01)	0.1514

Notes: Case groups included the additional 10% group and the 40% reduction group.
 LTC, Long-term care; CI, Confidence interval; OOPs, Out-of-pocket expenses.

^a All covariates are included in the regression.

5. Sensitivity Analyses

To confirm the robustness of the main results of this study, an additional 10% group and a 40% reduction group were combined to perform sensitivity analysis with the new control group through 1:2 PSM. Appendix 39 presents the flow chart of the subjects included in the sensitivity analyses, Appendix 40 presents the characteristics of the subjects included in the sensitivity analyses, and Appendix 41 presents the results of the pre-intervention parallel trend test.

1) Primary dependent variable

The adjusted differential change for OOPs between the additional 10% group and the control group was -15.7%, which was statistically significant ($p < .0001$). However, there was no significant difference in the change for OOPs and total expenses.

The adjusted differential change between the 40% reduction group and the control group was 7.1% for the number of LTC services, -14.8% for OOPs, and 5.8% for total expenses, which was statistically significant (number of long-term care services, $p = 0.0004$; OOPs, $p < .0001$; total expenses, $p = 0.0024$).

2) Secondary dependent variable

(1) Total medical utilization expenses

There was no significant difference in the change in total medical OOPs and total medical expenses between the additional 10% group and the control group.

The adjusted differential change between the 40% reduction group and the control group was -19.1% for total medical OOPs expenses and -20.2% for total medical expenses, which was statistically significant (total medical OOPs, $p=0.0021$; total medical expenses, $p=0.0024$).

(2) Outpatient services

There was no significant difference in the change for the number of outpatient visits, OOPs, and total expenses between the additional 10% group and the control group.

The adjusted differential change between the 40% reduction group and the control group was 7.3% for the number of outpatient visits, 10.6% for OOPs, and 11.9% for total expenses, which were statistically significant (number of outpatient visits, $p=0.0169$; OOPs, $p=0.0194$; total expenses, $p=0.0204$).

(3) Inpatient services

The adjusted differential change for LOS between the additional 10% group and the control group was -17.7%, which was statistically significant ($p=0.0324$). However, there were no significant difference in the change in OOPs and total expenses.

The adjusted differential change between the 40% reduction group and the control group was -32.0% for LOS, -27.8% for OOPs, and -26.9% for total expenses, which was statistically significant (LOS, $p=0.0020$; OOPs, $p=0.0022$; total expenses, $p=0.0032$).

3) Total LTC and medical utilization

The adjusted differential change between the additional 10% group and the control group for total LTC and medical OOPs was -11.4%, which was statistically significant ($p<.0001$). However, there was no significant difference in the change in total LTC and medical expenses.

The adjusted differential change between the 40% reduction group and the control group for total LTC and medical OOPs was -17.2%, which was statistically significant ($p<.0001$). There was no significant difference in the change in total LTC and medical expenses.

The results of sensitivity analyses were similar to the results of the main analyses.

Table 17. Results of difference-in-difference analyses according to participants in sensitivity study

Variables	Case				Unadjusted change, %	Control				Adjusted change ^a , DID estimates, % (95% CI)	p-value		
	Before (2017)		After (2019)			Before (2017)		After (2019)					
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)				
Primary dependent variable													
No. of long-term care service													
Additional 10%	346.7	(203.6)	400.0	(222.1)	13.3	347.8	(229.3)	398.9	(242.7)	12.8	0.6	(-0.02 to -0.03)	0.6429
40% reduction	323.3	(203.1)	396.9	(225.5)	18.5						7.1	(0.03 to 0.11)	0.0004
OOPs													
Additional 10%	1,112,367	(745,663)	1,177,115	(712,155)	5.5	1,643,605	(1,165,624)	2,092,539	(1,359,376)	21.5	-15.7	(-0.20 to -0.14)	<.0001
40% reduction	1,424,171	(1,064,478)	1,543,908	(1,030,154)	7.8						-14.8	(-0.21 to -0.11)	<.0001
Total expenses													
Additional 10%	11,894,765	(6,403,401)	16,109,520	(7,178,664)	26.2	10,467,659	(6,184,485)	14,201,262	(7,535,192)	26.3	1.1	(-0.01 to 0.04)	0.3882
40% reduction	10,515,344	(6,144,544)	15,092,585	(7,139,917)	30.3						5.8	(0.02 to 0.09)	0.0024

Notes: Case groups included the additional 10% group and the 40% reduction group; Control group was selected through a 1:2 PSM by combining an additional 10% group with a 40% reduction group.

SD, Standard deviation; OOPs, Out-of-pocket expenses.

^a All covariates are included in the regression.

Table 17. (Continued)

Variables	Case				Unadjusted change, %	Control				Adjusted change ^a , DID estimates, % (95% CI)	p- value		
	Before (2017)		After (2019)			Before (2017)		After (2019)					
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)				
Secondary dependent variable													
Medical utilization expenses													
Total medical OOPs expenses													
Additional 10%	796,084	(1,491,983)	946,342	1,828,350	15.9	1,068,996	1,905,390	1,325,477	2,270,174	19.4	-6.5	(-0.17 to 0.04)	0.2061
40% reduction	1,027,567	(1,932,213)	1,013,638	1,759,596	-1.4						-19.1	(-0.35 to -0.08)	0.0021
Total medical expenses													
Additional 10%	3,776,436	(7,526,940)	4,954,269	10,102,204	23.8	4,713,132	9,398,421	6,373,846	12,144,240	26.1	-7.2	(-0.18 to 0.03)	0.1750
40% reduction	4,761,642	(9,560,459)	5,081,446	9,507,320	6.3						-20.2	(-0.37 to -0.08)	0.0024
Outpatient services													
No. of outpatient visits													
Additional 10%	29.9	(31.8)	26.4	(30)	-13.0	30.9	(32.9)	26.4	(31.2)	-16.8	3.8	(-0.01 to 0.08)	0.0597
40% reduction	31.5	(34.7)	28.2	(30.4)	-11.8						7.3	(0.01 to 0.13)	0.0169
OOPs													
Additional 10%	268,090	(395,924)	251,449	(398,642)	-6.6	335,916	(471,537)	303,172	(472,247)	-10.8	4.5	(-0.01 to 0.10)	0.1211
40% reduction	304,090	(433,433)	289,942	(427,539)	-4.9						10.6	(0.02 to 0.19)	0.0194
Total expenses													
Additional 10%	1,137,631	(2,994,290)	1,157,184	(3,031,412)	1.7	1,251,659	(3,197,961)	1,242,992	(3,274,212)	-0.7	3.7	(-0.03 to 0.10)	0.2551
40% reduction	1,287,850	(3,307,801)	1,345,459	(3,298,282)	4.3						11.9	(0.02 to 0.21)	0.0204

Notes: Case groups included the additional 10% group and the 40% reduction group; Control group was selected through a 1:2 PSM by combining an additional 10% group with a 40% reduction group.

SD, Standard deviation; OOPs, Out-of-pocket expenses.

^a All covariates are included in the regression.

Table 17. (Continued)

Variables	Case				Unadjusted change, %	Control				Adjusted change ^a , DID estimates, % (95% CI)	p-value	
	Before (2017)		After (2019)			Before (2017)		After (2019)				
	Mean	(SD)	Mean	(SD)		Mean	(SD)	Mean	(SD)			
Secondary dependent variable												
Inpatient services												
LOS												
Additional 10%	18.1	(56.0)	22.2	(64.6)	18.8	23.7	(66.4)	32.9	(82.5)	28.1	-17.7 (-0.37 to -0.02)	0.0324
40% reduction	22.9	(63.9)	21.8	(61.4)	-4.9						-32.0 (-0.63 to -0.14)	0.0020
OOPs												
Additional 10%	527,994	(1,428,835)	694,893	(178,016)	24.0	733,080	(1,834,854)	1,022,305	(2,232,985)	28.3	-9.9 (-0.26 to -0.05)	0.1755
40% reduction	723,477	(1,865,298)	723,696	(1,711,111)	0.1						-27.8 (-0.53 to -0.12)	0.0022
Total expenses												
Additional 10%	2,638,805	(6,774,793)	3,797,085	(9,447,075)	30.5	3,461,473	(8,724,116)	5,130,854	(11,633,764)	32.5	-9.4 (-0.25 to 0.05)	0.1865
40% reduction	3,473,792	(8,964,898)	3,735,987	(8,805,354)	7.0						-26.9 (-0.52 to -0.10)	0.0032
Total LTC and Medical utilization												
Total LTC & Medical OOPs												
Additional 10%	1,908,451	(1,493,771)	2,123,457	(1,774,174)	10.1	2,712,601	(1,915,088)	3,418,016	(2,189,556)	20.6	-11.4 (-0.16 to -0.08)	<.0001
40% reduction	2,451,738	(1,941,383)	2,557,546	(1,818,908)	4.1						-17.2 (-0.24 to -0.14)	<.0001
Total LTC & Medical total expenses												
Additional 10%	15,671,201	(8,188,912)	21,063,789	(9,922,535)	25.6	15,180,791	(9,425,226)	20,575,108	(11,448,198)	26.2	-0.9 (-0.04 to 0.02)	0.5006
40% reduction	15,276,986	(9,562,541)	20,174,031	(9,671,210)	24.3						-2.5 (-0.76 to 0.01)	0.2132

Notes: Case groups included the additional 10% group and the 40% reduction group; Control group was selected through a 1:2 PSM by combining an additional 10% group with a 40% reduction group.

SD, Standard deviation; LOS, Length of stay; OOPs, Out-of-pocket expenses.

^a All covariates are included in the regression.

V. Discussion

1. Discussion of the study method

In this study, using NHIS-EC data, a quasi-experimental study design was applied to beneficiaries receiving LTC services to analyze the effect of the LTCI OOPs reduction policy expansion on LTC and medical utilization. Therefore, the strengths of this study include the utilization of a national data sample of LTCI beneficiaries. Furthermore, the strengths of the analytical model are as follows.

First, most of the previous studies evaluated the effect of LTCI introduction, and there are few studies investigating the effect of the LTCI OOPs reduction policy expansion in 2018. Indeed, some studies considered the effect of the LTCI OOPs reduction policy expansion, but they presented descriptive statistics only focusing mainly on equity using the HIwv.⁷ In addition, since the quasi-experimental study design was not applied in the previous studies, the influence of other policies might be included. However, since this study applied a quasi-experimental study design, it has the advantage of controlling external factors and identifying the effects of LTC and medical utilization according to changes in LTCI OOPs.

Second, we investigated the effectiveness of the LTCI OOPs reduction policy expansion using robust statistical techniques. In this study, difference-in-differences analysis, a type of quasi-experimental study design, was performed to investigate changes

in the LTC and medical utilization according to the LTCI OOPs reduction policy expansion. This difference-in-differences approach is a useful policy evaluation tool to compare the effectiveness of policy implementation for intervention and control groups.^{91,94} Considering that there is data up to 2019, it seemed reasonable to use difference-in-differences as a design to evaluate the LTCI OOPs reduction policy extension introduced in August 2018. One of the common issues when using difference-in-differences analysis is the adequacy of control groups. Incorrect selection of a control group can compromise the reliability of the study as a whole. Considering these points, in this study, two case groups (additional 10%, 40% reduction) were selected, and two similar control groups were designated for each case group using PSM. These methods would have contributed to eliminating the selective bias in this study.⁸⁹ Furthermore, we confirmed the robustness of the results by performing sensitivity analyses by selecting a different control group.

Although this study has these advantages, there are some limitations to be aware of when interpreting the results.

The first limitation is due to the limitations of data. The NHIS-EC data we used was collected for the covered services claimed by NHIS and providers, so data on non-covered services could not be identified. In fact, in the case of Institutional services, non-covered services such as food expenses and nutritional supplements are prevalent, and these can affect the use of low-income LTCI beneficiaries. Therefore, our results may differ for non-covered services. Nonetheless, excluding non-covered services, reductions in LTC

OOPs have been observed to change LTC and medical utilization. This is a valuable result of this study.

Also, we could not evaluate the long-term effectiveness of the LTCI OOPs reduction policy expansion due to data limitations. The evaluated LTCI OOPs reduction policy expansion was carried out in August 2018, and our data only includes information up to 2019. Therefore, this study was limited to identifying the short-term effects of the LTCI OOPs reduction policy expansion. Our study has found meaningful results, however, a study to examine the effect of the LTCI OOPS reduction policy expansion through a long-term observation period may be necessary, and thus additional research is required.

Furthermore, income level information, which is an important variable in classifying our policy targets in the data, is classified as health insurance premium payment, not actual salary, and may differ from actual income level information. However, since health insurance premiums are determined by income level, and according to previous studies, health insurance premiums have been widely used as a proxy for actual income levels, it seems that health insurance premiums can be reasonably interpreted as income levels.

Finally, the current study may have unobserved confounding variables due to data limitations. For example, in previous studies, education level, family type, and need for care have been shown to be related to LTC and medical utilization. However, this study used accessible variables to control for factors that could affect long-term care and medical utilization.

The second limitation is due to analytical design. In our analysis, the additional 10% group did not satisfy the parallel trend, the design assumption of DID analysis, for our primary dependent variable (LTC OOPs), secondary dependent variables (total medical OOPs, LOS, and inpatient OOPs), and total LTC and medical OOPs dependent variables. In this study, some LTCI OOPs reduction beneficiaries might benefit more from switching into medical aid beneficiaries due to income changes during the year. Therefore, we selected a new control group to perform sensitivity analyses and attempted to overcome some of these limitations.

In addition, in our study, DID analysis was performed considering only one year before and after 2018 when the policy was implemented. Considering our research design, in order to perform DID analysis, it was necessary to select a population with the same income for one year before and after as of 2018, the time of policy implementation. However, in the NHIS-EC data, only a few participants had the same income decile in 2017 and 2019. Therefore, more pre-intervention time points (2014, 2015, 2016) could not be included in the analysis. As a result, in our study, the time point at which we can see the parallel trend between the case group and the control group, which is the assumption of DID, was limited to one time point (2017). However, in order to overcome these limitations, we confirmed a parallel trend by tracking the long-term care and medical service utilization of the previous years (2014, 2015, 2016) of our participants with the same income in 2017 and 2019.

2. Discussion of the results

1) Summary of results

This study investigated the effects of the expansion of the LTCI OOPs reduction policy expansion, which had not been well investigated previously, on long-term care and medical use among LTCI users.

To summarize the results, concerning expenses, an additional 10% reduction in LTCI OOPs decreased LTC OOPs, and although it did not reduce total medical expenses, it resulted in a decrease in total LTC and medical OOPs. Furthermore, concerning utilization, it reduced the LOS of hospitalizations, especially LTCHs utilization.

In addition, the 40% reduction in LTCI OOPs reduced not only LTC OOPs, but also total medical OOPs and total medical expenses. This reduction LTC and medical expenses resulted in a decrease in total LTC and medical OOPs. Furthermore, regarding utilization, LTC and outpatient services utilization increased, while LOS decreased significantly. Moreover, as with the additional 10% reduction group, the utilization of LTCHs was significantly reduced.

This study confirmed that the LTCI OOPs reduction not only reduced LTC OOPs, but also total LTC and medical OOPs. Therefore, it can be interpreted that the expansion of the LTCI OOPs reduction policy, which was intended to relieve the burden of low-income LTCI beneficiaries, worked effectively. Furthermore, the other findings suggest that utilization and expenses of LTC and medical services may vary according to OOPs

reduction rates, and the effect was highlighted in the group that benefited from a higher OOPs reduction rate.

From a policy perspective, it is important to understand the changes in both medical and LTC utilization, especially as LTCI OOPs reduction expands, because either policy for medical care or LTC can be implemented depending on the policy objective.

2) Long term care utilization

The main result of this study on long-term care utilization suggested that the LTCI OOPs reduction policy (additional 10%, 40% reduction) reduced the LTC OOPs of LTCI beneficiaries. Furthermore, these findings were observed in both HCBS and institutional care services. Another notable finding was that the effect differed depending on the LTCI OOPs reduction rate. For the LTCI OOPs 40% reduction group, the LTC service utilization has increased. Our results of the increasing service utilization along with the OOPs decrease are consistent with many previous studies,^{56,95,96} and this is in the same context as the OECD report that the coverage and the degree of OOPs affect the accessibility of medical utilization.⁹⁷ In general, the amount of demand for medical services is determined when the marginal cost of the final additional unit matches the marginal benefit obtained from that unit. Therefore, in the 40% OOPs reduction group, the marginal benefit exceeds the marginal cost, and it is considered that the demand for LTC services has increased. In other words, a 40% reduction in LTCI OOPs can have a sufficient effect on improving LTC utilization accessibility.

Nevertheless, in the LTCI OOPs additional 10% reduction group, OOPs due to LTC utilization decreased, but it did not lead to an increase in LTC utilization. In other words, an additional 10% reduction in LTCI OOPs was not sufficient to increase the LTC utilization. Therefore, the result of the several preceding studies might help in the interpretation of our findings. First, the reason that the additional 10% reduction in LTCI OOPs did not lead to the increased utilization of LTC services could be due to the prevalence of non-covered LTC services. In the case of LTCI in Korea, there are a lot of non-covered services, such as snacks and nutritional supplements, in Institutional care and HCBS' day and night protection services, which remain a tremendous burden for low-income groups.^{98,99} In detail, LTC non-covered services in Korea include the cost of meal ingredients, various programs, and nutritional supplements, which are entirely left to the autonomy of the institution that provides LTC services. Therefore, there are frequent cases of the arbitrary application of the non-covered services due to the insufficient management system for such LTC services.^{99,100} This may increase the burden on of the LTC service users, so a new system to control it is considered necessary. Second, the OOPs reduction ratio that does not reflect the inflation rate may be the reason. Fees for long-term care services are raised to a certain level in consideration of prices, labor costs, and operation. In this case, due to the nature of the flat-rate system of the current policy, the beneficiaries' OOPs also increase alongside. The increase in OOPs due to the inflation rate may be more burdensome for the low-income group than for the general users who use

LTC services. This might prevent an increase in long-term care utilization among low-income groups who benefited from the additional 10% reduction in LTCI.

3) Medical utilization

The association between LTC and medical utilization is crucial because it can prevent unnecessary resource waste, increase resource utilization efficiency, and reduce costs through an appropriate resource allocation or movement, such as replacing or converting each other.

According to the results of this study, in the case of the LTCI OOPs 40% reduction group in which LTC utilization increased, the total OOPs and total expenses due to medical utilization decreased. However, in the case of the additional 10% group, only the tendency for a decrease in the total OOPs and total expenses due to medical utilization was confirmed, although it was not statistically significant. This may also be a result of the LTCI OOPs reduction rate, as in LTC utilization. According to the results of the subgroup analysis, as the LTC services increased in the 40% reduction group of LTCI OOPs, outpatient utilization also increased, while inpatient utilization decreased.

A further finding of this study suggests that use of long-term care services can be considered as a complementary for outpatient services and a substitute for inpatient services.^{63,65,101} As LTC utilization increased in the LTCI OOPs 40% reduction group, outpatient utilization also increased, while inpatient utilization decreased. These results are consistent with some previous.^{12,64} Most of the studies on the relationship between LTC

utilization and medical utilization have been conducted to examine the differences in medical utilization by dividing LTC utilization users and non-users or by dividing the period of use of LTC utilization.^{12,68,69,71} Therefore, for the LTCI beneficiaries who use LTC services, our result that more LTC service utilization may increase outpatient utilization may be a valuable finding. There are several possible explanations for such an outcome.

First, in the case of outpatient utilization, the entry barrier is low, and the patient's ability to pay and choose can affect continuous utilization.¹⁰² Therefore, it is possible that the amount saved due to the LTCI OOPs reduction policy expansion was used for outpatient utilization. Furthermore, in the case of HCBS, it can be interpreted that most services are focused on housework support, and the utilization of outpatient services has increased by improving access to outpatient services through an outing and hospital accompaniment rather than medical care.¹² In addition, the results of the previous studies that increased outpatient utilization as patients became aware of the need for medical care for previously unrecognized disease conditions as more long-term care services were used can be a plausible explanation.¹⁰³ Lastly, even if long-term care services are used, there may be unmet needs for medical services such as disease treatment, and as a result, outpatient utilization may increase.¹⁷ Therefore, the increase in long-term care service plays a role as a complementary while showing a positive relationship with outpatient service.¹⁰⁴

In the case of inpatient utilization, LOS significantly decreased in both the 40% reduction group and the additional 10% group due to the LTCI OOPs reduction policy

expansion. Furthermore, in the 40% reduction group of LTCI OOPs, not only OOPs due to hospitalization but also total expenses were significantly reduced. These results are similar to many previous studies showing that using LTC services reduces LOS, OOPs and total expenses due to hospitalization.^{64,67,69,71} In particular, the group that received a 40% reduction on LTCI OOPs had a 10% or more decrease in LOS compared to the group that received an additional 10% reduction. This may be because the group receiving the 40% reduction used more LTC services due to reduced LTCI OOPs. These findings can be explained for several reasons.

First, in the 40% reduction group, outpatient utilization increased due to the LTCI OOPs reduction policy expansion, and this frequent outpatient utilization may have reduced the hospitalization utilization by preventing the disease from developing into a serious condition.^{59,105} Second, the LTCI OOPs reduction policy reduced the burden of using LTC services, and as access to public LTC services such as HCBS and institutional care services improved, elderly patients have enough motivation to leave the hospital early.⁶⁵ Third, according to our results, beneficiaries of the LTCI OOPs reduction policy were found to decrease the utilization of LTCHs during hospitalization significantly. However, there was no change in the utilization of acute care hospitals. These results can be an important finding in Korea's special circumstances where the "social hospitalization" of elderly people without a need for long-term care treatment is a problem because the standards for hospitalization at LTCHs are very low. In Korea, due to the overlapping roles and functions of LTCHs (LTCHs, covered by NHI) and LTCFs (LTCFs, covered by LTCI),

and the lack of service connection, the indiscriminate use of services is becoming a social problem.^{106,107} In Korea, LTCFs provide welfare services including physical activity and daily housework support for people who have difficulty moving due to senile diseases such as dementia and stroke, and LTCHs provide medical services including hospitalization, outpatient, and rehabilitation for people with disabilities who need LTC. However, due to the recent increase in LTCHs, excessive medical treatment and rehabilitation services are provided to patients who do not need much medical or nursing care, and those excluded from LTCI beneficiaries are being “socially hospitalized” to LTCHs as the next best option.¹⁰⁷ Therefore, due to the lack of clear distinction between LTCHs and LTCFs, resource allocation is inefficient and the needs of the elderly are not met properly.¹⁰⁶ Our findings suggest that improved access to LTC services for the elderly can reduce unnecessary hospitalization for LTCHs. This result can be an important discovery in terms of cost-efficient utilization of resources. Furthermore, these findings may be explained by the results of other studies that provide insight into the substitutional relationship between LTCFs and LTCHs.^{108,109} This suggests that the utilization of LTCHs may decrease as beneficiaries of the LTCI OOPs reduction replace LTCHs with LTCFs services. Another explanation for this is that it is cheaper for beneficiaries of the LTCI OOPs reduction policy to use LTCFs services than to use LTCHs services.⁶⁸ In addition, in the case of the control group, which is not a beneficiary of the LTCI OOPs reduction policy expansion in this study, the utilization of LTCHs may be more cost-effective than the utilization of LTCFs, considering all non-covered services. These differences may have combined to cause

differences in LTCHs utilization. Despite these possible explanations, another additional reason for the decrease in LTCHs, the newly reorganized Copayment Ceiling system in Korea in 2018, our intervention period, could be the reason. Unlike the general group, a special upper limit is applied to the low-income group, so if the hospitalization exceeds 120 days, a monetary disadvantage is applied to the user. In our study, we tried to control the effects of other policy interventions through parallel trend tests, but the Copayment Ceiling system was introduced during the same period as our intervention, so it was not sufficiently controlled. Therefore, future research should consider the effects of these systems.

4) LTC and Medical utilization

Finally, we investigated changes in total expenses for both LTC and medical utilization. We found that although there was no change in total LTC and medical expenses, there was a significant decrease in total LTC and medical OOPs.

These results contributed to the decrease in both LTC and total medical OOPs in the LTCI OOPs 40% reduction group. Furthermore, for the LTCI OOPs additional 10% group, we found a decrease in total LTC and medical OOPs which resulted from the tendency of LTC OOPs, LOS and total medical OOPs to decrease. Therefore, the LTCI OOPs reduction policy reduces not only LTC OOPs, but also total LTC and medical OOPs, and has reduced the LTC and medical utilization burden of the low-income group who are beneficiaries of the LTCI OOPs reduction policy expansion. Although the findings of this

study provide some plausible results, they do not provide scientific evidence that the benefits of an extended LTCI OOPs reduction policy are cost-effective for medical utilization. Furthermore, when measuring the benefits of the LTCI OOPs reduction policy expansion, not only expenses, but also other aspects other than financial features, such as health improvement, family caregiver burden reduction, and labor performance improvement, should be considered.

3. Implications of the study

LTCI aims to improve the health and stable life of the elderly, reduce the burden on the family, and improve the quality of life by providing mobility support to the elderly who cannot lead a normal life due to old age or geriatric diseases. Many elderly people in Korea cannot use family caregivers, partly because their family size has decreased. Therefore, we expect that the role of LTCI in supporting the healthy lives of the elderly will continue to increase in the future. In this context, our results evaluating the LTCI OOPs reduction policy expansion provide several insights into policy implications.

As many previous studies have shown, low access to LTC contributes to high health care expenses among the elderly, such as social hospitalization for LTCHs, and consequently leads to inefficient utilization of health care resources.⁶⁶ For seniors, they choose LTCHs or LTC Services based on their needs, including social care and health care needs.¹¹⁰ In Korea, social hospitalization using LTCHs is emerging as a big problem in order not to burden the family because the elderly without medical needs do not have a supporter. This may be the result of unclear role-setting of LTC (especially, LTCFs) and LTCHs services.¹⁰⁶ In our study, the expanded LTCI OOPs reduction policy lowered the burden of long-term care service utilization in the 40% reduction group and the additional 10% group, resulting in a significant change in the reduction of LTCHs. These results were highlighted in a group with higher LTCI OOPs reduction rates. Therefore, these results suggest that LTC service users may be motivated to switch from LTCHs to institutional

care services if the burden on LTC services decreases. Furthermore, our results could serve as a good evidence for the government's policy to reduce social hospitalization at LTCHs, which is a continuing problem in the country, and also suggests that the LTCI OOPs reduction policy can mitigate inefficiencies between LTC and medical utilization. Therefore, policymakers should better understand that the amount paid by low-income beneficiaries in the decision-making process can have the greatest impact on service choices.

In addition, according to the results of this study, the utilization of long-term care services showed the effect of complementary for outpatient utilization and substitute for inpatient utilization. In light of these results, policymakers should carefully design policies with a better understanding of the chain effect of increasing long-term care services encouraging an increase in outpatient utilization and decrease in inpatient utilization.

In this study, the LTCI OOPs reduction policy expansion reduced the burden of the utilization the LTC service in the additional 10% group but did not lead to the utilization of additional LTC services as previously discussed. An additional 10% OOPs reduction may not have provided sufficient incentives to increase the utilization of LTC services due to the rise in LTC's non-covered services and price. Therefore, it is considered necessary for policy makers to calculate the appropriate LTC services OOPs rate for the target income group in consideration of the price increase and fee increase, and to establish a clear basis for it. Furthermore, it is essential to consider measures such as setting and controlling the

upper limit for each non-covered LTC service, or partially covering non-covered high-expenses services such as food expenses.

It is also important to design and provide appropriate LTCI programs to meet the needs of the elderly from a policy perspective. In recent years, key policy topics and practices have emerged, including diversifying the types of formal care provided by LTCI and promoting integration with community resources (i.e. community-based care).¹¹¹⁻¹¹³ Elderly people prefer to be cared for at home rather than in an institution. Therefore, policymakers need to seek ways to strengthen the seamless linkage system between LTC services and community medical resources in terms of continuity of care and treatment and integrated treatment. This could include empowering nurses who perform home-visiting services to provide basic medical care, and strengthening health care by combining the referral care system of institutional care services with telemedicine at all times.

Finally, the LTCI, which provides LTC, and the NHI system, which provides medical services, are administratively and financially separated. Policymakers need to be aware of challenges to the success of developing the system, including imbalanced resources between sectors, fragmentation of service delivery to the elderly, and financial stability.

VI. Conclusion

This study investigates the effects of the LTCI OOPs reduction policy expansion conducted among low-income LTCI beneficiaries on LTC and medical utilization. The results of this study suggest that the OOPs reduction for LTC services can increase access to LTC utilization and reduce OOPs related to LTC and medical utilization as well. Furthermore, LTC service suggests that it can be a complementary for outpatient utilization, and in the case of hospitalization, it can be a substitution, especially in LTCHs. However, it should be noted that these effects may vary depending on the LTCI OOPs reduction rates.

Considering that the aging trend will continue in the future, the role of LTC services is expected to increase substantially. Therefore, establishing appropriate OOPs for LTC utilization based on income and designing LTC programs will be critical to providing the elderly with the support and services they need. Furthermore, it suggests that appropriate LTCI OOPs rates can be a solution to reduce medical utilization, such as “social hospitalization” of LTCHs, and solve the resulting waste of medical resources.

Abbreviations

- WHO : World Health Organization
- OECD : Organization for Economic Co-operation and Development
- LTC : Long-term care
- LTCI : Long-term care insurance
- OOPs : Out-of-pocket expenses
- HCBS : Home- and community-based services
- LTCHs : Long-term care hospital
- LTCFs : Long-Term Care Facilities
- LOS : Length of stay
- DID : Difference-in-differences method
- HIwv index : Horizontal inequity index
- NHI : National Health Insurance
- NHIS : National Health Insurance Service
- NHIS-EC : National Health Insurance Service-Elderly Cohort
- ICD-10 : International Classification of Diseases 10th Revision
- CCI : Charlson comorbidity index
- PSM : Propensity score matching
- GEE : Generalized estimating equation

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Appendix

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Appendix 1. General Characteristics of the Study Population at Baseline (overall participants)

Variables	Total		Non-Beneficiaries		Beneficiaries				p-value
			Control		Additional 10%		40% reduction		
	N	%	N	%	N	%	N	%	
Total	15264	100.0	11862	77.7	2383	15.6	1019	6.7	
Gender									<.0001
Male	4021	26.3	3324	28.0	445	18.7	252	24.7	
Female	11243	73.7	8538	72.0	1938	81.3	767	75.3	
Age									<.0001
≤74	2851	18.7	2289	19.3	362	15.2	200	19.6	
75-79	3573	23.4	2916	24.6	441	18.5	216	21.2	
80-84	4924	32.3	3755	31.7	827	34.7	342	33.6	
≥85	3916	25.7	2902	24.5	753	31.6	261	25.6	
Insurance type									<.0001
Self-employed insured	4133	27.1	2336	19.7	1458	61.2	339	33.3	
Employee insured	11131	72.9	9526	80.3	925	38.8	680	66.7	
Region									<.0001
Metropolitan	5650	37.0	4468	37.7	787	33.0	395	38.8	
City	3307	21.7	2692	22.7	418	17.5	197	19.3	
Rural	6307	41.3	4702	39.6	1178	49.4	427	41.9	
primary caregiver									<.0001
Child	5607	36.7	4329	36.5	898	37.7	380	37.3	
Married partner	4260	27.9	3594	30.3	407	17.1	259	25.4	
Paid caregiver	2648	17.3	1942	16.4	522	21.9	184	18.1	
Other ^a	1968	12.9	1443	12.2	388	16.3	137	13.4	
None	781	5.1	554	4.7	168	7.0	59	5.8	
LTC grade									0.5360
1-2	2634	17.3	2062	17.4	407	17.1	165	16.2	
3-4	12610	82.6	8958	75.5	1826	76.6	1826	179.2	
5	1064	7.0	842	7.1	150	6.3	72	7.1	
Type of service									<.0001
Institutional care	3215	21.1	2237	18.9	755	31.7	223	21.9	
HCBS	11293	74.0	9047	76.3	1500	62.9	746	73.2	
Both	756	5.0	578	4.9	128	5.4	50	4.9	
CCI									0.0285
0	904	5.9	686	5.8	158	6.6	60	5.9	
1	6820	44.7	5238	44.2	1114	46.7	468	45.9	
≥2	7540	49.4	5938	50.1	1111	46.6	491	48.2	
Disability									<.0001
No	8802	57.7	6692	56.4	1460	61.3	650	63.8	
Yes	6462	42.3	5170	43.6	923	38.7	369	36.2	
ADL		19.4±5.8		19.5±5.8		19.3±5.8		19.2±5.7	0.1982
Cognitive score		3.6±1.7		3.6±1.8		3.8±1.7		3.6±1.7	<.0001
Behavioral problems		0.8±1.3		0.8±1.3		0.9±1.3		0.8±1.3	0.0031

^a Other includes grandchild, relative, neighborhood and parent.

CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 2. Change in the number of LTC services in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10%, control group)

Variable	Additional 10%			Control		
	Before (2017)	After (2019)	<i>p</i> -value	Before (2017)	After (2019)	<i>p</i> -value
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Total	346.7 ± 203.6	400.0 ± 222.1	<.0001	349.7 ± 230.1	399.8 ± 242.6	<.0001
Gender						
Male	350.8 ± 218.3	407.2 ± 236.9	0.0002	347.6 ± 240.7	405.5 ± 254.4	<.0001
Female	345.8 ± 200.1	398.4 ± 218.6	<.0001	350.2 ± 227.7	398.4 ± 239.8	<.0001
Age						
≤74	358.8 ± 236.6	422.2 ± 255.4	0.0006	366.5 ± 242.0	419.9 ± 254.1	<.0001
75-79	336.8 ± 205.3	398.4 ± 227.3	<.0001	331.9 ± 223.8	390.3 ± 236.7	<.0001
80-84	348.1 ± 195.8	399.3 ± 213.5	<.0001	348.5 ± 231.8	402.9 ± 247.0	<.0001
≥85	345.2 ± 193.6	391.1 ± 210.4	<.0001	353.5 ± 225.5	392.1 ± 235.0	<.0001
Insurance type						
Self-employed insured	337.8 ± 193.3	389.0 ± 207.9	<.0001	366.5 ± 240.1	413.1 ± 252.3	<.0001
Employee insured	360.8 ± 218.2	417.4 ± 241.9	<.0001	345.7 ± 227.5	396.5 ± 240.1	<.0001
Region						
Metropolitan	361.4 ± 206.5	411.2 ± 231.1	<.0001	365.0 ± 232.0	417.0 ± 248.6	<.0001
City	376.5 ± 222.4	436.5 ± 233.2	0.0002	369.3 ± 239.7	422.7 ± 248.9	<.0001
Rural	326.4 ± 192.4	379.7 ± 209.6	<.0001	324.3 ± 220.3	370.6 ± 230.1	<.0001
Primary caregiver						
Child	347.0 ± 227.2	428.0 ± 242.5	<.0001	355.6 ± 248.2	421.7 ± 258.4	<.0001
Married partner	379.6 ± 259.0	454.4 ± 266.9	<.0001	358.7 ± 261.8	421.8 ± 265.1	<.0001
Paid caregiver	343.2 ± 126.7	342.3 ± 153.3	0.9183	351.7 ± 166.1	354.9 ± 187.2	0.6554
Other ^a	335.5 ± 168.1	371.1 ± 181.6	0.0047	336.8 ± 201.5	375.9 ± 222.6	<.0001
None	302.8 ± 174.8	364.1 ± 198.7	0.0029	285.3 ± 151.7	335.2 ± 168.9	<.0001
LTC grade						
1-2	387.3 ± 190.6	381.7 ± 219.6	0.6952	416.7 ± 248.9	407.9 ± 269.0	0.4107
3-4	341.0 ± 205.2	399.3 ± 223.9	<.0001	338.6 ± 223.7	392.5 ± 235.9	<.0001
5	306.6 ± 203.7	458.5 ± 197.1	<.0001	309.1 ± 224.4	466.4 ± 239.6	<.0001
Type of service						
Institutional care	337.7 ± 73.3	327.4 ± 86.68	0.0126	335.5 ± 76.7	321.4 ± 105.6	<.0001
HCBS	348.5 ± 244.9	439.3 ± 259.7	<.0001	353.0 ± 259.8	424.8 ± 268.1	<.0001
Both	378.6 ± 189.3	368.2 ± 183.2	0.6539	360.1 ± 173.1	351.3 ± 160.7	0.4780
CCI						
0	343.3 ± 195.2	376 ± 231.1	0.1741	328.7 ± 216.0	380.0 ± 225.0	0.0004
1	349.4 ± 202.8	399.9 ± 220.4	<.0001	354.6 ± 224.1	402.9 ± 237.0	<.0001
≥2	344.5 ± 205.7	403.6 ± 222.5	<.0001	347.8 ± 237.8	399.4 ± 250.4	<.0001
Disability						
No	330.8 ± 191.6	389.2 ± 206.8	<.0001	336.2 ± 223.0	395.6 ± 236.9	<.0001
Yes	371.9 ± 219.0	417.2 ± 243.4	<.0001	371.1 ± 239.5	406.3 ± 251.3	<.0001

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 3. Change in the number of LTC services in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction, control group)

Variable	40% reduction			Control		
	Before (2017)		p-value	Before (2017)		p-value
	Mean ± SD	After (2019) Mean ± SD		Mean ± SD	After (2019) Mean ± SD	
Total	323.3 ± 203.1	396.9 ± 225.5	<.0001	345.9 ± 235.6	401.4 ± 248.1	<.0001
Gender						
Male	316.2 ± 195.9	385.8 ± 216.6	0.0002	346.9 ± 254.0	403.4 ± 260.2	<.0001
Female	325.6 ± 205.4	400.5 ± 228.4	<.0001	345.6 ± 229.3	400.8 ± 244.1	<.0001
Age						
≤74	323.4 ± 210.1	406.2 ± 237.4	0.0003	369.5 ± 254.7	423.7 ± 260.6	0.0003
75-79	330.3 ± 213.8	412.1 ± 239.2	0.0002	322.2 ± 227.9	382.0 ± 238.8	<.0001
80-84	318.9 ± 198.5	388.7 ± 217.0	<.0001	343.4 ± 231.4	406.5 ± 249.9	<.0001
≥85	323.1 ± 195.2	387.9 ± 215.7	0.0004	350.9 ± 230.7	393.9 ± 242.5	0.0003
Insurance type						
Self-employed insured	303.7 ± 192.8	376.0 ± 211.7	<.0001	357.6 ± 233.3	416.2 ± 250.9	<.0001
Employee insured	333.0 ± 207.4	407.3 ± 231.6	<.0001	343.0 ± 236.2	397.8 ± 247.4	<.0001
Region						
Metropolitan	345.8 ± 204.8	417.7 ± 223.3	<.0001	361.1 ± 230.3	417.6 ± 244.2	<.0001
City	336.2 ± 218.8	405.5 ± 230.0	0.0023	368.1 ± 252.2	422.6 ± 257.8	<.0001
Rural	296.5 ± 190.9	373.7 ± 223.8	<.0001	319.1 ± 228.2	374.2 ± 243.8	<.0001
Primary caregiver						
Child	344.4 ± 222.0	415.6 ± 236.8	<.0001	348.9 ± 244.1	424.2 ± 256.4	<.0001
Married partner	317.5 ± 226.7	430.2 ± 270.4	<.0001	358.0 ± 273.8	429.0 ± 276.2	<.0001
Paid caregiver	315.3 ± 114.5	348.9 ± 142.1	0.0129	348.4 ± 179.4	345.7 ± 189.4	0.8162
Other ^a	304.8 ± 209.7	371.9 ± 200.9	0.0073	335.5 ± 197.2	373.3 ± 228.2	0.0174
None	280.3 ± 149.8	337.7 ± 151.6	0.0410	268.0 ± 154.8	316.7 ± 161.5	0.0092
LTC grade						
1-2	383.9 ± 224.9	438.5 ± 272.0	0.0476	409.9 ± 269.9	410.4 ± 281.2	0.9781
3-4	310.4 ± 192.4	384.2 ± 214.2	<.0001	338.2 ± 226.2	394.4 ± 240.4	<.0001
5	324.5 ± 238.5	439.2 ± 214.4	0.0029	283.7 ± 223.0	456.8 ± 244.3	<.0001
Type of service						
Institutional care	327.8 ± 87.7	330.9 ± 78.2	0.6944	331.4 ± 82.2	315.8 ± 103.0	0.0044
HCBS	320.1 ± 228.0	418.3 ± 254.1	<.0001	349.6 ± 263.6	425.6 ± 271.2	<.0001
Both	350.7 ± 174.2	371.0 ± 141.6	0.5249	345.3 ± 157.9	355.0 ± 180.5	0.6317
CCI						
0	361.8 ± 241.1	469.7 ± 303.1	0.0329	336.8 ± 228.0	399.2 ± 261.1	0.0191
1	329.2 ± 197.0	393.6 ± 217.4	<.0001	354.8 ± 229.3	406.6 ± 239.9	<.0001
≥2	312.9 ± 203.4	391.1 ± 221.0	<.0001	339.3 ± 241.7	397.2 ± 253.7	<.0001
Disability						
No	313.2 ± 193.4	391.2 ± 211.7	<.0001	331.4 ± 225.7	397.1 ± 240.7	<.0001
Yes	341.1 ± 218.2	406.8 ± 248.0	0.0001	371.5 ± 250.2	409.1 ± 260.7	0.0006

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home- and community-based services.

Appendix 4. Changes in LTC services OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10%, control group)

Variable	Additional 10%					Control								
	Before (2017)			After (2019)		<i>p</i> -value	Before (2017)			After (2019)		<i>p</i> -value		
	Mean	±	SD	Mean	±		SD	Mean	±	SD	Mean		±	SD
Total	1,112,367	±	745,663	1,177,115	±	712,155	<.0001	1,657,753	±	1,171,632	2,107,186	±	1,359,665	<.0001
Gender														
Male	981,309	±	643,878	1,052,025	±	655,817	0.1049	1,439,327	±	1,042,079	1,842,755	±	1,238,979	<.0001
Female	1,142,461	±	764,112	1,205,838	±	721,576	0.0080	1,707,908	±	1,193,859	2,167,904	±	1,378,851	<.0001
Age														
≤74	987,259	±	675,716	1,084,674	±	649,551	0.0484	1,496,166	±	1,026,782	1,873,069	±	1,210,199	<.0001
75-79	1,063,432	±	723,505	1,145,717	±	700,005	0.0864	1,514,041	±	1,124,205	1,996,066	±	1,317,055	<.0001
80-84	1,149,625	±	764,246	1,185,439	±	730,727	0.3302	1,661,518	±	1,169,113	2,153,030	±	1,378,390	<.0001
≥85	1,160,253	±	762,512	1,230,802	±	723,231	0.0657	1,815,398	±	1,244,249	2,234,428	±	1,412,100	<.0001
Insurance type														
Self-employed insured	1,120,506	±	720,596	1,136,761	±	596,787	0.5072	1,667,310	±	1,162,647	2,031,267	±	1,350,147	<.0001
Employee insured	1,099,539	±	783,774	1,240,722	±	859,775	0.0002	1,655,450	±	1,173,875	2,125,477	±	1,361,432	<.0001
Region														
Metropolitan	1,181,517	±	792,344	1,233,356	±	787,111	0.1931	1,767,331	±	1,211,036	2,247,503	±	1,387,401	<.0001
City	1,095,599	±	744,853	1,185,932	±	756,772	0.0824	1,598,771	±	1,117,847	2,005,299	±	1,281,238	<.0001
Rural	1,072,119	±	710,297	1,136,412	±	637,150	0.0208	1,588,944	±	1,156,770	2,034,085	±	1,366,398	<.0001
Primary caregiver														
Child	869,665	±	602,443	1,043,038	±	677,212	<.0001	1,358,930	±	889,885	1,906,046	±	1,208,013	<.0001
Married partner	798,397	±	498,356	995,280	±	646,090	<.0001	1,237,908	±	740,929	1,680,076	±	1,037,012	<.0001
Paid caregiver	1,668,458	±	763,155	1,507,269	±	698,697	0.0004	2,659,530	±	1,405,993	2,918,697	±	1,603,660	<.0001
Other ^a	1,243,835	±	770,167	1,255,212	±	750,102	0.8349	1,911,401	±	1,299,059	2,331,816	±	1,424,007	<.0001
None	1,138,818	±	788,343	1,128,103	±	627,964	0.8905	1,943,182	±	1,342,334	2,393,865	±	1,430,183	<.0001
LTC grade														
1-2	1,597,144	±	855,658	1,470,417	±	855,959	0.0350	2,376,911	±	1,476,903	2,601,058	±	1,725,396	0.0007
3-4	1,040,803	±	678,128	1,120,453	±	666,607	0.0003	1,558,758	±	1,047,771	2,018,398	±	1,262,574	<.0001
5	668,180	±	598,288	1,071,050	±	618,919	<.0001	971,536	±	808,829	1,890,720	±	1,099,691	<.0001
Type of service														
Institutional care	1,891,210	±	599,522	1,677,774	±	614,912	<.0001	3,446,219	±	850,109	3,568,951	±	1,302,045	0.0025
HCBS	698,858	±	431,734	884,617	±	55,873	<.0001	1,129,872	±	640,952	1,627,281	±	991,270	<.0001

Both	1,364,234 ± 636,341	1,651,714 ± 944,826	0.0047	2,126,686 ± 901,575	3,199,622 ± 1,385,561	<.0001
CCI						
0	955,173 ± 654,171	939,208 ± 597,708	0.8210	1,526,610 ± 1,082,700	1,878,941 ± 1,232,854	<.0001
1	1,165,177 ± 753,263	1,205,831 ± 715,714	0.1917	1,756,523 ± 1,210,355	2,206,411 ± 1,364,348	<.0001
≥2	1,081,770 ± 745,959	1,182,155 ± 717,828	0.0012	1,577,298 ± 1,136,101	2,040,053 ± 1,364,474	<.0001
Disability						
No	1,122,664 ± 765,948	1,203,772 ± 711,818	0.0031	1,665,947 ± 1,195,222	2,179,415 ± 1,375,159	<.0001
Yes	1,096,080 ± 712,503	1,134,949 ± 711,034	0.2409	1,644,799 ± 1,133,429	1,993,001 ± 1,327,051	<.0001

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 5. Changes in LTC services OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction, control group)

Variable	40% reduction					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	1,424,171	± 1,064,478	1,543,908	± 1,030,154	0.0099	1,593,117	± 1,147,686	2,024,072	± 1,331,426	<.0001
Gender										
Male	1,210,260	± 951,225	1,346,072	± 982,268	0.1155	1,414,585	± 1,070,325	1,765,632	± 1,236,527	<.0001
Female	1,494,451	± 1,090,595	1,608,907	± 1,037,821	0.0354	1,651,774	± 1,166,260	2,108,984	± 1,350,664	<.0001
Age										
≤74	1,214,314	± 949,801	1,297,332	± 901,854	0.3706	1,483,253	± 1,060,219	1,847,851	± 1,250,073	<.0001
75-79	1,310,842	± 984,346	1,435,346	± 1,020,874	0.1976	1,484,448	± 1,134,654	1,917,989	± 1,296,602	<.0001
80-84	1,492,776	± 1,101,600	1,626,956	± 997,595	0.0954	1,625,223	± 1,152,319	2,109,784	± 1,350,057	<.0001
≥85	1,588,873	± 1,129,300	1,713,878	± 1,127,332	0.2062	1,725,166	± 1,201,228	2,134,590	± 1,376,798	<.0001
Insurance type										
Self-employed insured	1,461,109	± 1,096,433	1,484,203	± 1,027,127	0.7773	1,546,661	± 1,131,981	1,929,110	± 1,292,486	<.0001
Employee insured	1,405,756	± 1,048,517	1,573,673	± 1,031,122	0.0030	1,604,391	± 115,140	2,047,118	± 1,339,947	<.0001
Region										
Metropolitan	1,553,858	± 1,127,414	1,694,488	± 1,071,031	0.0727	1,707,713	± 1,191,452	2,159,925	± 1,362,740	<.0001
City	1,384,159	± 1,001,272	1,464,318	± 987,399	0.4242	1,527,344	± 1,089,520	1,883,858	± 1,272,357	<.0001
Rural	1,322,662	± 1,021,889	1,441,332	± 995,965	0.0861	1,524,052	± 1,130,986	1,977,990	± 1,324,629	<.0001
Primary caregiver										
Child	1,243,507	± 777,476	1,429,361	± 907,112	0.0025	1,326,560	± 865,174	1,866,138	± 1,191,209	<.0001
Married partner	985,723	± 660,411	1,147,574	± 768,459	0.0104	1,195,030	± 733,408	1,627,129	± 1,003,804	<.0001
Paid caregiver	2,309,204	± 1,360,264	2,208,520	± 1,205,379	0.4529	2,604,771	± 1,407,228	2,817,469	± 1,596,627	0.0246
Other ^a	1,502,995	± 1,184,607	1,617,023	± 1,014,443	0.3929	1,923,094	± 1,333,883	2,305,490	± 1,454,811	0.0003
None	1,569,341	± 1,129,721	1,779,042	± 1,169,417	0.3239	1,774,225	± 1,324,626	2,192,925	± 1,454,418	0.0109
LTC grade										
1-2	1,997,326	± 1,389,936	1,930,560	± 1,177,856	0.6381	2,232,262	± 1,495,772	2,519,424	± 1,725,073	0.0052
3-4	1,354,388	± 957,146	1,484,546	± 985,266	0.0068	1,521,209	± 1,024,524	1,941,865	± 1,230,447	<.0001
5	868,606	± 759,380	1,269,980	± 935,113	0.0054	909,402	± 816,483	1,781,753	± 1,071,716	<.0001
Type of service										
Institutional care	2,818,647	± 1,097,304	2,512,813	± 995,461	0.0022	3,397,777	± 904,728	3,517,785	± 1,347,523	0.0745
HCBS	988,518	± 595,952	1,220,356	± 827,310	<.0001	1,109,443	± 639,656	1,589,210	± 963,516	<.0001
Both	1,704,742	± 930,786	2,049,980	± 1,011,893	0.0789	2,141,534	± 879,508	3,053,608	± 1,479,203	<.0001

CCI							
0	1,447,943 ± 918,804	1,559,051 ± 966,877	0.5200	1,584,875 ± 1,118,326	1,870,705 ± 1,224,834	0.0249	
1	1,526,203 ± 1,085,314	1,606,383 ± 1,056,528	0.2524	1,725,817 ± 1,189,773	2,177,211 ± 1,339,877	<.0001	
≥2	1,324,013 ± 1,053,457	1,482,508 ± 1,010,336	0.0163	1,479,010 ± 1,101,200	1,908,303 ± 1,322,516	<.0001	
Disability							
No	1,505,502 ± 1,111,452	1,658,541 ± 1,076,974	0.0118	1,611,807 ± 1,181,072	2,100,199 ± 1,352,979	<.0001	
Yes	1,280,905 ± 961,078	1,341,980 ± 908,854	0.3754	1,560,194 ± 1,086,124	1,889,974 ± 1,282,235	<.0001	

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 6. Changes in LTC services total expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10%, control group)

Variable	Additional 10%					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	11,894,765	± 6,403,401	16,109,520	± 7,178,664	<.0001	10,542,149	± 6,201,924	14,271,625	± 7,510,595	<.0001
Gender										
Male	10,694,578	± 6,028,713	14,327,765	± 6,816,224	<.0001	9,455,379	± 5,803,133	12,833,583	± 7,174,142	<.0001
Female	12,170,349	± 6,456,434	16,518,643	± 7,199,007	<.0001	10,791,691	± 6,263,834	14,601,825	± 7,547,754	<.0001
Age										
≤74	10,963,586	± 6,255,357	14,856,897	± 7,086,885	<.0001	9,927,207	± 5,697,382	13,252,004	± 6,981,148	<.0001
75-79	11,440,475	± 6,511,345	15,868,256	± 7,245,910	<.0001	9,831,457	± 6,102,644	13,773,466	± 7,430,962	<.0001
80-84	12,131,494	± 6,393,497	16,292,184	± 7,198,500	<.0001	10,537,754	± 6,169,698	14,465,866	± 755,123	<.0001
≥85	12,348,488	± 6,370,564	16,652,393	± 7,096,851	<.0001	11,258,506	± 6,446,698	14,840,055	± 7,688,916	<.0001
Insurance type										
Self-employed insured	12,388,060	± 6,437,094	16,762,661	± 7,043,958	<.0001	10,660,535	± 6,249,280	14,321,216	± 7,688,466	<.0001
Employee insured	11,117,225	± 6,275,071	15,080,029	± 7,271,582	<.0001	10,513,626	± 6,190,667	14,305,212	± 7,467,398	<.0001
Region										
Metropolitan	12,131,683	± 6,479,408	16,092,503	± 7,491,798	<.0001	11,136,035	± 6,382,045	15,048,217	± 7,672,565	<.0001
City	11,626,987	± 6,211,481	15,960,537	± 6,828,380	<.0001	10,371,128	± 6,023,010	13,960,709	± 7,147,949	<.0001
Rural	11,831,502	± 6,419,507	16,173,753	± 7,090,779	<.0001	10,084,562	± 6,087,873	13,722,974	± 7,500,482	<.0001
Primary caregiver										
Child	9,930,959	± 5,469,800	14,878,150	± 6,725,781	<.0001	9,326,633	± 5,347,927	13,530,207	± 7,031,773	<.0001
Married partner	9,145,107	± 4,754,464	13,293,938	± 5,773,822	<.0001	8,710,950	± 4,808,210	12,313,608	± 6,399,848	<.0001
Paid caregiver	16,388,387	± 6,263,236	19,580,110	± 7,556,920	<.0001	14,731,947	± 7,103,770	17,622,524	± 8,675,621	<.0001
Other ^a	13,155,367	± 6,360,005	17,009,521	± 7,045,097	<.0001	11,703,792	± 6,547,339	15,359,101	± 7,520,406	<.0001
None	12,179,431	± 6,857,310	16,650,370	± 7,109,324	<.0001	11,575,024	± 6,732,234	15,294,809	± 7,444,039	<.0001
LTC grade										
1-2	15,888,088	± 7,198,770	18,622,637	± 8,788,249	<.0001	13,788,183	± 7,478,302	16,220,391	± 9,450,109	<.0001
3-4	11,328,538	± 5,861,606	15,575,994	± 6,715,212	<.0001	10,106,938	± 5,679,834	13,846,054	± 7,026,973	<.0001
5	7,952,413	± 5,507,423	15,785,384	± 6,341,872	<.0001	7,302,498	± 5,279,885	14,338,698	± 6,610,512	<.0001
Type of service										
Institutional care	18,346,878	± 4,244,101	21,350,163	± 5,876,944	<.0001	18,290,654	± 4,427,608	20,880,495	± 6,771,422	<.0001
HCBS	8,506,204	± 4,646,654	13,116,273	± 6,052,074	<.0001	8,246,010	± 4,732,871	12,101,565	± 6,413,993	<.0001

Both	13,547,071 ± 4,628,016	19,653,934 ± 7,150,884	<.0001	12,706,993 ± 4,970,404	19,215,592 ± 7,236,431	<.0001
CCI						
0	10,694,678 ± 6,010,461	13,393,064 ± 6,781,376	0.0002	9,959,974 ± 5,821,338	13,307,185 ± 6,860,942	<.0001
1	12,449,569 ± 6,494,412	16,572,193 ± 7,218,033	<.0001	11,025,435 ± 6,280,202	14,808,613 ± 7,402,844	<.0001
≥2	11,509,131 ± 6,318,827	16,031,916 ± 7,111,329	<.0001	10,140,031 ± 6,140,923	13,869,892 ± 7,667,754	<.0001
Disability						
No	11,923,540 ± 6,527,847	16,562,650 ± 7,193,892	<.0001	10,504,867 ± 6,300,444	14,658,751 ± 7,540,305	<.0001
Yes	11,849,248 ± 6,204,685	15,392,760 ± 7,099,532	<.0001	10,601,086 ± 6,043,560	13,659,629 ± 7,423,660	<.0001

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 7. Changes in LTC services total expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction, control group)

Variable	40% reduction				Control									
	Before (2017)			p-value	Before (2017)			p-value						
	Mean	±	SD		Mean	±	SD							
Total	10,515,344	±	6,144,544	15,092,585	±	7,139,917	<.0001	10,211,428	±	6,139,481	13,869,304	±	7,460,127	<.0001
Gender														
Male	9,296,645	±	5,866,207	13,525,219	±	7,232,732	<.0001	9,272,941	±	5,997,901	12,386,960	±	7,306,777	<.0001
Female	10,915,751	±	6,184,739	15,607,547	±	7,038,048	<.0001	10,519,771	±	6,155,412	14,356,332	±	7,447,246	<.0001
Age														
≤74	9,528,345	±	5,876,556	13,861,953	±	7,016,155	<.0001	9,776,935	±	5,848,614	12,975,230	±	7,153,622	<.0001
75-79	10,228,367	±	5,857,242	14,501,080	±	6,905,665	<.0001	9,583,286	±	6,138,256	13,352,550	±	7,421,214	<.0001
80-84	10,882,703	±	6,323,803	15,677,696	±	7,139,596	<.0001	10,390,370	±	6,151,526	14,326,899	±	7,459,756	<.0001
≥85	11,027,797	±	6,270,393	15,758,422	±	7,299,543	<.0001	10,829,740	±	6,279,377	14,382,467	±	7,642,731	<.0001
Insurance type														
Self-employed insured	10,004,787	±	6,025,647	14,636,517	±	7,266,053	<.0001	10,018,441	±	6,189,985	13,809,772	±	7,628,007	<.0001
Employee insured	10,769,872	±	6,171,632	15,319,948	±	7,070,596	<.0001	10,258,263	±	6,127,512	13,883,751	±	7,420,318	<.0001
Region														
Metropolitan	11,362,787	±	6,395,768	16,239,270	±	6,969,550	<.0001	10,849,562	±	6,323,008	14,676,118	±	7,623,350	<.0001
City	10,443,873	±	5,934,416	14,541,597	±	7,059,390	<.0001	10,017,698	±	5,965,411	13,338,256	±	7,272,814	<.0001
Rural	9,764,384	±	5,912,119	14,286,037	±	7,208,010	<.0001	9,727,627	±	6,016,385	13,422,147	±	7,352,862	<.0001
Primary caregiver														
Child	9,825,175	±	5,075,133	14,580,440	±	6,668,870	<.0001	9,170,803	±	5,253,078	13,425,664	±	7,001,558	<.0001
Married partner	8,132,875	±	4,630,672	12,637,065	±	6,235,967	<.0001	8,425,598	±	4,828,236	12,007,648	±	6,344,873	<.0001
Paid caregiver	14,629,363	±	7,091,952	19,081,418	±	7,932,176	<.0001	14,507,746	±	7,074,800	17,191,914	±	8,716,759	<.0001
Other ^a	11,114,129	±	7,011,581	15,426,770	±	6,783,262	<.0001	11,630,999	±	6,716,279	15,022,870	±	7,673,345	<.0001
None	11,198,574	±	6,444,161	15,954,722	±	6,679,204	0.0001	10,750,643	±	6,880,134	14,035,194	±	7,711,965	0.0002
LTC grade														
1-2	13,571,547	±	7,553,123	17,867,496	±	8,318,997	<.0001	13,041,135	±	7,640,695	15,791,778	±	9,546,194	<.0001
3-4	10,116,346	±	5,620,569	14,609,818	±	6,781,549	<.0001	9,926,533	±	5,597,716	13,476,167	±	6,940,327	<.0001
5	7,845,112	±	5,601,097	13,976,793	±	6,592,943	<.0001	6,820,965	±	5,384,944	13,733,536	±	6,788,700	<.0001
Type of service														
Institutional care	17,740,755	±	4,987,120	21,595,470	±	5,438,669	<.0001	18,054,202	±	4,699,710	20,570,389	±	7,136,882	<.0001
HCBS	8,236,294	±	4,633,562	12,813,392	±	6,167,706	<.0001	8,102,327	±	4,720,208	11,912,965	±	6,331,331	<.0001
Both	12,293,437	±	5,037,788	20,095,270	±	7,045,768	<.0001	12,713,615	±	4,825,699	18,579,033	±	7,909,187	<.0001

CCI							
0	10,717,266 ± 5,693,605	15,556,239 ± 6,784,411	<.0001	10,193,621 ± 5,833,390	13,150,434 ± 6,820,264	<.0001	
1	11,046,031 ± 6,099,073	15,556,325 ± 6,956,417	<.0001	10,906,493 ± 6,222,600	14,754,604 ± 7,297,939	<.0001	
≥2	9,984,842 ± 6,207,005	14,593,910 ± 7,332,588	<.0001	9,610,949 ± 6,039,445	13,181,479 ± 7,589,138	<.0001	
Disability							
No	10,905,044 ± 6,368,851	15,799,326 ± 7,143,086	<.0001	10,234,594 ± 6,273,580	14,313,008 ± 7,527,246	<.0001	
Yes	9,828,882 ± 5,671,609	13,847,648 ± 6,971,428	<.0001	10,170,622 ± 5,898,421	13,087,711 ± 7,278,226	<.0001	

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 8. Parallel trend test results for all dependent variables in study participants by additional 10%, 40% reduction and control groups

Variable	Case * Year (interaction effect)					
	"Additional 10% vs Control"			"40% reduction vs Control"		
	β	SE	<i>p</i> -value	β	SE	<i>p</i> -value
Primary dependent variables						
Number of long-term care services	-0.0283	0.0161	0.0798	-0.0115	0.0165	0.4884
OOPs	-0.0512	0.0098	<.0001	-0.0011	0.0161	0.9467
Total expenses	0.0031	0.0095	0.7485	0.0051	0.0158	0.7448
Secondary dependent variables						
Medical utilization expenses						
Total medical OOPs	-0.0400	0.0164	0.0148	-0.0186	0.0249	0.4548
Total medical expenses	-0.0354	0.0221	0.1094	-0.0329	0.0240	0.1718
Outpatient care						
Number of outpatient visits	0.0028	0.0094	0.7666	0.0001	0.0147	0.9996
OOPs	0.0049	0.0115	0.6713	0.0044	0.0176	0.8039
Total expenses	-0.0116	0.0116	0.3143	0.0053	0.0181	0.7687
Inpatient care						
LOS	-0.1215	0.0292	<.0001	-0.0772	0.0438	0.0781
OOPs	-0.0637	0.0216	0.0032	-0.0335	0.0318	0.2919
Total expenses	-0.0733	0.0506	0.1476	-0.0373	0.0317	0.2391
LTC + Medical utilization						
Total LTC & Medical OOPs	-0.0232	0.0081	0.0041	-0.0056	0.0129	0.6636
Total LTC & Medical expenses	0.0009	0.0073	0.9054	-0.0060	0.0122	0.6250

Note : Case included the additional 10% group and the 40% reduction group.
 OOPs, Out-of-pocket expense; LOS, Length of stay; SE, Standard error.
 All covariates are included in the regression.

Appendix 9. Results of the Generalized Linear Model of Additional 10% group for LTC utilization

Variables	No. of long-term care services			OOPs			Total expenses		
	%	95% CI	p-value	%	95% CI	p-value	%	95% CI	p-value
Intervention									
Before	Ref.			Ref.			Ref.		
After	14.3	(0.12 – 0.15)	<0.0001	34.7	(0.28 – 0.31)	<0.0001	39.6	(0.32 – 0.35)	<0.0001
Case^a	2.6	(-0.01 – 0.06)	0.0937	-37.1	(-0.49 – -0.44)	<0.0001	4.0	(0.02 – 0.06)	0.0001
Control^b	Ref.			Ref.			Ref.		
Case*Intervention^c	0.9	(-0.02 – 0.04)	0.4773	-15.7	(-0.20 – -0.14)	<0.0001	1.2	(-0.01 – 0.04)	0.3299
Gender									
Male	Ref.			Ref.			Ref.		
Female	1.7	(-0.01 – 0.05)	0.2620	5.6	(0.03 – 0.08)	<0.001	6.1	(0.04 – 0.08)	<0.001
Age									
≤74	Ref.			Ref.			Ref.		
75-79	-3.9	(-0.08 – -0.00)	0.0390	-2.2	(-0.05 – 0.01)	0.1761	-2.4	(-0.05 – 0.00)	0.0985
80-84	0.8	(-0.03 – 0.04)	0.6647	1.5	(-0.01 – 0.05)	0.3218	-0.2	(-0.03 – 0.03)	0.9037
≥85	0.9	(-0.03 – 0.05)	0.6217	1.3	(-0.02 – 0.04)	0.4077	-0.4	(-0.03 – 0.02)	0.7934
Insurance type									
Self-employed insured	Ref.			Ref.			Ref.		
Employee insured	-1.1	(-0.04 – 0.01)	0.3850	6.7	(0.04 – 0.09)	<0.001	-0.9	(-0.03 – 0.01)	0.3514
Region									
Metropolitan	Ref.			Ref.			Ref.		
City	2.3	(-0.01 – 0.05)	0.1055	-3.3	(-0.06 – -0.01)	0.0060	-1.2	(-0.03 – 0.01)	0.2905
Rural	-8.7	(-0.11 – -0.07)	<0.0001	-7.1	(-0.09 – -0.05)	<0.0001	-4.8	(-0.07 – -0.03)	<0.0001
Primary caregiver									
Child	Ref.			Ref.			Ref.		
Married partner	0.5	(-0.03 – 0.04)	0.7825	1.8	(-0.01 – 0.04)	0.1909	0.3	(-0.02 – 0.03)	0.8259
Paid caregiver	-5.1	(-0.08 – -0.02)	0.0018	-5.7	(-0.09 – -0.03)	0.0002	-6.9	(-0.10 – -0.04)	<0.0001
Other ^d	-5.0	(-0.08 – -0.02)	0.0017	-0.2	(-0.03 – 0.02)	0.8836	-0.5	(-0.03 – 0.02)	0.6917
None	-11.0	(-0.16 – -0.07)	<0.0001	-2.2	(-0.06 – 0.01)	0.2393	-3.0	(-0.06 – 0.00)	0.0747
LTC grade									
1-2	Ref.			Ref.			Ref.		
3-4	9.9	(0.05 – 0.14)	<0.0001	-1.2	(-0.05 – 0.03)	0.5694	-1.1	(-0.05 – 0.03)	0.5671
5	21.6	(0.13 – 0.26)	<0.0001	-7.7	(-0.14 – -0.02)	0.0126	-2.8	(-0.09 – 0.03)	0.3262
Type of service									
Institutional care	Ref.			Ref.			Ref.		

HCBS	26.3	(0.21 – 0.26)	<0.0001	-60.0	(-0.94 – -0.89)	<0.0001	-49.0	(-0.70 – -0.65)	<0.0001
Both	11.4	(0.07 – 0.15)	<0.0001	-56.0	(-0.32 – -0.24)	<0.0001	-21.0	(-0.27 – -0.21)	<0.0001
CCI									
0	Ref.			Ref.			Ref.		
1	7.8	(0.03 – 0.12)	0.0007	4.1	(0.01 – 0.08)	0.0252	3.1	(-0.01 – 0.06)	0.0700
≥2	5.9	(0.01 – 0.10)	0.0098	1.3	(-0.02 – 0.05)	0.4829	-0.1	(-0.03 – 0.03)	0.9706
Disability									
No	Ref.			Ref.			Ref.		
Yes	4.7	(0.02 – 0.07)	<0.0001	3.2	(0.01 – 0.05)	0.0013	3.0	(0.01 – 0.05)	0.0009
ADL	2.0	(0.02 – 0.02)	<0.0001	0.0	(-0.01 – 0.01)	0.9066	-0.2	(-0.01 – 0.00)	0.1709
Cognitive score	1.2	(0.01 – 0.02)	0.0006	1.5	(0.01 – 0.02)	<0.0001	1.7	(0.01 – 0.02)	<0.0001
Behavioral problems	2.6	(0.02 – 0.03)	<0.0001	1.7	(0.01 – 0.02)	<0.0001	1.4	(0.01 – 0.02)	<0.0001

^a Additional 10% group.

^b Control group selected through additional 10% group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 10. Results of the Generalized Linear Model of 40% reduction group for LTC utilization

Variables	No. of long-term care services			OOBs			Total expenses		
	%	95% CI	p-value	%	95% CI	p-value	%	95% CI	p-value
Intervention									
Before	Ref.			Ref.			Ref.		
After	16.0	(0.13 – 0.17)	<.0001	34.8	(0.28 – 0.32)	<.0001	40.1	(0.32 – 0.36)	<.0001
Case^a	-5.2	(-0.10 – -0.01)	0.0186	-12.7	(-0.17 – -0.10)	<.0001	1.0	(-0.03 – 0.05)	0.5844
Control^b	Ref.			Ref.			Ref.		
Case*Intervention^c	5.8	(0.01 – 0.10)	0.0084	-14.6	(-0.21 – -0.11)	<.0001	5.5	(0.01 – 0.09)	0.0077
Gender									
Male	Ref.			Ref.			Ref.		
Female	4.0	(-0.01 – 0.08)	0.0653	7.3	(0.03 – 0.11)	0.0002	7.8	(0.04 – 0.11)	<.0001
Age									
≤74	Ref.			Ref.			Ref.		
75-79	-3.6	(-0.09 – 0.02)	0.1272	-2.5	(-0.07 – 0.02)	0.2777	-2.7	(-0.07 – 0.01)	0.1989
80-84	0.0	(-0.05 – 0.05)	0.9946	4.2	(-0.01 – 0.08)	0.0609	1.8	(-0.02 – 0.06)	0.3800
≥85	0.3	(-0.05 – 0.06)	0.9091	3.2	(-0.01 – 0.08)	0.1786	-0.2	(-0.04 – 0.04)	0.9252
Insurance type									
Self-employed insured	Ref.			Ref.			Ref.		
Employee insured	0.9	(-0.03 – 0.05)	0.6491	0.2	(-0.03 – 0.04)	0.9324	0.8	(-0.02 – 0.04)	0.6294
Region									
Metropolitan	Ref.			Ref.			Ref.		
City	0.8	(-0.04 – 0.05)	0.7097	-6.4	(-0.10 – -0.03)	0.0005	-4.6	(-0.08 – -0.01)	0.0075
Rural	-10.0	(-0.14 – -0.07)	<.0001	-6.2	(-0.10 – -0.03)	<.0001	-6.9	(-0.10 – -0.04)	<.0001
Primary caregiver									
Child	Ref.			Ref.			Ref.		
Married partner	0.5	(-0.04 – 0.05)	0.8256	-1.2	(-0.05 – 0.03)	0.5439	-1.5	(-0.05 – 0.02)	0.4279
Paid caregiver	-7.8	(-0.13 – -0.03)	0.0024	-6.2	(-0.11 – -0.01)	0.0141	-8.1	(-0.13 – -0.04)	0.0005
Other ^d	-7.1	(-0.13 – -0.02)	0.0084	-3.0	(-0.08 – 0.02)	0.1918	-4.1	(-0.08 – 0.00)	0.0505
None	-17.0	(-0.25 – -0.12)	<.0001	-2.7	(-0.09 – 0.04)	0.4021	-6.5	(-0.12 – -0.01)	0.0207
LTC grade									
1-2	Ref.			Ref.			Ref.		
3-4	6.4	(-0.02 – 0.14)	0.1183	-5.3	(-0.12 – 0.01)	0.1131	-4.4	(-0.11 – 0.02)	0.1582
5	15.9	(0.04 – 0.26)	0.0071	-18.8	(-0.31 – -0.11)	<.0001	-10.7	(-0.20 – -0.02)	0.0157

Type of service									
Institutional care	Ref.			Ref.			Ref.		
HCBS	24.9	(0.18 – 0.27)	<.0001	-60.9	(-0.98 – -0.90)	<.0001	-49.6	(-0.73 – -0.65)	<.0001
Both	12.6	(0.06 – 0.18)	<.0001	-27.9	(-0.39 – -0.26)	<.0001	-21.7	(-0.30 – -0.19)	<.0001
CCI				0.0					
0	Ref.			Ref.			Ref.		
1	2.1	(-0.06 – 0.10)	0.6027	-0.3	(-0.06 – 0.06)	0.9214	-0.2	(-0.05 – 0.05)	0.9365
≥2	-2.3	(-0.10 – 0.05)	0.5505	-6.8	(-0.13 – -0.01)	0.0188	-6.2	(-0.12 – -0.01)	0.0180
Disability									
No	Ref.			Ref.			Ref.		
Yes	4.2	(0.01 – 0.08)	0.0260	2.5	(-0.01 – 0.06)	0.1193	2.6	(-0.00 – 0.05)	0.0817
ADL	1.9	(0.01 – 0.02)	<.0001	-0.5	(-0.01 – -0.00)	0.0310	-0.5	(-0.01 – -0.01)	0.0214
Cognitive score	1.7	(0.01 – 0.03)	0.0024	1.7	(0.01 – 0.03)	0.0006	1.8	(0.01 – 0.03)	<.0001
Behavioral problems	2.1	(0.01 – 0.03)	0.0015	1.0	(-0.01 – 0.02)	0.0792	1.3	(0.00 – 0.02)	0.0153

^a 40% reduction group.

^b Control group selected through 40% reduction group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 11. Changes in total medical OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%					Control								
	Before (2017)			After (2019)			<i>p</i> -value	Before (2017)			After (2019)			<i>p</i> -value
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	796,084	±	1,491,983	946,342	±	1,828,350	0.0019	1,045,037	±	1,879,079	1,310,955	±	2,240,648	<.0001
Gender														
Male	879,246	±	1,670,623	1,089,778	±	2,309,146	0.1195	1,086,804	±	1,965,787	1,509,321	±	2,467,437	<.0001
Female	776,989	±	1,447,656	913,406	±	1,697,878	0.0071	1,035,446	±	1,858,641	1,265,407	±	2,182,939	<.0001
Age														
≤74	927,086	±	1,549,066	1,130,197	±	1,960,170	0.1224	1,394,912	±	2,328,680	1,517,615	±	2,463,865	0.2331
75-79	957,148	±	1,655,852	1,037,123	±	1,791,325	0.4913	1,219,237	±	2,037,263	1,459,989	±	2,290,597	0.0043
80-84	825,915	±	1,643,383	953,915	±	2,060,936	0.1628	1,043,275	±	1,830,307	1,303,511	±	2,253,023	<.0001
≥85	606,015	±	1,125,928	796,472	±	1,468,879	0.0048	776,866	±	1,521,316	1,132,574	±	2,064,917	<.0001
Insurance type														
Self-employed insured	699,632	±	1,340,500	873,472	±	1,782,814	0.0029	1,133,001	±	2,127,437	1,394,476	±	2,460,546	0.0028
Employee insured	948,114	±	1,693,277	1,061,200	±	1,893,194	0.1759	1,023,843	±	1,813,734	1,290,833	±	2,184,114	<.0001
Region														
Metropolitan	765,643	±	1,486,592	981,874	±	1,893,061	0.0118	1,116,219	±	2,052,683	1,318,441	±	2,315,070	0.0007
City	880,060	±	1,639,211	1,002,836	±	1,803,552	0.3033	1,023,114	±	1,817,926	1,375,783	±	2,305,697	<.0001
Rural	786,623	±	1,440,132	902,558	±	1,793,248	0.0837	991,001	±	1,736,767	1,267,038	±	2,129,420	<.0001
Primary caregiver														
Child	726,581	±	1,276,944	922,115	±	1,757,871	0.0071	905,471	±	1,565,928	1,267,140	±	2,189,246	<.0001
Married partner	768,195	±	1,176,692	1,066,104	±	2,066,922	0.0117	1,022,894	±	1,705,112	1,442,230	±	2,240,481	<.0001
Paid caregiver	1,148,238	±	2,166,625	1,018,050	±	2,061,113	0.3201	1,687,419	±	2,828,635	1,472,733	±	2,573,496	0.0467
Other ^a	618,503	±	1,245,354	779,506	±	1,393,167	0.0901	749,567	±	1,350,934	1,069,830	±	1,916,856	<.0001
None	551,092	±	915,474	948,211	±	1,681,326	0.0075	769,217	±	1,421,637	1,062,077	±	2,079,277	0.0286
LTC grade														
1-2	1,242,164	±	2,358,107	1,167,876	±	2,270,466	0.6472	1,653,060	±	2,796,413	1,603,173	±	2,625,215	0.6540
3-4	721,473	±	1,261,042	908,964	±	1,744,334	0.0002	944,242	±	1,650,920	1,264,363	±	2,176,257	<.0001
5	493,984	±	503,219	800,254	±	1,397,764	0.0121	674,251	±	922,522	1,110,106	±	1,814,697	<.0001
Type of service														

Institutional care	599,889 ± 1,156,788	665,995 ± 1,217,148	0.2795	614,839 ± 1,149,784	750,056 ± 1,333,241	0.0032
HCBS	858,228 ± 1,602,879	1,097,076 ± 2,080,684	0.0004	1,145,659 ± 2,024,017	1,473,899 ± 2,414,889	<.0001
Both	1,225,080 ± 1,738,224	833,536 ± 1,433,839	0.0504	1,317,962 ± 1,804,175	1,202,105 ± 2,156,393	0.4327
CCI						
0	429,984 ± 977,928	731,579 ± 1,714,376	0.0557	430,686 ± 922,047	805,886 ± 1,675,973	<.0001
1	591,970 ± 1,226,973	775,227 ± 1,607,688	0.0025	740,524 ± 1,437,658	1,075,570 ± 1,932,981	<.0001
≥2	1,052,814 ± 1,733,565	1,148,461 ± 2,022,229	0.2315	1,437,648 ± 2,253,991	1,618,723 ± 2,537,361	0.0021
Disability						
No	736,147 ± 1,397,884	890,653 ± 1,797,339	0.0096	926,766 ± 1,608,272	1,242,216 ± 2,170,774	<.0001
Yes	890,892 ± 1,626,057	1,034,430 ± 1,873,961	0.0790	1,232,007 ± 2,228,965	1,419,624 ± 2,343,157	0.0023

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 12. Changes in total medical expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%					Control								
	Before (2017)			After (2019)			<i>p</i> -value	Before (2017)			After (2019)			<i>p</i> -value
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	3,776,436	±	7,526,940	4,954,269	±	10,102,204	<.0001	4,590,415	±	9,218,605	6,290,547	±	12,016,921	<.0001
Gender														
Male	4,501,116	±	8,484,611	6,539,215	±	12,305,951	0.0041	5,368,854	±	10,693,175	8,237,483	±	14,803,125	<.0001
Female	3,610,037	±	7,281,545	4,590,337	±	9,490,956	0.0003	4,411,671	±	8,836,752	5,843,495	±	11,234,422	<.0001
Age														
≤74	5,776,405	±	10,390,121	7,244,705	±	15,064,717	0.1273	6,758,173	±	11,895,880	8,222,831	±	14,265,928	0.0094
75-79	4,320,930	±	7,747,255	5,174,911	±	9,066,066	0.1330	5,578,404	±	10,931,762	7,287,083	±	13,789,921	0.0004
80-84	3,617,732	±	7,432,945	4,758,431	±	9,907,558	0.0082	4,407,851	±	8,603,959	5,997,897	±	11,404,225	<.0001
≥85	2,670,377	±	5,336,453	3,939,020	±	7,401,210	0.0001	3,170,708	±	6,699,255	5,099,793	±	10,064,247	<.0001
Insurance type														
Self-employed insured	3,442,623	±	7,132,934	4,745,416	±	10,190,098	<.0001	5,159,272	±	11,175,504	6,864,461	±	13,674,459	0.0003
Employee insured	4,302,597	±	8,085,240	5,283,467	±	9,958,677	0.0201	4,453,360	±	8,677,015	6,152,274	±	11,579,236	<.0001
Region														
Metropolitan	3,652,615	±	7,827,633	5,339,008	±	11,577,216	0.0007	4,971,135	±	10,404,279	6,570,944	±	13,291,209	<.0001
City	4,256,497	±	8,242,867	5,518,950	±	10,402,547	0.0521	4,464,588	±	8,652,776	6,604,036	±	12,313,764	<.0001
Rural	3,688,815	±	7,040,462	4,496,861	±	8,847,030	0.0142	4,306,294	±	8,296,548	5,849,976	±	10,484,985	<.0001
Primary caregiver														
Child	3,239,198	±	6,123,304	4,644,423	±	8,712,502	<.0001	3,889,663	±	7,680,990	5,850,835	±	10,916,555	<.0001
Married partner	4,356,457	±	8,026,710	6,579,619	±	14,578,854	0.0072	4,807,144	±	9,224,421	7,488,196	±	14,059,122	<.0001
Paid caregiver	5,089,597	±	9,795,400	4,933,627	±	9,616,713	0.7952	7,345,533	±	13,311,278	6,930,761	±	12,540,408	0.4216
Other ^a	3,087,263	±	6,810,149	4,034,268	±	8,215,580	0.0809	3,144,491	±	6,524,245	5,077,168	±	10,744,441	<.0001
None	2,754,414	±	5,773,613	4,861,763	±	8,794,800	0.0098	3,137,926	±	6,253,863	4,736,142	±	9,815,882	0.0098
LTC grade														
1-2	5,621,860	±	11,027,053	5,716,795	±	10,961,848	0.9020	7,332,731	±	13,341,219	7,487,691	±	12,562,976	0.7707
3-4	3,512,056	±	6,736,224	4,903,309	±	10,163,251	<.0001	4,167,228	±	8,264,970	6,159,028	±	12,134,299	<.0001
5	1,987,570	±	2,284,498	3,505,637	±	5,932,839	0.0037	2,533,328	±	4,213,795	4,740,754	±	8,268,428	<.0001
Type of service														

Institutional care	2,724,282 ± 5,863,824	3,315,020 ± 6,800,651	0.0709	2,484,309 ± 5,002,179	3,427,912 ± 6,525,561	<.0001
HCBS	4,207,137 ± 8,227,805	5,849,795 ± 11,510,268	<.0001	5,101,091 ± 10,043,526	7,119,307 ± 13,093,563	<.0001
Both	4,935,220 ± 7,022,193	4,128,832 ± 7,046,736	0.3600	5,662,238 ± 8,548,449	5,776,666 ± 10,901,651	0.8750
CCI						
0	1,835,640 ± 4,159,827	3,450,112 ± 7,919,301	0.0240	1,729,334 ± 4,072,943	3,919,416 ± 9,313,560	<.0001
1	2,638,072 ± 5,898,467	3,838,934 ± 7,915,650	<.0001	3,034,817 ± 6,608,656	4,897,382 ± 10,192,388	<.0001
≥2	5,193,883 ± 8,966,439	6,286,528 ± 11,998,294	0.0151	6,556,708 ± 11,344,474	8,024,389 ± 13,694,971	<.0001
Disability						
No	3,204,825 ± 6,403,971	4,251,944 ± 8,563,554	0.0002	3,825,947 ± 7,514,763	5,662,920 ± 10,775,914	<.0001
Yes	4,680,610 ± 8,951,868	6,065,206 ± 12,066,321	0.0052	5,798,936 ± 11,300,717	7,282,742 ± 13,695,737	<.0001

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 13. Changes in No. of outpatient visits for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%			Control		
	Before (2017)		p-value	Before (2017)		p-value
	Mean ± SD	After (2019) Mean ± SD		Mean ± SD	After (2019) Mean ± SD	
Total	29.9 ± 31.8	26.4 ± 30.1	0.0001	30.6 ± 32.7	26.2 ± 30.7	<.0001
Gender						
Male	30.4 ± 36.6	27.8 ± 37.9	0.2943	32.5 ± 37.8	27.8 ± 35.9	0.0011
Female	29.8 ± 30.6	26.1 ± 28.0	0.0001	30.2 ± 31.3	25.8 ± 29.4	<.0001
Age						
≤74	39.1 ± 47.3	34.2 ± 42.7	0.1391	35.7 ± 41.4	32.1 ± 40.9	0.0425
75-79	30.4 ± 26.4	27.9 ± 26.7	0.1560	34.5 ± 37.6	29.4 ± 34.3	0.0003
80-84	28.6 ± 29.5	24.9 ± 29.4	0.0109	31.2 ± 31.8	26.2 ± 30.2	<.0001
≥85	26.5 ± 26.8	23.5 ± 24.3	0.0237	25.4 ± 23.8	21.4 ± 21.2	<.0001
Insurance type						
Self-employed insured	29.4 ± 31.5	25.9 ± 28.7	0.0016	29.5 ± 32.1	26.1 ± 31.6	0.0046
Employee insured	30.6 ± 32.3	27.3 ± 32.2	0.0264	30.9 ± 32.8	26.2 ± 30.5	<.0001
Region						
Metropolitan	27.9 ± 29.1	25.8 ± 27.5	0.1391	28.9 ± 31.5	25.0 ± 28.9	<.0001
City	32.0 ± 34.4	28.3 ± 36.3	0.1332	31.3 ± 32.5	27.2 ± 30.5	0.0002
Rural	30.5 ± 32.5	26.2 ± 29.4	0.0009	31.9 ± 33.7	26.8 ± 32.4	<.0001
Primary caregiver						
Child	30.5 ± 30.2	26.0 ± 27.6	0.0009	30.5 ± 31.9	25.9 ± 30.1	<.0001
Married partner	37.8 ± 42.0	34.6 ± 43.7	0.2779	37.3 ± 38.5	31.4 ± 36.7	<.0001
Paid caregiver	21.8 ± 19.3	21.5 ± 22.0	0.8076	23.3 ± 24.7	21.2 ± 23.8	0.0262
Other ^a	28.9 ± 31.1	25.1 ± 27.4	0.0734	28.4 ± 30.1	24.7 ± 28.2	0.0057
None	34.5 ± 38.3	27.4 ± 26.7	0.0509	30.3 ± 31.2	24.6 ± 27.1	0.0096
LTC grade						
1-2	24.0 ± 24.5	22.5 ± 24.4	0.4075	23.3 ± 27.6	20.6 ± 24.9	0.0099
3-4	31.4 ± 33.7	27.4 ± 31.7	0.0002	32.3 ± 34.0	27.7 ± 32.1	<.0001
5	27.8 ± 231.7	25.7 ± 22.3	0.3982	30.1 ± 25.1	23.1 ± 25.0	<.0001
Type of service						
Institutional care	22.8 ± 18.3	21.7 ± 17.4	0.2231	21.6 ± 16.8	19.8 ± 14.3	0.0018
HCBS	33.8 ± 37.0	29.2 ± 35.2	0.0005	33.5 ± 36.1	28.2 ± 34.3	<.0001
Both	26.4 ± 18.0	22.6 ± 19.7	0.1093	25.4 ± 16.6	22.2 ± 16.7	0.0109
CCI						
0	22.0 ± 25.3	19.7 ± 22.0	0.3839	21.7 ± 25.6	18.4 ± 19.2	0.0229
1	23.6 ± 23.0	20.8 ± 19.1	0.0017	24.5 ± 24.1	21.9 ± 23.5	<.0001
≥2	37.3 ± 38.0	33.1 ± 37.9	0.0085	38.1 ± 38.8	31.6 ± 36.9	<.0001
Disability						
No	27.5 ± 27.3	24.4 ± 25.2	0.0013	28.9 ± 27.9	24.5 ± 27.1	<.0001
Yes	33.7 ± 37.6	29.7 ± 36.4	0.0225	33.4 ± 38.9	28.9 ± 35.6	<.0001

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 14. Changes in outpatient OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%				Control					
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD						
Total	268,090 ± 395,924	251,449 ± 398,642	0.1483	333,262 ± 473,876	300,892 ± 468,100	<.0001				
Gender										
Male	284,331 ± 434,282	246,621 ± 391,859	0.1742	365,687 ± 554,109	321,638 ± 519,916	0.0343				
Female	264,360 ± 386,604	252,557 ± 400,275	0.3505	325,816 ± 453,180	296,128 ± 455,285	0.0004				
Age										
≤74	434,684 ± 702,757	399,258 ± 668,200	0.4872	482,064 ± 738,493	433,164 ± 675,909	0.1076				
75-79	281,606 ± 346,245	272,484 ± 382,244	0.7104	386,359 ± 521,697	344,831 ± 482,991	0.0337				
80-84	243,746 ± 301,353	220,971 ± 303,885	0.1261	321,487 ± 393,002	288,357 ± 388,480	0.0028				
≥85	206,821 ± 267,723	201,545 ± 296,339	0.7170	243,596 ± 315,202	225,364 ± 395,419	0.0866				
Insurance type										
Self-employed insured	233,007 ± 354,215	220,218 ± 345,497	0.3238	350,281 ± 532,300	314,746 ± 473,644	0.0633				
Employee insured	323,388 ± 448,618	300,676 ± 466,349	0.2859	329,161 ± 458,645	297,554 ± 466,734	0.0002				
Region										
Metropolitan	278,555 ± 415,643	290,753 ± 460,586	0.5813	356,474 ± 560,513	323,860 ± 491,641	0.0239				
City	302,009 ± 493,186	271,865 ± 482,851	0.3721	329,466 ± 440,607	306,976 ± 445,998	0.1481				
Rural	249,062 ± 338,900	217,947 ± 308,283	0.0198	313,732 ± 396,737	275,964 ± 456,645	0.0009				
Primary caregiver										
Child	277,733 ± 358,349	243,915 ± 347,266	0.0424	338,169 ± 464,548	304,312 ± 483,444	0.0071				
Married partner	376,906 ± 540,792	363,195 ± 598,232	0.7317	440,128 ± 588,243	392,225 ± 571,440	0.0141				
Paid caregiver	187,852 ± 271,522	189,292 ± 258,733	0.9301	241,938 ± 426,761	222,466 ± 356,259	0.2146				
Other ^a	248,721 ± 435,296	238,609 ± 409,245	0.7390	272,256 ± 319,542	253,403 ± 354,881	0.2310				
None	246,966 ± 339,457	243,787 ± 329,645	0.9307	243,013 ± 234,988	219,251 ± 246,927	0.1888				
LTC grade										
1-2	219,742 ± 319,854	226,279 ± 352,172	0.7817	270,699 ± 488,971	253,269 ± 513,760	0.0886				
3-4	278,769 ± 419,953	258,112 ± 419,737	0.1372	345,340 ± 478,812	313,069 ± 464,977	0.0003				
5	269,276 ± 243,547	238,633 ± 205,495	0.2398	350,508 ± 342,024	277,483 ± 359,108	0.0018				
Type of service										
Institutional care	191,783 ± 302,546	196,135 ± 283,067	0.7729	192,300 ± 294,775	186,137 ± 220,954	0.5209				
HCBS	305,397 ± 437,417	282,936 ± 452,160	0.1668	375,715 ± 515,804	337,483 ± 519,785	0.0001				
Both	280,991 ± 295,110	208,731 ± 244,963	0.0340	283,896 ± 258,711	230,989 ± 292,287	0.0100				

CCI										
0	152,897	± 201,395	149,321	± 192,954	0.8721	181,486	± 264,710	175,638	± 240,308	0.7221
1	193,677	± 220,552	182,980	± 240,665	0.2742	244,692	± 288,757	227,926	± 296,935	0.0193
≥2	359,085	± 515,892	334,627	± 514,360	0.2632	443,637	± 604,030	391,852	± 597,999	0.0004
Disability										
No	232,830	± 269,231	219,682	± 284,919	0.2001	296,112	± 330,339	262,815	± 3,430,333	<.0001
Yes	323,864	± 534,036	301,697	± 527,232	0.3696	391,991	± 633,605	361,088	± 611,287	0.0647

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 15. Changes in total outpatient expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%					Control								
	Before (2017)			After (2019)		<i>p</i> -value	Before (2017)			After (2019)		<i>p</i> -value		
	Mean	±	SD	Mean	±		SD	Mean	±	SD	Mean		±	SD
Total	1,137,631	±	2,994,290	1,157,184	±	3,031,412	0.8228	1,236,899	±	3,198,181	1,219,666	±	3,206,631	0.7477
Gender														
Male	1,304,021	±	3,431,383	1,270,111	±	3,240,573	0.8796	1,668,292	±	4,830,751	1,591,756	±	4,389,939	0.6684
Female	1,099,425	±	2,884,231	1,131,254	±	2,981,593	0.7355	1,137,843	±	2,677,595	1,134,228	±	2,860,470	0.9439
Age														
≤74	2,569,931	±	6,323,725	2,390,323	±	5,966,436	0.6944	2,211,996	±	5,266,707	2,270,859	±	5,714,438	0.9490
75-79	1,044,898	±	2,106,442	1,167,077	±	2,435,398	0.4258	1,492,388	±	4,190,743	1,457,597	±	3,593,858	0.8187
80-84	887,896	±	1,616,091	913,244	±	2,065,232	0.7811	1,048,140	±	2,010,753	1,014,571	±	2,000,943	0.5557
≥85	777,649	±	1,595,811	826,480	±	1,719,510	0.5680	825,904	±	1,903,725	821,346	±	2,042,998	0.9382
Insurance type														
Self-employed insured	1,052,856	±	2,847,607	1,047,060	±	2,706,847	0.9551	1,330,896	±	4,030,168	1,240,397	±	3,004,606	0.5025
Employee insured	1,271,255	±	3,208,967	1,330,763	±	3,476,618	0.7021	1,214,252	±	2,962,998	1,214,672	±	3,253,659	0.9942
Region														
Metropolitan	1,166,936	±	3,075,828	1,329,256	±	3,339,757	0.3160	1,297,270	±	3,627,085	1,295,720	±	3,378,674	0.9871
City	1,497,966	±	4,399,908	1,419,890	±	4,165,061	0.7923	1,236,911	±	3,082,604	1,270,963	±	3,246,239	0.7591
Rural	990,192	±	2,213,539	949,008	±	2,216,999	0.6519	1,180,475	±	2,811,882	1,119,379	±	3,011,390	0.4282
Primary caregiver														
Child	1,069,721	±	2,372,100	1,022,097	±	2,127,432	0.6543	1,241,564	±	3,477,711	1,175,929	±	2,985,060	0.4448
Married partner	1,949,949	±	4,816,041	2,059,898	±	5,263,664	0.7560	1,787,454	±	4,078,564	1,770,323	±	4,433,350	0.9048
Paid caregiver	674,616	±	1,425,506	760,534	±	1,529,196	0.3480	811,226	±	1,949,695	842,081	±	2,338,539	0.7195
Other ^a	1,112,587	±	3,398,546	1,129,843	±	3,288,273	0.9427	918,688	±	1,903,086	979,922	±	2,386,540	0.5427
None	1,029,182	±	2,418,591	987,922	±	2,108,802	0.8677	788,867	±	839,359	785,560	±	1,121,070	0.9645
LTC grade														
1-2	839,797	±	2,244,011	894,812	±	2,005,136	0.7124	884,670	±	1,986,885	954,209	±	2,306,461	0.4312
3-4	1,224,679	±	3,240,362	1,235,859	±	3,316,904	0.9179	1,329,274	±	3,498,280	1,298,575	±	3,427,218	0.6417
5	886,089	±	778,061	911,355	±	934,696	0.7993	1,035,493	±	1,320,172	954,109	±	2,270,850	0.5112
Type of service														
Institutional care	749,726	±	2,163,989	805,039	±	1,988,407	0.6051	597,906	±	1,008,850	633,254	±	834,626	0.3002
HCBS	1,355,631	±	3,421,861	1,368,012	±	3,521,960	0.9222	1,439,171	±	3,633,935	1,404,620	±	3,639,171	0.6244
Both	870,981	±	791,816	763,650	±	1,027,704	0.3502	869,302	±	1,286,068	892,198	±	1,964,282	0.8527
CCI														

0	593,262 ± 794,403	564,722 ± 676,141	0.7312	601,583 ± 786,739	619,996 ± 860,882	0.7314
1	673,571 ± 820,995	709,862 ± 1,048,459	0.3631	777,974 ± 1,274,238	795,014 ± 1,481,134	0.6141
≥2	1,680,361 ± 4,233,417	1,689,971 ± 4,244,795	0.9574	1,787,361 ± 4,433,343	1,730,695 ± 4,388,627	0.6000
Disability						
No	813,702 ± 1,039,422	885,230 ± 1,779,301	0.1849	927,676 ± 1,882,205	919,981 ± 1,700,326	0.8409
Yes	1,650,021 ± 4,585,255	1,587,360 ± 4,292,889	0.7619	1,725,738 ± 4,518,001	1,693,428 ± 4,648,221	0.7931

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 16. Changes in LOS for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%			Control		
	Before (2017)		p-value	Before (2017)		p-value
	Mean ± SD	After (2019) Mean ± SD		Mean ± SD	After (2019) Mean ± SD	
Total	18.1 ± 56.0	22.2 ± 64.6	0.0188	23.0 ± 65.7	32.8 ± 82.4	<.0001
Gender						
Male	19.5 ± 58.0	25.2 ± 64.2	0.1690	22.7 ± 63.8	38.1 ± 86.9	<.0001
Female	17.8 ± 55.5	21.5 ± 64.7	0.0520	23.1 ± 66.1	31.6 ± 81.3	<.0001
Age						
≤74	21.1 ± 61.4	23.0 ± 66.0	0.6850	28.1 ± 71.3	34.3 ± 85.8	0.0680
75-79	20.5 ± 55.7	22.5 ± 62.5	0.6292	25.8 ± 67.8	37.0 ± 87.0	0.0002
80-84	19.5 ± 60.4	23.9 ± 70.6	0.1687	23.4 ± 66.7	32.0 ± 81.0	<.0001
≥85	13.8 ± 47.5	19.9 ± 57.9	0.0261	18.6 ± 59.7	30.6 ± 79.3	<.0001
Insurance type						
Self-employed insured	17.0 ± 53.9	21.5 ± 62.8	0.0384	24.8 ± 71.6	34.6 ± 85.7	0.0011
Employee insured	19.8 ± 59.1	23.3 ± 67.3	0.2316	22.6 ± 64.1	32.4 ± 81.6	<.0001
Region						
Metropolitan	14.2 ± 47.4	18.6 ± 57.3	0.1016	22.9 ± 67.7	30.1 ± 80.8	0.0005
City	21.6 ± 66.8	23.5 ± 70.7	0.4726	24.2 ± 70.0	35.7 ± 86.4	<.0001
Rural	19.5 ± 56.9	23.7 ± 66.8	0.0999	22.5 ± 61.0	33.8 ± 81.4	<.0001
Primary caregiver						
Child	13.7 ± 44.0	21.5 ± 63.6	0.0024	16.8 ± 50.4	31.3 ± 79.2	<.0001
Married partner	10.7 ± 29.8	19.0 ± 54.4	0.0078	16.2 ± 46.6	31.5 ± 76.0	<.0001
Paid caregiver	37.8 ± 88.2	28.7 ± 78.7	0.0808	54.3 ± 109.3	44.3 ± 102.2	0.0180
Other ^a	12.9 ± 45.8	16.9 ± 51.2	0.2508	14.9 ± 49.4	26.3 ± 73.8	0.0001
None	10.4 ± 38.0	25.8 ± 70.1	0.0131	17.5 ± 53.5	28.7 ± 77.1	0.0247
LTC grade						
1-2	36.7 ± 88.5	31.3 ± 83.3	0.3707	50.7 ± 106.5	48.7 ± 106.4	0.6432
3-4	14.9 ± 47.2	20.5 ± 60.0	0.0019	18.2 ± 53.6	29.8 ± 76.5	<.0001
5	6.3 ± 15.2	18.6 ± 58.0	0.0127	9.5 ± 31.0	28.5 ± 74.8	<.0001
Type of service						
Institutional care	13.7 ± 41.9	12.7 ± 38.3	0.6351	13.9 ± 42.2	15.3 ± 46.6	0.3926
HCBS	19.3 ± 61.5	27.3 ± 74.7	0.0016	24.9 ± 70.9	37.9 ± 89.6	<.0001
Both	29.5 ± 58.3	19.2 ± 52.2	0.1353	32.7 ± 59.7	29.4 ± 75.6	0.5119
CCI						
0	8.2 ± 34.5	16.4 ± 56.6	0.1209	8.0 ± 36.9	21.4 ± 65.3	0.0001
1	14.5 ± 52.4	20.5 ± 63.5	0.0148	17.0 ± 57.1	28.4 ± 76.6	<.0001
≥2	23.1 ± 61.2	24.7 ± 66.6	0.5502	31.2 ± 75.2	38.9 ± 89.7	0.0002
Disability						
No	16.4 ± 51.1	20.2 ± 62.0	0.0705	20.7 ± 59.7	31.6 ± 80.1	<.0001
Yes	20.8 ± 62.8	25.4 ± 68.4	0.1323	26.7 ± 73.9	34.8 ± 85.9	0.0002

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; LOS, Length of stay; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 17. Changes in inpatient OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	527,994	± 1,428,835	694,893	± 1,780,164	0.0004	711,775	± 1,805,131	1,010,063	± 2,204,753	<.0001
Gender										
Male	594,914	± 1,611,798	843,157	± 2,264,787	0.0599	721,117	± 1,888,625	1,187,683	± 2,437,786	<.0001
Female	512,628	± 1,383,415	660,849	± 1,647,748	0.0024	709,629	± 1,785,570	969,279	± 2,145,831	<.0001
Age										
≤74	492,402	± 1,380,256	730,939	± 1,815,494	0.0470	912,848	± 2,184,681	1,084,451	± 2,410,288	0.0823
75-79	675,543	± 1,598,842	764,639	± 1,736,819	0.4282	832,878	± 1,966,877	1,115,158	± 2,261,932	0.0006
80-84	582,168	± 1,605,422	732,944	± 2,066,041	0.0977	721,788	± 1,784,228	1,015,153	± 2,219,046	<.0001
≥85	399,194	± 1,091,924	594,927	± 1,409,617	0.0026	533,271	± 1,483,500	907,210	± 2,042,842	<.0001
Insurance type										
Self-employed insured	466,625	± 1,285,582	653,254	± 1,743,386	0.0010	782,720	± 2,036,507	1,079,730	± 2,406,146	0.0005
Employee insured	624,726	± 1,625,305	760,525	± 1,835,677	0.0922	694,682	± 1,744,570	993,278	± 2,153,305	<.0001
Region										
Metropolitan	487,088	± 1,409,181	691,121	± 1,832,302	0.0134	759,745	± 1,961,042	994,581	± 2,272,567	<.0001
City	578,051	± 1,572,610	730,971	± 1,733,929	0.1820	693,649	± 1,776,086	1,068,808	± 2,294,128	<.0001
Rural	537,561	± 1,388,271	684,611	± 1,762,264	0.0246	677,269	± 1,663,661	991,075	± 2,085,454	<.0001
Primary caregiver										
Child	448,848	± 1,196,389	678,200	± 1,718,271	0.0010	567,302	± 1,455,133	962,828	± 2,141,787	<.0001
Married partner	391,289	± 1,003,108	702,909	± 1,967,025	0.0045	582,765	± 158,643	1,050,005	± 2,172,906	<.0001
Paid caregiver	960,386	± 2,161,777	828,757	± 2,066,292	0.3148	1,445,482	± 2,809,613	120,267	± 2,575,028	0.0696
Other ^a	369,782	± 1,139,317	540,897	± 1,298,388	0.0514	477,310	± 1,299,780	816,427	± 1,910,223	<.0001
None	304,126	± 791,011	704,423	± 1,611,295	0.0041	526,204	± 1,385,470	842,826	± 2,081,590	0.0172
LTC grade										
1-2	1,022,421	± 2,340,972	941,597	± 2,247,666	0.6155	1,382,362	± 2,767,379	1,349,903	± 2,606,614	0.7686
3-4	442,705	± 1,166,727	650,853	± 1,686,853	<.0001	598,902	± 1,549,815	951,293	± 2,133,228	<.0001
5	224,708	± 427,384	561,621	± 1,354,683	0.0039	323,742	± 809,785	832,623	± 1,788,612	<.0001
Type of service										
Institutional care	408,106	± 1,110,606	469,860	± 1,179,050	0.2950	422,539	± 1,091,579	563,919	± 1,303,142	0.0014
HCBS	552,831	± 1,535,704	814,140	± 2,032,535	<.0001	769,944	± 1,950,729	1,136,415	± 2,384,803	<.0001
Both	944,089	± 1,692,585	624,805	± 1,395,954	0.1009	1,034,066	± 1,778,412	971,116	± 2,139,355	0.6665

CCI							
0	277,086 ± 921,723	582,259 ± 1,701,084	0.0483	249,200 ± 846,515	630,248 ± 1,642,962	<.0001	
1	398,293 ± 1,204,355	592,248 ± 1,598,065	0.0012	495,832 ± 1,404,470	847,644 ± 1,926,734	<.0001	
≥2	693,729 ± 1,659,278	813,834 ± 1,950,365	0.1181	994,011 ± 2,180,256	1,226,871 ± 2,495,631	<.0001	
Disability							
No	503,318 ± 1,352,757	670,971 ± 1,775,786	0.0041	630,654 ± 1,562,816	979,401 ± 2,156,600	<.0001	
Yes	567,028 ± 1,541,481	732,733 ± 1,787,377	0.0331	840,016 ± 2,126,769	1,058,536 ± 2,278,354	0.0002	

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; LOS, Length of stay; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 18. Changes in total inpatient expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional 10%				Control					
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	2,638,805	± 6,774,793	3,797,085	± 9,447,075	<.0001	3,353,516	± 8,526,531	5,070,881	± 11,525,460	<.0001
Gender										
Male	3,197,095	± 7,803,079	5,269,104	± 11,761,886	0.0020	3,700,562	± 9,362,361	6,645,727	± 14,006,311	<.0001
Female	2,510,612	± 6,511,329	3,459,083	± 8,799,300	0.0001	3,273,828	± 8,321,595	4,709,267	± 10,845,412	<.0001
Age										
≤74	3,206,474	± 7,890,797	4,854,382	± 13,309,228	0.0431	4,546,177	± 10,500,610	5,995,746	± 13,142,111	0.0046
75-79	3,276,033	± 7,355,686	4,007,834	± 8,611,477	0.1751	4,086,016	± 9,986,062	5,829,486	± 13,166,336	0.0001
80-84	2,729,836	± 7,189,663	3,845,187	± 9,764,198	0.0082	3,359,711	± 8,373,282	4,983,325	± 11,197,293	<.0001
≥85	1,892,728	± 5,108,616	3,112,540	± 6,965,162	0.0001	2,344,804	± 6,306,455	4,278,447	± 9,846,129	<.0001
Insurance type										
Self-employed insured	2,389,768	± 6,377,251	3,698,355	± 9,691,617	<.0001	3,828,376	± 10,280,306	5,624,064	± 13,166,891	<.0001
Employee insured	3,031,343	± 7,344,377	3,952,704	± 9,051,202	0.0163	3,239,108	± 8,043,922	4,937,602	± 11,090,898	<.0001
Region										
Metropolitan	2,485,679	± 6,869,287	4,009,752	± 10,797,315	0.0009	3,673,865	± 9,645,807	5,275,224	± 1,254,943	<.0001
City	2,758,531	± 6,868,176	4,099,060	± 9,182,962	0.0171	3,227,677	± 8,086,480	5,333,073	± 11,887,362	<.0001
Rural	2,698,623	± 6,681,250	3,547,853	± 8,530,135	0.0072	3,125,819	± 7,599,419	4,730,596	± 10,000,725	<.0001
Primary caregiver										
Child	2,169,477	± 5,510,699	3,622,327	± 8,300,429	<.0001	2,648,099	± 6,590,234	4,674,906	± 10,432,720	<.0001
Married partner	2,406,508	± 5,738,858	4,519,721	± 13,440,151	0.0036	3,019,690	± 7,987,196	5,717,873	± 13,134,289	<.0001
Paid caregiver	4,414,981	± 9,746,508	4,173,094	± 9,586,726	0.6861	6,534,307	± 13,194,972	6,088,680	± 12,452,916	0.3841
Other ^a	1,974,676	± 5,720,772	2,904,425	± 6,831,764	0.0402	2,225,803	± 6,207,629	4,097,246	± 10,562,184	<.0001
None	1,725,232	± 5,122,361	3,873,841	± 8,070,886	0.0038	2,349,059	± 6,159,478	3,950,583	± 9,741,882	0.0089
LTC grade										
1-2	4,782,063	± 10,797,411	4,821,983	± 10,645,993	0.9577	6,448,061	± 13,227,775	6,533,482	± 12,362,104	0.8708
3-4	2,287,377	± 5,679,454	3,667,450	± 9,389,644	<.0001	2,837,954	± 7,273,323	4,860,454	± 11,555,966	<.0001
5	1,101,481	± 2,133,645	2,594,282	± 5,789,894	0.0033	1,497,835	± 3,686,210	3,786,645	± 8,006,017	<.0001
Type of service										
Institutional care	1,974,556	± 5,445,817	2,509,981	± 6,313,030	0.0778	1,886,403	± 4,833,855	2,794,658	± 6,456,847	<.0001
HCBS	2,851,507	± 7,315,184	4,481,783	± 10,784,885	<.0001	3,661,920	± 9,256,838	5,714,687	± 12,547,106	<.0001
Both	4,064,239	± 6,925,845	3,365,182	± 6,989,630	0.4223	4,792,936	± 8,420,699	4,884,468	± 10,775,231	0.8986
CCI										

0	1,242,378 ± 3,963,296	2,885,389 ± 7,888,933	0.0199	1,127,751 ± 3,897,252	3,299,420 ± 9,245,441	<.0001
1	1,964,501 ± 5,848,792	3,129,072 ± 7,881,909	<.0001	2,256,843 ± 6,459,424	4,102,368 ± 10,128,661	<.0001
≥2	3,513,522 ± 7,776,373	4,596,557 ± 10,918,736	0.0071	4,769,348 ± 10,394,611	6,293,695 ± 12,925,922	<.0001
Disability						
No	2,391,123 ± 6,225,611	3,366,713 ± 8,319,488	0.0003	2,898,271 ± 7,201,087	4,742,938 ± 10,613,442	<.0001
Yes	3,030,589 ± 7,549,482	4,477,845 ± 10,967,596	0.0010	4,073,198 ± 10,239,206	5,589,314 ± 12,820,642	<.0001

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; LOS, Length of stay; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 19. Changes in total medical OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40% reduction				Control					
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	1,027,567	± 1,932,213	1,013,638	± 1,759,596	0.5054	1,123,268	± 1,982,770	1,418,854	± 2,400,261	<.0001
Gender										
Male	1,193,214	± 2,431,380	1,281,345	± 2,143,505	0.6662	1,305,930	± 2,290,467	1,697,388	± 2,738,196	0.0026
Female	973,143	± 1,735,684	925,683	± 1,605,583	0.5784	1,063,254	± 1,867,325	1,327,341	± 2,271,533	<.0001
Age										
≤74	1,390,457	± 2,699,753	1,283,181	± 2,335,194	0.6711	1,572,852	± 2,582,796	1,609,169	± 2,611,700	0.8087
75-79	1,217,912	± 2,053,602	1,171,999	± 1,817,447	0.8058	1,218,450	± 2,002,399	1,517,015	± 2,357,241	0.0141
80-84	946,653	± 1,714,557	952,803	± 1,506,647	0.9603	1,046,475	± 1,799,894	1,425,388	± 2,498,321	<.0001
≥85	697,987	± 1,203,038	755,752	± 1,446,390	0.6201	800,616	± 1,554,193	1,183,219	± 2,102,356	<.0001
Insurance type										
Self-employed insured	959,739	± 1,859,478	923,363	± 1,668,828	0.7887	1,291,187	± 2,278,959	1,565,984	± 2,661,612	0.0556
Employee insured	1,061,380	± 1,967,941	1,058,644	± 1,802,651	0.9787	1,082,518	± 1,902,243	1,383,148	± 2,331,613	<.0001
Region										
Metropolitan	1,152,824	± 2,180,175	1,108,936	± 1,899,137	0.7630	1,205,399	± 2,134,022	1,464,027	± 2,476,218	0.0077
City	1,188,524	± 2,132,498	1,055,147	± 1,799,317	0.5027	1,104,202	± 1,933,885	1,548,075	± 2,638,656	0.0003
Rural	837,437	± 1,539,655	906,333	± 1,597,724	0.5213	1,057,627	± 1,859,114	1,302,409	± 2,170,203	0.0028
Primary caregiver										
Child	969,031	± 1,807,473	959,839	± 1,653,768	0.9417	940,943	± 1,619,257	1,356,995	± 2,311,668	<.0001
Married partner	935,907	± 1,999,804	1,101,391	± 1,830,397	0.3264	1,163,071	± 1,913,040	1,543,531	± 2,432,625	0.0003
Paid caregiver	1,621,503	± 2,539,625	992,977	± 1,763,336	0.0061	1,769,705	± 2,900,385	1,520,514	± 2,627,976	0.1520
Other ^a	655,234	± 1,181,204	1,073,454	± 1,876,409	0.0283	840,571	± 1,501,252	1,217,958	± 2,194,188	0.0072
None	819,235	± 1,103,983	900,471	± 1,850,899	0.7727	821,874	± 1,683,080	1,330,813	± 2,548,774	0.0459
LTC grade										
1-2	1,711,841	± 3,165,529	1,204,247	± 2,141,267	0.0891	1,829,064	± 3,019,991	1,613,654	± 2,666,740	0.2345
3-4	919,963	± 1,606,528	959,570	± 1,660,202	0.6317	1,021,373	± 1,730,868	1,408,872	± 2,388,430	<.0001
5	628,135	± 785,143	1,164,073	± 1,828,602	0.0245	612,516	± 852,261	1,080,855	± 1,768,361	0.0005
Type of service										
Institutional care	648,536	± 1,295,252	683,484	± 1,028,832	0.7525	686,858	± 1,276,385	792,868	± 1,454,170	0.1861
HCBS	1,101,328	± 2,069,427	1,124,957	± 1,925,042	0.8194	1,221,451	± 2,133,766	1,573,312	± 2,556,215	<.0001
Both	1,617,524	± 1,938,984	825,262	± 1,570,048	0.0271	1,303,766	± 1,483,679	1,450,604	± 2,468,547	0.5468
CCI										

0	745,726 ± 1,745,924	580,607 ± 1,385,355	0.5672	553,973 ± 1,200,745	882,873 ± 1,680,241	0.0381
1	631,939 ± 1,134,178	808,922 ± 1,397,674	0.0337	741,144 ± 1,509,658	1,107,698 ± 2,080,532	<.0001
≥2	1,439,103 ± 2,415,469	1,261,682 ± 2,053,033	0.2152	1,517,445 ± 2,307,470	1,747,833 ± 2,666,372	0.0102
Disability						
No	875,468 ± 1,482,172	878,768 ± 1,492,433	0.9681	960,660 ± 1,622,501	1,344,905 ± 2,357,959	<.0001
Yes	1,295,491 ± 2,518,076	1,251,216 ± 2,132,629	0.7967	1,409,706 ± 2,468,819	1,549,116 ± 2,468,711	0.1841

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; LOS, Length of stay; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 20. Changes in total medical expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40% reduction					Control				
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	4,761,642	± 9,560,459	5,081,446	± 9,507,320	0.4490	5,026,132	± 9,844,145	6,902,170	± 12,836,649	<.0001
Gender										
Male	6,151,652	± 11,713,619	7,480,790	± 12,507,986	0.2188	6,447,465	± 12,237,931	9,207,472	± 16,338,104	0.0002
Female	4,304,951	± 8,698,709	4,293,135	± 8,145,214	0.9781	4,559,149	± 8,872,167	6,144,755	± 11,357,696	<.0001
Age										
≤74	6,918,913	± 13,350,678	6,825,504	± 12,705,732	0.9429	7,825,361	± 13,538,403	8,767,769	± 14,960,771	0.2528
75-79	5,732,949	± 9,941,351	6,341,069	± 9,837,596	0.5231	5,433,011	± 10,045,774	7,313,627	± 12,061,582	0.0023
80-84	4,064,917	± 7,847,806	4,253,790	± 7,494,576	0.7476	4,437,422	± 8,575,533	6,702,779	± 13,331,822	<.0001
≥85	3,217,673	± 7,180,348	3,787,074	± 8,391,153	0.4053	3,315,814	± 6,992,145	5,393,344	± 10,678,183	<.0001
Insurance type										
Self-employed insured	4,502,908	± 9,362,932	4,805,370	± 9,029,314	0.6687	5,867,337	± 11,301,396	7,988,176	± 15,574,400	0.0072
Employee insured	4,890,629	± 9,661,656	5,219,079	± 9,740,429	0.5325	4,821,986	± 9,447,989	6,638,614	± 12,068,067	<.0001
Region										
Metropolitan	5,593,869	± 11,293,579	5,795,585	± 11,151,186	0.8006	5,437,435	± 10,533,744	7,369,259	± 1,348,996	0.0002
City	5,409,066	± 10,028,412	4,790,716	± 7,917,072	0.4974	4,862,505	± 9,734,524	7,450,347	± 14,145,784	<.0001
Rural	3,693,091	± 7,225,362	4,554,957	± 8,447,699	0.1095	4,736,592	± 9,216,077	6,151,264	± 11,008,446	0.0006
Primary caregiver										
Child	4,391,480	± 9,055,238	4,784,788	± 9,327,307	0.5556	4,037,541	± 7,809,919	6,385,966	± 11,466,926	<.0001
Married partner	4,572,008	± 9,805,132	5,834,533	± 9,998,408	0.1474	5,554,237	± 10,102,456	7,815,920	± 14,130,506	0.0001
Paid caregiver	7,404,405	± 12,589,660	4,489,052	± 7,961,247	0.0083	7,941,240	± 14,028,655	7,508,564	± 13,555,382	0.6176
Other ^a	3,053,041	± 6,026,412	5,607,857	± 11,280,917	0.0203	3,621,952	± 7,813,421	5,991,451	± 13,084,521	0.0033
None	3,703,799	± 4,929,330	4,311,333	± 8,333,518	0.6309	3,287,431	± 7,448,117	5,861,836	± 11,898,511	0.0280
LTC grade										
1-2	7,830,214	± 14,726,463	5,583,942	± 9,740,099	0.1032	8,283,495	± 14,553,120	7,637,778	± 13,115,683	0.4635
3-4	4,321,610	± 8,360,696	4,903,922	± 9,423,007	0.1963	4,587,111	± 8,774,722	6,919,928	± 13,075,311	<.0001
5	2,508,740	± 3,393,813	5,858,008	± 9,929,635	0.0076	2,329,597	± 4,144,231	5,023,522	± 8,799,296	<.0001
Type of service										
Institutional care	2,995,036	± 6,507,798	3,282,624	± 5,456,081	0.6133	2,749,776	± 5,372,267	3,669,843	± 7,071,986	0.0125
HCBS	5,145,765	± 10,320,910	5,683,422	± 10,379,714	0.3159	5,547,711	± 10,685,971	7,686,181	± 13,778,531	<.0001
Both	6,909,602	± 8,144,872	4,122,727	± 9,152,274	0.1110	5,810,059	± 8,137,293	7,291,897	± 13,139,132	0.2576

CCI								
0	3,324,370 ± 7,666,784	2,364,749 ± 5,768,530	0.4400	2,491,043 ± 6,429,274	4,148,174 ± 8,844,792	0.0483		
1	2,590,788 ± 5,095,334	3,864,578 ± 7,365,724	0.0022	3,042,760 ± 6,991,457	5,093,119 ± 10,516,958	<.0001		
≥2	7,006,441 ± 12,176,552	6,573,292 ± 1,129,737	0.5634	7,025,626 ± 11,689,603	8,774,783 ± 14,638,283	0.0002		
Disability								
No	3,653,519 ± 6,964,482	4,158,351 ± 7,523,348	0.2095	3,966,542 ± 7,378,873	6,203,370 ± 11,881,519	<.0001		
Yes	6,713,622 ± 12,701,034	6,707,495 ± 12,085,826	0.9946	6,892,619 ± 12,897,702	8,133,117 ± 14,288,283	0.0321		

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; LOS, Length of stay; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 21. Changes in No. of outpatient visits for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40% reduction			Control		
	Before (2017)	After (2019)	<i>p</i> -value	Before (2017)	After (2019)	<i>p</i> -value
	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD	
Total	31.5 ± 34.7	28.2 ± 30.4	0.0218	31.9 ± 34.2	26.9 ± 31.9	<.0001
Gender						
Male	31.1 ± 39.5	29.4 ± 37.3	0.6086	33.1 ± 39.1	28.0 ± 36.5	0.0088
Female	31.7 ± 33.0	27.8 ± 27.7	0.0140	31.6 ± 32.4	26.6 ± 30.3	<.0001
Age						
≤74	29.4 ± 30.4	27.9 ± 31.7	0.6422	34.1 ± 39.4	30.5 ± 38.6	0.1082
75-79	40.1 ± 49.3	33.7 ± 40.4	0.1447	35.2 ± 36.4	29.7 ± 35.0	0.0055
80-84	31.6 ± 30.7	27.7 ± 25.6	0.0740	31.7 ± 33.2	26.7 ± 31.3	0.0004
≥85	26.0 ± 25.8	24.5 ± 24.3	0.4864	27.8 ± 28.4	22.3 ± 22.5	<.0001
Insurance type						
Self-employed insured	32.1 ± 34.0	26.8 ± 31.6	<.0001	31.2 ± 35.0	27.7 ± 33.5	0.0771
Employee insured	30.2 ± 32.7	27.3 ± 29.5	0.0846	34.2 ± 38.3	30.1 ± 32.1	0.1289
Region						
Metropolitan	29.8 ± 36.3	27.3 ± 28.9	0.2911	30.1 ± 32.9	26.1 ± 31.0	0.0030
City	31.8 ± 30.2	28.7 ± 29.3	0.3068	32.1 ± 34.7	26.1 ± 29.4	0.0006
Rural	33.0 ± 35.1	28.8 ± 32.1	0.0676	33.6 ± 34.9	28.2 ± 34.1	0.0001
Primary caregiver						
Child	32.1 ± 34.2	27.8 ± 30.2	0.0693	32.2 ± 35.0	27.1 ± 32.9	0.0003
Married partner	31.4 ± 36.0	28.8 ± 33.5	0.3863	36.9 ± 37.4	31.1 ± 36.3	0.0010
Paid caregiver	23.2 ± 22.1	25.4 ± 22.3	0.3267	24.2 ± 26.4	20.9 ± 23.6	0.0373
Other ^a	40.6 ± 46.7	30.3 ± 34.3	0.0390	29.2 ± 29.8	25.1 ± 27.6	0.0543
None	33.4 ± 25.7	31.9 ± 28.9	0.7752	34.2 ± 36.3	26.6 ± 27.9	0.0460
LTC grade						
1-2	23.9 ± 23.2	23.9 ± 21.2	0.9921	24.2 ± 31.3	20.5 ± 24.1	0.0382
3-4	33.4 ± 37.2	29.3 ± 32.4	0.0234	33.9 ± 35.4	28.6 ± 33.5	<.0001
5	29.2 ± 24.2	25.7 ± 23.4	0.3847	28.5 ± 21.8	24.1 ± 27.5	0.0642
Type of service						
Institutional care	25.3 ± 23.0	26.6 ± 23.5	0.5486	21.9 ± 18.8	19.6 ± 13.9	0.0202
HCBS	33.7 ± 38.0	28.7 ± 32.4	0.0067	34.8 ± 37.3	29.0 ± 35.3	<.0001
Both	26.7 ± 20.9	27.3 ± 25.6	0.8948	25.9 ± 17.4	22.7 ± 20.8	0.1601
CCI						
0	19.7 ± 32.5	19.8 ± 21.8	0.9869	23.6 ± 30.4	18.7 ± 20.7	0.0776
1	24.9 ± 29.4	24.1 ± 26.7	0.6517	24.7 ± 22.9	22.1 ± 23.2	0.0031
≥2	39.3 ± 37.9	33.2 ± 33.6	0.0077	39.1 ± 40.6	32.1 ± 38.1	<.0001
Disability						
No	29.8 ± 31.0	26.4 ± 25.8	0.0343	30.2 ± 30.5	25.3 ± 29.5	<.0001
Yes	34.6 ± 40.2	31.3 ± 36.9	0.2529	34.9 ± 39.7	29.8 ± 35.7	0.0013

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 22. Changes in outpatient OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40% reduction					Control				
	Before (2017)		After (2019)		p-value	Before (2017)		After (2019)		p-value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	304,090	± 433,433	289,942	± 427,539	0.4583	353,859	± 496,614	316,092	± 479,505	0.0025
Gender										
Male	298,264	± 523,595	288,867	± 540,906	0.8430	390,730	± 598,313	346,808	± 561,853	0.1414
Female	306,004	± 399,775	290,296	± 383,474	0.4324	341,746	± 457,805	306,000	± 448,846	0.0075
Age										
≤74	359,487	± 516,473	334,242	± 503,665	0.6209	465,321	± 693,226	413,708	± 667,656	0.1892
75-79	379,113	± 505,789	366,778	± 541,543	0.8068	388,604	± 522,558	346,498	± 476,062	0.1297
80-84	279,481	± 355,906	264,779	± 329,381	0.5752	333,567	± 422,061	302,324	± 419,538	0.0928
≥85	231,799	± 375,023	225,382	± 353,976	0.8408	266,286	± 342,817	234,167	± 351,878	0.0675
Insurance type										
Self-employed insured	296,241	± 406,478	257,925	± 342,526	0.1849	385,345	± 602,728	344,090	± 525,784	0.2078
Employee insured	308,003	± 446,503	305,904	± 463,552	0.9322	346,219	± 467,067	309,297	± 467,446	0.0056
Region										
Metropolitan	335,075	± 520,949	328,286	± 497,395	0.8515	369,530	± 559,627	340,434	± 505,473	0.0006
City	280,054	± 320,571	285,056	± 375,106	0.8869	343,433	± 469,121	310,310	± 452,791	0.1788
Rural	286,517	± 386,242	256,727	± 375,196	0.2533	345,239	± 447,041	296,712	± 468,841	0.0090
Primary caregiver										
Child	299,602	± 409,513	283,155	± 389,337	0.5706	347,349	± 442,438	305,613	± 445,620	0.0221
Married partner	346,587	± 515,599	337,821	± 546,935	0.8512	452,983	± 605,513	407,076	± 598,279	0.1144
Paid caregiver	219,076	± 341,630	267,952	± 391,737	0.2029	262,696	± 512,063	234,202	± 391,205	0.3197
Other ^a	341,321	± 471,882	266,878	± 375,175	0.1496	303,632	± 378,344	275,696	± 407,086	0.3405
None	325,117	± 306,179	245,612	± 239,896	0.1191	264,073	± 242,558	250,121	± 283,842	0.6531
LTC grade										
1-2	280,921	± 433,452	294,075	± 444,738	0.7857	305,294	± 565,544	258,843	± 417,456	0.1418
3-4	309,628	± 444,194	286,109	± 422,300	0.2834	365,115	± 493,703	330,841	± 499,102	0.0108
5	297,033	± 295,964	322,102	± 448,349	0.6927	342,911	± 324,345	287,092	± 374,168	0.0983
Type of service										
Institutional care	229,944	± 368,596	255,175	± 400,460	0.4891	218,766	± 412,825	192,670	± 230,679	0.1830
HCBS	329,313	± 458,324	604,092	± 441,849	0.2794	391,876	± 519,976	351,666	± 524,567	0.0086
Both	258,460	± 238,359	233,896	± 301,540	0.6523	282,635	± 254,324	236,985	± 349,688	0.2126

CCI							
0	133,447 ± 244,049	212,612 ± 345,267	0.1499	194,677 ± 272,361	208,694 ± 306,372	0.6550	
1	221,602 ± 293,849	236,759 ± 306,999	0.4405	250,906 ± 300,050	229,595 ± 305,759	0.0687	
≥2	403,567 ± 529,954	350,084 ± 518,188	0.1102	460,702 ± 614,991	402,942 ± 590,021	0.0077	
Disability							
No	264,698 ± 294,934	254,838 ± 300,149	0.5503	311,155 ± 341,304	275,360 ± 376,018	0.0019	
Yes	373,479 ± 598,927	351,780 ± 583,747	0.6184	429,084 ± 683,591	387,842 ± 614,875	0.1357	

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 23. Changes in total outpatient expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40% reduction				Control					
	Before (2017)		After (2019)		<i>p</i> -value	Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	1,287,850	± 3,307,801	1,345,459	± 3,298,282	0.6939	1,333,962	± 3,197,583	1,342,394	± 3,576,851	0.9226
Gender										
Male	1,729,186	± 4,708,037	1,828,363	± 4,722,701	0.8135	1,737,444	± 4,295,797	1,725,117	± 4,641,646	0.9573
Female	1,142,848	± 2,681,948	1,186,800	± 2,654,649	0.7471	1,201,397	± 2,730,663	1,216,649	± 3,140,519	0.8605
Age										
≤74	1,741,020	± 4,453,038	1,760,763	± 4,329,024	0.9642	2,157,874	± 5,164,951	2,222,522	± 5,850,436	0.8392
75-79	1,787,366	± 4,045,720	1,893,774	± 4,242,647	0.7898	1,428,843	± 3,078,754	1,443,646	± 3,437,354	0.9349
80-84	1,013,586	± 2,261,340	995,420	± 1,794,124	0.9074	1,060,698	± 1,996,707	1,097,509	± 2,331,694	0.7010
≥85	886,581	± 2,606,835	1,032,114	± 2,915,814	0.5480	982,158	± 2,388,410	905,054	± 2,450,463	0.5285
Insurance type										
Self-employed insured	1,277,884	± 3,013,878	1,249,466	± 2,466,870	0.8932	1,465,108	± 3,634,841	1,414,195	± 3,502,425	0.8054
Employee insured	1,292,818	± 3,447,105	1,393,315	± 3,643,324	0.6014	1,302,135	± 3,082,110	1,324,969	± 3,595,165	0.8110
Region										
Metropolitan	1,546,337	± 4,157,687	1,574,954	± 3,923,806	0.9208	1,319,430	± 2,981,878	1,386,031	± 3,514,023	0.6261
City	889,287	± 954,597	1,104,887	± 1,949,600	0.1644	1,279,148	± 3,257,842	1,329,074	± 3,434,533	0.7801
Rural	1,232,616	± 3,098,567	1,244,153	± 3,149,925	0.9570	1,379,037	± 3,355,146	1,309,351	± 3,714,955	0.6270
Primary caregiver										
Child	1,226,121	± 3,143,074	1,265,606	± 3,115,497	0.8620	1,287,568	± 3,179,145	1,258,449	± 3,318,283	0.8272
Married partner	1,553,557	± 3,963,662	1,695,855	± 4,295,490	0.6954	1,832,909	± 4,004,893	1,863,758	± 4,581,930	0.8820
Paid caregiver	882,393	± 2,701,369	1,111,472	± 2,416,228	0.3918	944,730	± 2,454,024	948,827	± 3,023,588	0.9811
Other ^a	1,598,264	± 3,731,652	1,343,623	± 3,270,935	0.5486	1,034,068	± 2,364,954	1,094,515	± 2,757,754	0.7523
None	1,062,705	± 886,911	1,055,579	± 1,039,414	0.9681	866,892	± 840,141	936,095	± 1,501,694	0.6286
LTC grade										
1-2	1,094,028	± 2,342,455	1,238,709	± 2,181,843	0.5619	958,523	± 1,881,084	986,254	± 2,380,695	0.6722
3-4	1,357,278	± 3,605,645	1,388,117	± 3,604,871	0.8657	1,441,394	± 3,501,407	1,435,823	± 3,822,452	0.9585
5	977,964	± 980,098	1,126,784	± 1,393,407	0.4599	1,096,263	± 1,709,313	1,143,803	± 3,006,431	0.8400
Type of service										
Institutional care	987,913	± 3,184,305	1,178,573	± 2,836,987	0.5047	680,128	± 1,336,463	650,012	± 835,783	0.6447
HCBS	1,408,328	± 3,440,198	1,420,151	± 3,512,238	0.9476	1,528,126	± 3,571,836	1,534,734	± 3,994,455	0.9525

Both	828,034 ± 768,700	975,372 ± 1,280,242	0.4874	819,721 ± 699,254	1,019,079 ± 2,795,751	0.4143
CCI						
0	524,094 ± 1,195,862	797,115 ± 1,928,489	0.3533	649,464 ± 807,735	709,036 ± 986,089	0.5415
1	804,615 ± 1,891,755	921,812 ± 1,658,584	0.3138	810,336 ± 1,491,727	842,298 ± 1,873,446	0.6252
≥2	1,841,780 ± 4,306,594	1,816,269 ± 4,370,474	0.9266	1,863,527 ± 4,201,600	1,845,907 ± 4,652,135	0.9120
Disability						
No	873,941 ± 1,021,497	986,005 ± 1,417,460	0.1023	981,987 ± 1,377,410	1,011,671 ± 2,065,099	0.5975
Yes	2,016,959 ± 5,252,788	1,978,644 # 5,091,176	0.9199	1,953,972 ± 4,930,008	1,924,968 ± 5,225,242	0.8932

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 24. Changes in LOS for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40% reduction					control				
	Before (2017)		After (2019)		p-value	Before (2017)		After (2019)		p-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD		Mean ± SD	Mean ± SD			
Total	22.9 ± 63.9	21.8 ± 61.4	0.7021	24.5 ± 67.2	35.5 ± 85.9	<.0001				
Gender										
Male	31.2 ± 81.8	30.8 ± 71.3	0.9505	29.6 ± 75.0	43.2 ± 93.6	0.0018				
Female	20.1 ± 56.6	18.9 ± 57.5	0.6626	22.8 ± 64.3	33.0 ± 83.1	<.0001				
Age										
≤74	33.0 ± 81.1	27.8 ± 75.4	0.5037	34.6 ± 79.8	38.3 ± 90.5	0.4491				
75-79	26.2 ± 69.7	25.5 ± 67.9	0.9237	24.4 ± 64.0	39.5 ± 91.2	0.0006				
80-84	21.2 ± 60.6	21.9 ± 61.3	0.8844	24.3 ± 68.8	34.8 ± 83.7	0.0019				
≥85	14.5 ± 44.2	14.0 ± 39.4	0.8927	17.2 ± 55.1	31.1 ± 80.3	<.0001				
Insurance type										
Self-employed insured	21.3 ± 62.8	21.9 ± 62.3	0.8955	29.8 ± 79.0	39.0 ± 91.0	0.0613				
Employee insured	23.6 ± 64.5	21.7 ± 61.0	0.5755	23.2 ± 63.9	34.7 ± 84.6	<.0001				
Region										
Metropolitan	22.1 ± 60.7	22.0 ± 66.5	0.9786	25.7 ± 72.2	34.6 ± 87.4	0.0080				
City	33.8 ± 80.1	25.4 ± 67.3	0.2584	25.6 ± 71.2	39.3 ± 91.9	0.0019				
Rural	18.5 ± 57.6	20.0 ± 53.1	0.6976	22.8 ± 59.5	34.2 ± 80.7	<.0001				
Primary caregiver										
Child	17.7 ± 48.6	19.4 ± 56.0	0.6551	16.8 ± 49.5	33.2 ± 81.2	<.0001				
Married partner	16.1 ± 53.0	21.2 ± 55.1	0.2885	20.1 ± 53.2	34.3 ± 82.2	<.0001				
Paid caregiver	56.9 ± 106.4	25.3 ± 76.7	0.0012	56.0 ± 109.0	45.9 ± 102.3	0.1291				
Other ^a	8.0 ± 32.7	27.4 ± 70.3	0.0037	18.8 ± 61.1	31.2 ± 82.6	0.2200				
None	14.2 ± 28.7	16.4 ± 41.5	0.7321	18.1 ± 59.2	35.9 ± 88.3	0.0449				
LTC grade										
1-2	47.2 ± 99.2	30.6 ± 83.6	0.1016	54.5 ± 108.0	46.5 ± 101.9	0.2277				
3-4	19.1 ± 55.3	19.6 ± 55.9	0.8543	19.7 ± 55.8	33.8 ± 82.9	<.0001				
5	7.8 ± 19.0	25.2 ± 56.8	0.0151	8.4 ± 28.4	29.3 ± 75.4	0.0002				
Type of service										
Institutional care	14.9 ± 47.4	10.2 ± 28.5	0.2009	15.1 ± 43.9	17.5 ± 51.7	0.4009				
HCBS	23.8 ± 67.5	25.4 ± 67.4	0.6370	26.3 ± 72.0	39.9 ± 91.9	<.0001				
Both	44.3 ± 68.2	19.2 ± 69.3	0.0714	34.1 ± 59.3	38.6 ± 87.0	0.6136				
CCI										
0	20.5 ± 60.0	10.3 ± 49.2	0.3098	13.3 ± 52.9	24.0 ± 71.7	0.1174				
1	13.7 ± 45.5	16.9 ± 48.1	0.2980	16.4 ± 55.6	28.6 ± 76.9	<.0001				
≥2	31.9 ± 76.9	27.9 ± 72.5	0.4025	32.8 ± 76.2	42.8 ± 93.8	0.0012				
Disability										
No	19.2 ± 53.6	17.9 ± 52.0	0.6537	21.0 ± 59.8	34.3 ± 84.1	<.0001				
Yes	29.4 ± 78.4	28.7 ± 74.6	0.9131	30.6 ± 78.2	37.6 ± 88.9	0.0487				

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; LOS, Length of stay; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 25. Changes in inpatient OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

variable	40% reduction					Control								
	Before (2017)			After (2019)		<i>p</i> -value	Before (2017)			After (2019)		<i>p</i> -value		
	Mean	±	SD	Mean	±		SD	Mean	±	SD	Mean		±	SD
Total	723,477	±	1,865,298	723,696	±	1,711,111	0.9978	769,409	±	1,904,559	1,102,762	±	2,364,937	<.0001
Gender														
Male	894,950	±	2,356,723	992,478	±	2,071,880	0.6220	915,201	±	2,233,950	1,350,580	±	2,708,796	0.0007
Female	667,139	±	1,670,675	635,387	±	1,566,186	0.7010	721,509	±	1,781,056	1,021,341	±	2,235,137	<.0001
Age														
≤74	1,030,971	±	2,608,388	948,940	±	2,304,273	0.7391	1,107,532	±	2,473,463	1,195,461	±	2,569,308	0.5460
75-79	838,799	±	2,012,445	805,222	±	1,771,414	0.8540	829,846	±	1,923,310	1,170,517	±	2,341,227	0.0043
80-84	667,172	±	1,660,545	688,024	±	1,472,671	0.8621	712,908	±	1,747,005	1,123,064	±	2,452,252	<.0001
≥85	466,188	±	1,138,271	530,370	±	1,370,019	0.5607	534,330	±	1,509,265	949,052	±	2,085,271	<.0001
Insurance type														
Self-employed insured	663,498	±	1,801,495	665,438	±	1,646,907	0.9883	905,842	±	2,166,946	1,221,895	±	2,596,049	0.0226
Employee insured	753,377	±	1,896,899	752,740	±	1,742,698	0.9949	736,299	±	1,834,195	1,073,851	±	230,500	<.0001
Region														
Metropolitan	817,750	±	2,074,252	780,649	±	1,832,175	0.7900	835,869	±	2,055,820	1,123,593	±	2,439,319	0.0024
City	908,470	±	2,118,411	770,091	±	1,786,809	0.4838	760,769	±	1,898,801	1,237,764	±	2,631,192	0.0001
Rural	550,920	±	1,488,784	649,607	±	1,553,568	0.3435	712,388	±	1,754,921	1,005,697	±	2,117,541	0.0002
Primary caregiver														
Child	669,429	±	1,750,074	676,684	±	1,602,877	0.9525	593,594	±	1,524,238	1,051,382	±	2,269,325	<.0001
Married partner	589,320	±	1,864,538	763,570	±	1,744,090	0.2726	710,087	±	1,766,845	1,136,455	±	2,367,375	<.0001
Paid caregiver	1,402,427	±	2,528,842	725,024	±	1,772,005	0.0031	1,507,009	±	2,867,973	1,286,312	±	2,617,263	0.2009
Other ^a	313,912	±	1,040,881	806,576	±	1,820,885	0.0064	536,939	±	1,447,522	942,262	±	2,200,533	0.0036
None	494,118	±	927,784	654,859	±	1,829,155	0.5484	557,801	±	1,663,951	1,080,692	±	2,563,331	0.0404
LTC grade														
1-2	1,430,920	±	3,111,661	910,172	±	2,090,258	0.0753	1,523,770	±	2,966,736	1,354,810	±	2,631,544	0.3434
3-4	610,334	±	1,525,019	673,461	±	1,616,155	0.4271	656,258	±	1,633,581	1,078,031	±	2,353,605	<.0001
5	331,102	±	692,126	841,971	±	1,741,784	0.0222	269,606	±	727,218	793,762	±	1,708,378	<.0001

Type of service

Institutional care	418,592 ± 1,217,169	428,309 ± 930,042	0.9246	468,092 ± 1,173,444	600,198 ± 1,417,667	0.0833
HCBS	772,015 ± 2,005,056	820,865 ± 1,882,725	0.6277	829,575 ± 2,061,028	1,221,646 ± 2,526,814	<.0001
Both	1,359,064 ± 1,891,433	591,366 ± 1,567,751	0.0295	1,021,131 ± 1,477,209	123,619 ± 2,465,028	0.4287
CCI						
0	612,279 ± 1,666,242	367,995 ± 1,350,056	0.3794	359,296 ± 1,156,122	674,179 ± 1,643,171	0.0412
1	410,337 ± 1,061,116	572,163 ± 1,346,390	0.0414	490,238 ± 1,467,738	878,102 ± 2,074,061	<.0001
≥2	1,035,536 ± 2,372,411	911,598 ± 2,015,669	0.3779	1,056,743 ± 2,234,267	1,344,891 ± 2,629,591	0.0010
Disability						
No	610,770 ± 1,432,598	623,931 ± 1,467,300	0.8701	649,505 ± 1,571,957	1,069,545 ± 2,339,373	<.0001
Yes	922,012 ± 2,437,922	899,436 ± 2,062,515	0.8920	980,622 ± 2,366,063	1,161,274 ± 2,409,259	0.0752

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 26. Changes in total inpatient expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40%reduction					Control				
	Before (2017)		After (2019)		p-value	Before (2017)		After (2019)		p-value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	3,473,792	± 8,964,898	3,735,987	± 8,805,354	0.5054	3,692,170	± 9,172,241	5,559,776	± 12,243,278	<.0001
Gender										
Male	4,422,466	± 10,770,129	5,652,427	± 11,333,704	0.2123	4,710,021	± 11,420,967	7,482,355	± 15,552,312	<.0001
Female	3,162,103	± 8,270,857	3,106,336	± 7,703,599	0.8913	3,357,752	± 8,277,252	4,928,107	± 10,869,986	<.0001
Age										
≤74	5,177,893	± 12,724,721	5,064,741	± 12,229,085	0.9278	5,667,487	± 12,407,703	6,545,247	± 13,846,932	0.2477
75-79	3,945,583	± 9,253,522	4,447,295	± 9,039,348	0.5690	4,004,168	± 9,468,374	5,869,981	± 11,520,113	0.0015
80-84	3,051,331	± 7,387,831	3,258,370	± 7,230,506	0.7112	3,376,724	± 8,341,651	5,605,270	± 12,959,421	<.0001
≥85	2,331,092	± 6,662,698	2,754,960	± 7,066,322	0.4811	2,333,655	± 6,357,516	4,488,290	± 10,344,476	<.0001
Insurance type										
Self-employed insured	3,225,024	± 8,801,294	3,555,904	± 8,595,972	0.6206	4,402,229	± 10,471,671	6,573,981	± 14,961,946	0.0037
Employee insured	3,597,811	± 9,049,218	3,825,764	± 8,912,795	0.6399	3,519,851	± 8,821,863	5,313,645	± 11,477,019	<.0001
Region										
Metropolitan	4,047,532	± 10,484,241	4,220,631	± 1,038,758	0.8136	4,118,005	± 10,039,649	5,983,228	± 13,183,222	0.0002
City	4,519,779	± 10,016,119	3,685,829	± 7,800,243	0.3571	3,583,356	± 9,145,095	6,121,273	± 13,687,505	<.0001
Rural	2,460,475	± 6,511,203	3,310,805	± 7,862,228	0.0856	3,357,555	± 8,289,942	4,841,912	± 10,269,664	<.0001
Primary caregiver										
Child	3,165,359	± 8,495,665	3,519,182	± 8,281,643	0.5612	2,749,973	± 6,934,451	5,127,517	± 10,882,324	<.0001
Married partner	3,018,451	± 8,888,134	4,138,678	± 9,221,306	0.1598	3,721,328	± 8,960,791	5,952,162	± 13,060,651	<.0001
Paid caregiver	6,522,013	± 1,208,276	3,377,579	± 7,766,393	0.0036	6,996,510	± 13,783,774	6,559,737	± 13,326,106	0.6081
Other ^a	1,454,777	± 4,506,566	4,264,234	± 10,827,371	0.0054	2,587,884	± 7,447,076	4,896,936	± 12,966,182	0.0035
None	2,641,094	± 4,539,524	3,255,754	± 8,179,759	0.6147	2,420,539	± 7,429,045	4,925,741	± 11,831,323	0.0317
LTC grade										
1-2	6,736,187	± 14,423,187	4,345,233	± 9,614,644	0.0774	7,354,972	± 14,414,971	6,651,523	± 12,645,693	0.4146
3-4	2,964,332	± 7,573,145	3,515,805	± 8,525,186	0.1764	3,145,717	± 7,826,128	5,484,105	± 1,250,573	<.0001
5	1,530,776	± 3,085,992	4,731,224	± 981,259	0.0092	1,233,333	± 3,182,604	3,879,719	± 8,173,450	<.0001
Type of service										
Institutional care	2,007,123	± 5,429,440	2,104,051	± 4,337,767	0.8351	2,069,648	± 5,102,429	3,019,831	± 6,980,050	0.0081
HCBS	3,737,437	± 9,778,974	4,263,271	± 9,678,917	0.2967	4,019,585	± 9,943,808	6,151,447	± 13,120,360	<.0001
Both	6,081,568	± 8,026,830	3,147,355	± 9,193,375	0.0923	4,990,338	± 8,154,383	6,272,818	± 12,994,526	0.3235

CCI										
0	2,800,276 ±	7,167,776	1,567,635 ±	5,493,939	0.2926	1,841,579 ±	6,296,044	3,439,137 ±	8,741,578	0.0533
1	1,786,174 ±	4,550,382	2,942,766 ±	7,041,621	0.0029	2,232,425 ±	6,773,947	4,250,821 ±	10,337,360	<.0001
≥2	5,164,661 ±	11,636,608	4,757,023 ±	10,390,802	0.5627	5,162,099 ±	10,857,692	6,928,875 ±	13,842,564	<.0001
Disability										
No	2,779,578 ±	6,828,686	3,172,346 ±	7,371,231	0.3192	2,984,555 ±	7,174,531	5,191,699 ±	11,649,218	<.0001
Yes	4,696,663 ±	11,736,173	4,728,851 ±	10,821,701	0.9691	4,938,647 ±	11,803,175	6,208,149 ±	13,205,521	0.0172

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, Standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 27. Results of the Generalized Linear Model of additional 10% group for medical utilization expenses

Variables	Total medical OOPs			Total medical expenses		
	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value
Intervention						
Before	Ref.			Ref.		
After	40.8	(0.29 – 0.39)	<.0001	56.8	(0.40 – 0.50)	<.0001
Case^a	-14.3	(-0.24 – -0.07)	0.0002	-7.4	(-0.17 – 0.01)	0.0865
Control^b	Ref.			Ref.		
Case*Intervention^c	-7.7	(-0.18 – 0.02)	0.1298	-8.2	(-0.19 – 0.02)	0.1188
Gender						
Male	Ref.			Ref.		
Female	-8.0	(-0.17 – -0.00)	0.0439	-17.8	(-0.29 – -0.10)	<.0001
Age						
≤74	Ref.			Ref.		
75-79	-1.4	(-0.10 – 0.08)	0.7663	-6.9	(-0.18 – 0.04)	0.1890
80-84	-8.8	(-0.18 – -0.00)	0.0387	-17.4	(-0.29 – -0.09)	0.0001
≥85	-21.0	(-0.33 – -0.14)	<.0001	-29.0	(-0.45 – -0.24)	<.0001
Insurance type						
Self-employed insured	Ref.			Ref.		
Employee insured	3.2	(-0.03 – 0.10)	0.3461	-0.9	(-0.08 – 0.06)	0.8119
Region						
Metropolitan	Ref.			Ref.		
City	0.3	(-0.07 – 0.08)	0.9407	-1.0	(-0.09 – 0.07)	0.8001
Rural	-0.3	(-0.06 – 0.06)	0.9313	-2.8	(-0.10 – 0.04)	0.4156
Primary caregiver						
Child	Ref.			Ref.		
Married partner	-11.8	(-0.20 – -0.05)	0.0013	-10.3	(-0.20 – -0.02)	0.0196
Paid caregiver	52.8	(0.32 – 0.53)	<.0001	51.4	(0.31 – 0.52)	<.0001
Other ^d	-2.0	(-0.11 – 0.07)	0.6691	-0.5	(-0.11 – 0.10)	0.9218
None	1.9	(-0.12 – 0.15)	0.7794	0.3	(-0.14 – 0.15)	0.9636
LTC grade						
1-2	Ref.			Ref.		
3-4	-6.2	(-0.20 – 0.07)	0.3481	-9.4	(-0.24 – 0.04)	0.1652
5	-21.8	(-0.43 – -0.06)	0.0088	-33.5	(-0.60 – -0.21)	<.0001
Type of service						
Institutional care	Ref.			Ref.		
HCBS	111.0	(0.64 – 0.85)	<.0001	113.8	(0.65 – 0.87)	<.0001
Both	99.0	(0.55 – 0.82)	<.0001	97.0	(0.53 – 0.82)	<.0001
CCI						
0	Ref.			Ref.		
1	52.7	(0.29 – 0.56)	<.0001	57.0	(0.31 – 0.59)	<.0001
≥2	134.0	(0.72 – 0.98)	<.0001	157.2	(0.81 – 1.08)	<.0001
Disability						
No	Ref.			Ref.		
Yes	-2.5	(-0.09 – 0.03)	0.4013	6.2	(-0.01 – 0.13)	0.0778
ADL	3.4	(0.02 – 0.04)	<.0001	3.2	(0.02 – 0.04)	<.0001
Cognitive score	-5.2	(-0.07 – -0.04)	<.0001	-6.0	(-0.08 – -0.04)	<.0001
Behavioral problems	-1.8	(-0.04 – 0.01)	0.1476	-2.8	(-0.06 – -0.01)	0.0346

^a Additional 10% group.

^b Control group selected through additional 10% group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 28. Results of the Generalized Linear Model of additional 10% group for outpatient utilization expenses

Variables	No. of outpatient visit			OOPs			Total expenses		
	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value
Intervention									
Before	Ref.			Ref.			Ref.		
After	-14.0	(-0.17 – -0.13)	<.0001	-9.0	(-0.12 – -0.07)	<.0001	-0.3	(-0.04 – 0.03)	0.8505
Case^a	0.1	(-0.05 – 0.05)	0.9554	-11.8	(-0.19 – -0.06)	<.0001	-2.8	(-0.11 – 0.06)	0.5040
Control^b	Ref.			Ref.			Ref.		
Case*Intervention^c	3.8	(-0.00 – 0.08)	0.0552	4.0	(-0.02 – 0.09)	0.1643	4.1	(-0.02 – 0.10)	0.1921
Gender									
Male	Ref.			Ref.			Ref.		
Female	10.0	(0.04 – 0.15)	0.0016	17.9	(0.10 – 0.23)	<.0001	5.7	(-0.06 – 0.17)	0.3492
Age									
≤74	Ref.			Ref.			Ref.		
75-79	-1.0	(-0.08 – 0.06)	0.7664	-11.6	(-0.20 – -0.04)	0.0030	-21.3	(-0.37 – -0.11)	0.0003
80-84	-6.6	(-0.13 – -0.01)	0.0318	-20.2	(-0.30 – -0.15)	<.0001	-33.4	(-0.52 – -0.29)	<.0001
≥85	-15.3	(-0.23 – -0.10)	<.0001	-30.7	(-0.45 – -0.29)	<.0001	-40.5	(-0.64 – -0.40)	<.0001
Insurance type									
Self-employed insured	Ref.			Ref.			Ref.		
Employee insured	0.0	(-0.04 – 0.04)	0.9925	4.9	(-0.01 – 0.10)	0.0840	-0.3	(-0.08 – 0.08)	0.9348
Region									
Metropolitan	Ref.			Ref.			Ref.		
City	5.1	(0.00 – 0.10)	0.0391	-8.1	(-0.15 – -0.02)	0.0065	-6.7	(-0.16 – 0.02)	0.1140
Rural	3.3	(-0.01 – 0.07)	0.1071	-14.9	(-0.21 – -0.11)	<.0001	16.3	(-0.22 – -0.08)	<.0001
Primary caregiver									
Child	Ref.			Ref.			Ref.		
Married partner	12.2	(0.06 – 0.17)	<.0001	10.9	(0.04 – 0.17)	0.0022	11.9	(0.01 – 0.22)	0.0366
Paid caregiver	-6.2	(-0.13 – -0.00)	0.0422	-9.3	(-0.18 – -0.02)	0.0157	-7.7	(-0.19 – 0.03)	0.1532
Other ^d	-1.4	(-0.07 – 0.04)	0.6263	-7.3	(-0.14 – -0.01)	0.0301	-4.9	(-0.15 – 0.05)	0.3164
None	0.9	(-0.07 – 0.09)	0.8111	-13.8	(-0.24 – -0.06)	0.0011	-15.1	(-0.28 – -0.05)	0.0044
LTC grade									
1-2	Ref.			Ref.			Ref.		
3-4	-10.1	(-0.19 – -0.02)	0.0147	-4.4	(-0.15 – 0.06)	0.4145	-9.5	(-0.25 – 0.05)	0.1803
5	-26.6	(-0.43 – -0.19)	<.0001	-13.8	(-0.29 – -0.00)	0.4443	-29.6	(-0.54 – -0.16)	0.0004
Type of service									
Institutional care	Ref.			Ref.			Ref.		

HCBS	9.6	(0.04 - 0.14)	0.0005	30.4	(0.19 - 0.34)	<.0001	34.3	(0.20 - 0.39)	<.0001
Both	-2.3	(-0.08 - 0.04)	0.4488	11.3	(0.01 - 0.20)	0.0248	7.2	(-0.05 - 0.18)	0.2389
CCI									
0	Ref.			Ref.			Ref.		
1	24.5	(0.14 - 0.30)	<.0001	42.7	(0.26 - 0.45)	<.0001	42.6	(0.25 - 0.46)	<.0001
≥2	77.8	(0.50 - 0.65)	<.0001	128.4	(0.73 - 0.93)	<.0001	163.4	(0.86 - 1.08)	<.0001
Disability									
No	Ref.			Ref.			Ref.		
Yes	7.0	(0.03 - 0.11)	0.0009	12.8	(0.07 - 0.17)	<.0001	30.7	(0.19 - 0.34)	<.0001
ADL	-2.1	(-0.03 - -0.01)	<.0001	-0.1	(-0.02 - 0.00)	0.1272	-1.5	(-0.02 - -0.00)	0.0079
Cognitive score	-4.0	(-0.05 - -0.03)	<.0001	-5.5	(-0.07 - -0.04)	<.0001	-6.7	(-0.09 - -0.05)	<.0001
Behavioral problems	-7.2	(-0.09 - -0.06)	<.0001	-3.9	(-0.06 - -0.02)	<.0001	-6.1	(-0.09 - -0.04)	<.0001

^a Additional 10% group.

^b Control group selected through additional 10% group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 29. Results of the Generalized Linear Model of additional 10% group for inpatient utilization expenses

Variables	LOS			OOPs			Total expenses		
	%	95% CI	p-value	%	95% CI	p-value	%	95% CI	p-value
Intervention									
Before	Ref.			Ref.			Ref.		
After	83.3	(0.52 – 0.69)	<.0001	75.7	(0.49 – 0.63)	<.0001	86.4	(0.55 – 0.69)	<.0001
Case^a	-12.4	(-0.28 – 0.02)	0.0851	-16.8	(-0.31 – -0.06)	0.0032	-11.1	(-0.23 – 0.01)	0.0672
Control^b	Ref.			Ref.			Ref.		
Case*Intervention^c	-18.9	(-0.39 – -0.03)	0.0217	-11.3	(-0.27 – 0.03)	0.1177	-10.7	(-0.26 – 0.03)	0.1290
Gender									
Male	Ref.			Ref.			Ref.		
Female	-18.7	(-0.33 – -0.08)	0.0014	-16.4	(-0.29 – -0.07)	0.0015	-23.6	(-0.38 – -0.15)	<.0001
Age									
≤74	Ref.			Ref.			Ref.		
75-79	0.1	(-0.16 – 0.16)	0.9881	4.9	(-0.08 – 0.18)	0.4663	1.7	(-0.12 – 0.15)	0.8129
80-84	-10.3	(-0.26 – 0.04)	0.1592	-3.4	(-0.16 – 0.09)	0.5823	-9.6	(-0.23 – 0.02)	0.1122
≥85	-14.8	(-0.32 – 0.00)	0.0535	-15.3	(-0.30 – -0.04)	0.0124	-22.6	(-0.39 – -0.12)	0.0001
Insurance type									
Self-employed insured	Ref.			Ref.			Ref.		
Employee insured	1.8	(-0.09 – 0.13)	0.7474	3.5	(-0.06 – 0.12)	0.4579	-0.3	(-0.09 – 0.09)	0.9458
Region									
Metropolitan	Ref.			Ref.			Ref.		
City	17.9	(0.04 – 0.29)	0.0110	2.2	(-0.08 – 0.12)	0.6802	-1.0	(-0.11 – 0.09)	0.8470
Rural	27.6	(0.14 – 0.35)	<.0001	6.7	(-0.02 – 0.15)	0.1448	0.6	(-0.08 – 0.09)	0.8868
Primary caregiver									
Child	Ref.			Ref.			Ref.		
Married partner	-28.4	(-0.46 – -0.20)	<.0001	-20.5	(-0.34 – -0.12)	<.0001	-16.5	(-0.30 – -0.06)	0.0023
Paid caregiver	100.7	(0.53 – 0.87)	<.0001	74.8	(0.42 – 0.69)	<.0001	67.1	(0.38 – 0.65)	<.0001
Other ^d	-2.1	(-0.19 – 0.15)	0.8042	-2.1	(-0.15 – 0.11)	0.7477	-0.4	(-0.13 – 0.13)	0.9475
None	14.3	(-0.09 – 0.36)	0.2386	6.5	(-0.12 – 0.25)	0.4994	4.6	(-0.14 – 0.23)	0.6302
LTC grade									
1-2	Ref.			Ref.			Ref.		
3-4	-9.6	(-0.31 – 0.11)	0.3465	-4.0	(-0.22 – 0.14)	0.6480	-6.0	(-0.23 – 0.11)	0.4750
5	-26.8	(-0.62 – -0.00)	0.0467	-25.2	(-0.54 – -0.04)	0.0256	-32.8	(-0.65 – -0.15)	0.0016

Type of service									
Institutional care	Ref.			Ref.			Ref.		
HCBS	164.1	(0.78 – 1.16)	<.0001	129.1	(0.68 – 0.97)	<.0001	126.0	(0.66 – 0.97)	<.0001
Both	176.2	(0.80 – 1.24)	<.0001	144.3	(0.71 – 1.07)	<.0001	132.6	(0.67 – 1.02)	<.0001
CCI									
0	Ref.			Ref.			Ref.		
1	69.1	(0.29 – 0.77)	<.0001	54.8	(0.25 – 0.62)	<.0001	60.5	(0.29 – 0.65)	<.0001
≥2	139.5	(0.64 – 1.11)	<.0001	134.4	(0.67 – 1.03)	<.0001	151.8	(0.75 – 1.10)	<.0001
Disability									
No	Ref.			Ref.			Ref.		
Yes	-7.0	(-0.18 – 0.03)	0.1817	-8.4	(-0.17 – -0.00)	0.0434	-1.9	(-0.10 – 0.07)	0.6614
ADL	5.8	(0.04 – 0.07)	<.0001	5.2	(0.04 – 0.06)	<.0001	4.8	(0.03 – 0.06)	<.0001
Cognitive score	-6.4	(-0.10 – -0.04)	<.0001	-5.6	(-0.08 – -0.03)	<.0001	-6.0	(-0.09 – -0.04)	<.0001
Behavioral problems	0.9	(-0.03 – 0.05)	0.6812	-1.1	(-0.46 – 0.02)	0.5112	-2.0	(-0.05 – 0.01)	0.2482

^a Additional 10% group.

^b Control group selected through additional 10% group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; LOS, Length of stay; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 30. Results of the Generalized Linear Model of 40% reduction group for medical utilization expenses

Variables	Total medical OOPs			Total medical expenses		
	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value
Intervention						
Before	Ref.			Ref.		
After	42.5	(0.28 – 0.43)	<.0001	59.0	(0.38 – 0.54)	<.0001
Case^a	-7.3	(-0.19 – 0.04)	0.2002	-4.0	(-0.17 – 0.09)	0.5322
Control^b	Ref.			Ref.		
Case*Intervention^c	-20.5	(-0.38 – -0.08)	0.0021	-21.4	(-0.40 – -0.08)	0.0028
Gender						
Male	Ref.			Ref.		
Female	-9.3	(-0.20 – 0.01)	0.0695	-21.8	(-0.37 – -0.13)	<.0001
Age						
≤74	Ref.			Ref.		
75-79	-5.6	(-0.18 – 0.07)	0.3611	-9.9	(-0.24 – 0.03)	0.1238
80-84	-8.9	(-0.22 – 0.03)	0.1361	-16.1	(-0.31 – -0.04)	0.0122
≥85	-22.5	(-0.39 – -0.12)	0.0003	-28.7	(-0.49 – -0.19)	<.0001
Insurance type						
Self-employed insured	Ref.			Ref.		
Employee insured	0.3	(-0.09 – 0.10)	0.9561	-2.6	(-0.13 – 0.08)	0.6399
Region						
Metropolitan	Ref.			Ref.		
City	2.1	(-0.09 – 0.13)	0.7060	-3.5	(-0.15 – 0.08)	0.5565
Rural	-8.4	(-0.18 – 0.00)	0.0573	-12.0	(-0.23 – -0.03)	0.0134
Primary caregiver						
Child	Ref.			Ref.		
Married partner	-14.0	(0.00 – -0.04)	0.0080	-16.7	(-0.31 – -0.06)	0.0040
Paid caregiver	50.7	(0.27 – 0.55)	<.0001	48.8	(0.23 – 0.56)	<.0001
Other ^d	0.3	(-0.15 – 0.15)	0.9668	1.3	(-0.16 – 0.18)	0.8844
None	7.5	(-0.15 – 0.30)	0.5262	2.5	(-0.21 – 0.26)	0.8380
LTC grade						
1-2	Ref.			Ref.		
3-4	8.5	(-0.11 – 0.27)	0.4039	4.3	(-0.17 – 0.25)	0.6922
5	-3.5	(-0.31 – 0.23)	0.7928	-12.1	(-0.42 – 0.16)	0.3827
Type of service						
Institutional care	Ref.			Ref.		
HCBS	112.1	(0.60 – 0.91)	<.0001	109.3	(0.55 – 0.92)	<.0001
Both	111.2	(0.54 – 0.95)	<.0001	114.3	(0.54 – 0.98)	<.0001
CCI						
0	Ref.			Ref.		
1	38.7	(0.11 – 0.55)	0.0037	37.7	(0.08 – 0.56)	0.0079
≥2	123.4	(0.59 – 1.02)	<.0001	137.8	(0.63 – 1.10)	<.0001
Disability						
No	Ref.			Ref.		
Yes	3.9	(-0.06 – 0.14)	0.4413	15.0	(0.03 – 0.25)	0.0140
ADL	4.6	(0.03 – 0.06)	<.0001	4.1	(0.03 – 0.06)	<.0001
Cognitive score	-5.0	(-0.08 – -0.02)	0.0002	-5.7	(-0.09 – -0.03)	<.0001
Behavioral problems	-2.1	(-0.06 – 0.02)	0.2558	-4.2	(-0.08 – -0.00)	0.0358

^a 40% reduction group.

^b Control group selected through 40% reduction group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 31. Results of the Generalized Linear Model of 40% reduction group for outpatient utilization

Variables	No. of outpatient visit			OOPs			Total expenses		
	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value
Intervention									
Before	Ref.			Ref.			Ref.		
After	-15.6	(-0.20 – -0.14)	<.0001	-10.7	(-0.16 – -0.07)	<.0001	1.0	(-0.05 – 0.07)	0.7352
Case^a	-2.0	(-0.09 – 0.05)	0.5712	-11.8	(-0.22 – -0.04)	0.0062	-2.5	(-0.15 – 0.10)	0.7034
Control^b	Ref.			Ref.			Ref.		
Case*Intervention^c	9.6	(0.03 – 0.15)	0.0044	11.6	(0.02 – 0.20)	0.0162	10.9	(0.00 – 0.21)	0.0491
Gender									
Male	Ref.			Ref.			Ref.		
Female	6.6	(-0.01 – 0.14)	0.1079	13.4	(0.03 – 0.22)	0.0104	-5.2	(-0.21 – 0.10)	0.4891
Age									
≤74	Ref.			Ref.			Ref.		
75-79	12.2	(0.02 – 0.21)	0.0213	0.7	(-0.11 – 0.12)	0.9077	-7.7	(-0.26 – 0.10)	0.3811
80-84	0.8	(-0.08 – 0.09)	0.8491	-10.1	(-0.22 – 0.01)	0.0638	-25.2	(-0.46 – -0.12)	0.0011
≥85	-8.6	(-0.18 – -0.00)	0.0461	-22.2	(-0.37 – -0.13)	<.0001	-31.9	(-0.57 – -0.20)	<.0001
Insurance type									
Self-employed insured	Ref.			Ref.			Ref.		
Employee insured	-3.9	(-0.11 – 0.02)	0.2103	-1.9	(-0.11 – 0.07)	0.6651	-3.7	(-0.16 – 0.09)	0.5554
Region									
Metropolitan	Ref.			Ref.			Ref.		
City	1.0	(-0.06 – 0.08)	0.7977	-11.1	(-0.21 – -0.03)	0.0108	-16.1	(-0.30 – -0.05)	0.0055
Rural	2.6	(-0.04 – 0.09)	0.4191	-16.1	(-0.25 – -0.10)	<.0001	-13.6	(-0.26 – -0.03)	0.0152
Primary caregiver									
Child	Ref.			Ref.			Ref.		
Married partner	4.5	(-0.04 – 0.12)	0.2905	9.9	(-0.00 – 0.19)	0.0585	4.0	(-0.11 – 0.19)	0.5992
Paid caregiver	-7.0	(-0.17 – 0.02)	0.1384	-4.1	(-0.17 – 0.08)	0.5080	-4.4	(-0.24 – 0.15)	0.6507
Other ^d	3.0	(0.06 – 0.12)	0.5273	-1.4	(-0.12 – 0.09)	0.7897	-3.3	(-0.19 – 0.12)	0.6685
None	2.5	(-0.09 – 0.14)	0.6707	-10.6	(-0.24 – 0.02)	0.0912	-16.3	(-0.34 – -0.02)	0.0287
LTC grade									

1-2	Ref.			Ref.			Ref.		
3-4	-10.3	(-0.26 – 0.04)	0.1433	-11.8	(-0.31 – 0.06)	0.1796	-22.3	(-0.48 – -0.02)	0.0311
5	-28.6	(-0.53 – -0.14)	0.0008	-19.5	(-0.46 – 0.02)	0.0778	-34.7	(-0.76 – -0.10)	0.0112
Type of service									
Institutional care	Ref.			Ref.			Ref.		
HCBS	3.8	(-0.04 – 0.12)	0.3495	22.3	(0.09 – 0.31)	0.0005	16.4	(-0.03 – 0.34)	0.1060
Both	-7.6	(-0.19 – 0.04)	0.1749	-2.6	(-0.19 – 0.13)	0.7427	-7.2	(-0.30 – 0.15)	0.5172
CCI									
0	Ref.			Ref.			Ref.		
1	22.3	(0.06 – 0.34)	0.0052	37.2	(0.15 – 0.49)	0.0003	38.4	(0.11 – 0.54)	0.0027
≥2	75.3	(0.42 – 0.70)	<.0001	115.9	(0.60 – 0.94)	<.0001	143.6	(0.67 – 1.11)	<.0001
Disability									
No	Ref.			Ref.			Ref.		
Yes	6.4	(-0.00 – 0.13)	0.0615	16.4	(0.07 – 0.24)	0.0005	41.2	(0.21 – 0.48)	<.0001
ADL	-2.4	(-0.04 – -0.01)	<.0001	-0.9	(-0.02 – 0.00)	0.1775	-2.6	(-0.04 – -0.01)	0.004
Cognitive score	-3.8	(-0.06 – -0.02)	<.0001	-6.2	(-0.09 – -0.04)	<.0001	-7.4	(-0.11 – -0.04)	<.0001
Behavioral problems	-8.7	(-0.11 – -0.07)	<.0001	-6.1	(-0.09 – -0.03)	<.0001	-9.9	(-0.14 – -0.07)	<.0001

^a 40% reduction group.

^b Control group selected through 40% reduction group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 32. Results of the Generalized Linear Model of 40% reduction group for inpatient utilization

Variables	LOS			OOPs			Total expenses		
	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value	%	95% CI	<i>p</i> -value
Intervention									
Before	Ref.			Ref.			Ref.		
After	91.6	(0.53 – 0.77)	<.0001	79.2	(0.48 – 0.69)	<.0001	90.0	(0.53 – 0.75)	<.0001
Case^a	-10.3	(-0.30 – 0.09)	0.2736	-6.6	(-0.25 – 0.11)	0.4459	-6.2	(-0.24 – 0.11)	0.4853
Control^b	Ref.			Ref.			Ref.		
Case*Intervention^c	-35.3	(-0.69 – -0.18)	0.0009	-29.3	(-0.57 – -0.12)	0.0025	-27.9	(-0.55 – -0.10)	0.0043
Gender									
Male	Ref.			Ref.			Ref.		
Female	-20.4	(-0.39 – -0.07)	0.0050	-16.1	(-0.32 – -0.03)	0.0157	-25.1	(-0.43 – -0.14)	0.0001
Age									
≤74	Ref.			Ref.			Ref.		
75-79	-12.0	(-0.33 – 0.07)	0.2152	-9.4	(-0.27 – 0.07)	0.2611	-11.3	(-0.29 – 0.05)	0.1637
80-84	-12.4	(-0.32 – 0.06)	0.1796	-9.0	(-0.26 – 0.07)	0.2628	-13.0	(-0.30 – 0.02)	0.0956
≥85	-22.1	(-0.48 – -0.02)	0.0328	-22.1	(-0.44 – -0.06)	0.0101	-27.2	(-0.51 – -0.13)	0.0010
Insurance type									
Self-employed insured	Ref.			Ref.			Ref.		
Employee insured	-1.2	(-0.17 – 0.15)	0.8795	3.7	(-0.09 – 0.16)	0.5781	0.8	(-0.12 – 0.13)	0.9029
Region									
Metropolitan	Ref.			Ref.			Ref.		
City	22.3	(0.02 – 0.38)	0.0273	8.4	(-0.07 – 0.23)	0.2807	1.8	(-0.13 – 0.16)	0.8149
Rural	11.0	(-0.05 – 0.26)	0.1863	-3.3	(-0.16 – 0.09)	0.6080	-9.9	(-0.23 – 0.02)	0.1049
Primary caregiver									
Child	Ref.			Ref.			Ref.		
Married partner	-27.9	(-0.51 – -0.14)	0.0005	-22.4	(-0.41 – -0.10)	0.0017	-21.6	(-0.40 – -0.09)	0.0024
Paid caregiver	103.9	(0.47 – 0.95)	<.0001	69.1	(0.33 – 0.72)	<.0001	62.9	(0.30 – 0.68)	<.0001
Other ^d	8.4	(-0.19 – 0.35)	0.5563	-0.4	(-0.22 – 0.22)	0.9746	1.6	(-0.20 – 0.24)	0.8906
None	21.6	(-0.14 – 0.53)	0.2512	12.2	(-0.18 – 0.41)	0.4500	8.7	(-0.21 – 0.38)	0.5799

LTC grade									
1-2	Ref.			Ref.			Ref.		
3-4	11.3	(-0.19 – 0.40)	0.4759	19.8	(-0.08 – 0.44)	0.1677	18.0	(-0.09 – 0.42)	0.2041
5	11.7	(-0.34 – 0.56)	0.6297	4.0	(-0.34 – 0.41)	0.8391	1.4	(-0.35 – 0.38)	0.9417
Type of service									
Institutional care	Ref.			Ref.			Ref.		
HCBS	175.7	(0.73 – 1.30)	<.0001	142.4	(0.67 – 1.10)	<.0001	136.2	(0.64 – 1.08)	<.0001
Both	237.9	(0.89 – 1.55)	<.0001	174.9	(0.75 – 1.28)	<.0001	170.4	(0.73 – 1.26)	<.0001
CCI									
0	Ref.			Ref.			Ref.		
1	32.8	(-0.07 – 0.63)	0.1112	32.8	(-0.03 – 0.60)	0.0735	29.0	(-0.05 – 0.56)	0.1058
≥2	105.9	(0.38 – 1.07)	<.0001	117.0	(0.47 – 1.08)	<.0001	121.9	(0.49 – 1.10)	<.0001
Disability									
No	Ref.			Ref.			Ref.		
Yes	2.2	(-0.16 – 0.20)	0.8158	0.6	(-0.14 – 0.15)	0.9390	5.8	(-0.08 – 0.20)	0.4297
ADL	7.4	(0.05 – 0.09)	<.0001	6.9	(0.05 – 0.09)	<.0001	6.7	(0.05 – 0.08)	<.0001
Cognitive score									
Behavioral problems	-4.7	(-0.09 – -0.01)	0.0280	-4.8	(-0.09 – -0.01)	0.0115	-5.2	(-0.09 – -0.02)	0.0056
	2.1	(-0.04 – 0.08)	0.5169	0.2	(-0.05 – 0.05)	0.9498	-1.6	(-0.07 – 0.03)	0.5274

^a 40% reduction group.

^b Control group selected through 40% reduction group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; LOS, Length of stay; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 33. Changes in total LTC and Medical OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional10%				<i>p</i> -value	Control				
	Before (2017)		After (2019)			Before (2017)		After (2019)		<i>p</i> -value
	Mean	± SD	Mean	± SD		Mean	± SD	Mean	± SD	
Total	1,908,451	± 1,493,771	2,123,457	± 1,774,174	<.0001	2,702,790	± 1,898,073	3,418,141	± 2,165,721	<.0001
Gender										
Male	1,860,555	± 1,649,280	2,141,803	± 2,251,249	0.0338	2,526,131	± 1,987,650	3,352,076	± 2,358,447	<.0001
Female	1,919,450	± 1,455,960	2,119,244	± 1,645,911	<.0001	2,743,354	± 1,874,729	3,433,311	± 2,118,921	<.0001
Age										
≤74	1,914,345	± 1,530,816	2,214,871	± 1,883,164	0.0187	2,891,078	± 2,227,569	3,390,684	± 2,308,675	<.0001
75-79	2,020,580	± 1,614,038	2,182,840	± 1,754,786	0.1533	2,733,278	± 1,987,604	3,456,055	± 2,185,112	<.0001
80-84	1,975,540	± 1,623,585	2,139,354	± 1,981,581	0.0661	2,704,793	± 1,864,225	3,456,541	± 2,197,868	<.0001
≥85	1,766,268	± 1,220,938	2,027,274	± 1,462,079	0.0002	2,592,264	± 1,691,419	3,367,002	± 2,044,654	<.0001
Insurance type										
Self-employed insured	1,820,138	± 1,369,532	2,010,233	± 1,708,581	0.0009	2,800,311	± 2,077,466	3,425,743	± 2,327,139	<.0001
Employee insured	2,047,653	± 1,662,227	2,301,922	± 1,859,896	0.0020	2,679,293	± 1,851,683	3,416,310	± 2,125,208	<.0001
Region										
Metropolitan	1,947,160	± 1,487,644	2,215,230	± 1,871,306	0.0017	2,883,550	± 2,032,688	3,565,944	± 2,225,937	<.0001
City	1,975,659	± 1,611,922	2,188,768	± 1,754,514	0.0678	2,621,885	± 1,821,203	3,381,082	± 2,190,135	<.0001
Rural	1,858,742	± 1,453,361	2,038,970	± 1,710,810	0.0059	2,579,945	± 1,795,592	3,301,123	± 2,085,919	<.0001
Primary caregiver										
Child	1,596,246	± 1,319,782	1,965,153	± 1,731,769	<.0001	2,264,401	± 1,603,672	3,173,186	± 2,127,488	<.0001
Married partner	1,566,592	± 1,235,028	2,061,384	± 2,057,508	<.0001	2,260,802	± 1,723,212	3,122,306	± 2,161,529	<.0001
Paid caregiver	2,816,696	± 1,823,064	2,525,319	± 1,848,634	0.0105	4,346,949	± 2,093,831	4,391,430	± 2,160,509	0.6004
Other ^a	1,862,338	± 1,298,419	2,034,718	± 1,414,068	0.0773	2,660,968	± 1,623,988	3,401,646	± 1,963,913	<.0001
None	1,689,910	± 1,023,174	2,076,314	± 1,591,178	0.0085	2,712,399	± 1,648,404	3,455,942	± 2,029,268	<.0001
LTC grade										
1-2	2,839,308	± 2,044,394	2,638,293	± 2,096,180	0.1664	4,029,971	± 2,299,601	4,204,231	± 2,351,074	0.0679

3-4	1,762,276 ±	1,293,511	2,029,417 ±	1,702,551	<.0001	2,503,000 ±	1,710,337	3,282,761 ±	2,114,008	<.0001
5	1,162,164 ±	774,706	1,871,304 ±	1,395,585	<.0001	1,645,787 ±	1,098,152	3,000,826 ±	1,783,096	<.0001
Type of service										
Institutional care	2,491,099 ±	1,070,820	2,343,769 ±	1,204,578	0.0121	4,061,058 ±	1,011,615	4,319,007 ±	1,477,196	<.0001
HCBS	1,557,086 ±	1,549,151	1,981,693 ±	2,006,696	<.0001	2,275,531 ±	1,905,728	3,101,180 ±	2,250,596	<.0001
Both	2,589,314 ±	1,665,463	2,485,250 ±	1,495,359	0.5993	3,444,648 ±	1,716,238	4,401,727 ±	1,915,262	<.0001
CCI										
0	1,385,157 ±	1,052,481	1,670,787 ±	1,705,008	0.0741	1,957,296 ±	1,326,891	2,684,827 ±	1,807,901	<.0001
1	1,757,147 ±	1,280,743	1,981,058 ±	1,565,670	0.0002	2,497,047 ±	1,619,262	3,281,981 ±	1,933,358	<.0001
≥2	2,134,584 ±	1,695,232	2,330,616 ±	1,947,610	0.0115	3,014,946 ±	2,151,874	3,658,776 ±	2,386,849	<.0001
Disability										
No	1,858,811 ±	1,418,175	2,094,425 ±	1,739,515	<.0001	2,592,713 ±	1,721,922	3,421,631 ±	2,115,996	<.0001
Yes	1,986,972 ±	1,603,758	2,169,379 ±	1,827,669	0.0228	2,876,806 ±	2,136,053	3,412,625 ±	2,242,457	<.0001

^aOther includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 34. Changes in total LTC and Medical expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (additional 10% group, control group)

Variable	Additional10%					Control								
	Before (2017)			After (2019)			<i>p</i> -value	Before (2017)			After (2019)			<i>p</i> -value
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	15,671,201	±	8,188,912	21,063,789	±	9,922,535	<.0001	15,132,564	±	9,308,043	20,562,172	±	11,324,811	<.0001
Gender														
Male	15,195,694	±	8,535,401	20,866,980	±	11,758,198	<.0001	14,824,233	±	10,713,504	21,071,066	±	13,846,471	<.0001
Female	15,780,386	±	8,105,599	21,108,980	±	9,453,780	<.0001	15,203,362	±	8,953,776	20,445,320	±	10,659,927	<.0001
Age														
≤74	16,739,991	±	10,468,040	22,101,602	±	1,467,793	<.0001	16,685,380	±	11,315,743	21,474,835	±	13,139,611	<.0001
75-79	15,761,405	±	8,193,962	21,043,167	±	9,393,363	<.0001	15,409,861	±	10,547,892	21,060,549	±	12,913,567	<.0001
80-84	15,749,226	±	8,010,031	21,050,615	±	9,478,171	<.0001	14,945,605	±	8,820,654	20,463,763	±	10,855,089	<.0001
≥85	15,018,865	±	7,004,292	20,591,413	±	7,943,373	<.0001	14,429,214	±	7,772,958	19,939,848	±	9,749,374	<.0001
Insurance type														
Self-employed insured	15,830,683	±	8,084,762	21,508,077	±	9,922,868	<.0001	15,819,807	±	10,854,773	20,996,677	±	12,600,395	<.0001
Employee insured	15,419,822	±	8,348,655	20,363,496	±	9,886,882	<.0001	14,966,986	±	8,888,409	20,457,486	±	10,994,012	<.0001
Region														
Metropolitan	15,784,298	±	8,298,470	21,431,511	±	11,403,206	<.0001	16,107,170	±	10,216,658	21,619,161	±	12,442,322	<.0001
City	15,883,484	±	8,576,393	21,479,487	±	10,041,673	<.0001	14,835,716	±	8,749,301	20,564,745	±	11,407,211	<.0001
Rural	15,520,317	±	7,976,030	20,670,614	±	8,740,030	<.0001	14,390,856	±	8,624,297	19,572,950	±	10,021,557	<.0001
Primary caregiver														
Child	13,170,157	±	7,210,023	19,522,573	±	8,796,933	<.0001	13,216,296	±	8,170,188	19,381,042	±	10,372,558	<.0001
Married partner	13,501,564	±	8,733,595	19,873,557	±	13,957,498	<.0001	13,518,094	±	9,529,662	19,801,804	±	13,557,375	<.0001
Paid caregiver	21,477,984	±	6,731,967	24,513,737	±	8,097,995	<.0001	22,077,480	±	9,557,910	24,553,285	±	10,105,800	<.0001
Other ^a	16,242,630	±	7,877,277	21,043,789	±	9,073,787	<.0001	14,848,283	±	7,906,212	20,436,269	±	10,442,615	<.0001
None	14,933,845	±	7,404,980	21,512,133	±	8,126,828	<.0001	14,712,950	±	7,659,329	20,030,951	±	9,489,288	<.0001

LTC grade									
1-2	21,509,948 ± 8,531,863	24,339,432 ± 10,088,743	<.0001	21,120,914 ± 10,597,426	23,708,082 ± 10,942,114	<.0001			
3-4	14,840,594 ± 7,589,413	20,479,303 ± 9,937,407	<.0001	14,274,166 ± 8,629,219	20,005,082 ± 11,520,241	<.0001			
5	9,939,983 ± 5,792,041	19,291,021 ± 7,102,006	<.0001	9,835,826 ± 6,045,952	19,079,452 ± 8,022,707	<.0001			
Type of service									
Institutional care	21,071,160 ± 4,967,837	24,665,183 ± 7,109,113	<.0001	20,774,963 ± 4,707,026	24,308,407 ± 7,076,711	<.0001			
HCBS	12,713,341 ± 8,154,791	19,019,068 ± 10,715,011	<.0001	13,347,101 ± 9,661,346	19,220,872 ± 12,083,289	<.0001			
Both	18,482,291 ± 6,453,808	23,782,766 ± 7,584,033	<.0001	18,369,231 ± 8,009,069	24,992,258 ± 9,116,289	<.0001			
CCI									
0	12,530,318 ± 6,317,641	16,843,176 ± 9,374,073	<.0001	11,689,308 ± 6,616,989	17,226,601 ± 9,554,686	<.0001			
1	15,087,641 ± 7,263,605	20,411,127 ± 8,103,266	<.0001	14,060,252 ± 7,705,324	19,705,995 ± 9,981,881	<.0001			
≥2	16,703,014 ± 9,085,372	22,318,444 ± 11,334,671	<.0001	16,696,739 ± 10,715,773	21,894,281 ± 12,576,693	<.0001			
Disability									
No	15,128,365 ± 7,553,493	20,814,594 ± 8,742,214	<.0001	14,330,814 ± 8,232,916	20,321,671 ± 10,257,363	<.0001			
Yes	16,529,858 ± 9,041,867	21,457,966 ± 11,539,982	<.0001	16,400,022 ± 10,670,731	20,942,371 ± 12,825,217	<.0001			

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 35. Changes in total LTC and Medical OOPs for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40%reduction					Control								
	Before (2017)			After (2019)			<i>p</i> -value	Before (2017)			After (2019)			<i>p</i> -value
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	2,451,738	±	1,941,383	2,557,546	±	1,818,908	0.2044	2,716,385	±	1,982,613	3,442,926	±	2,280,329	<.0001
Gender														
Male	2,403,474	±	2,356,141	2,627,417	±	2,089,742	0.2595	2,720,515	±	2,238,951	3,463,020	±	2,570,354	<.0001
Female	2,467,594	±	1,785,724	2,534,590	±	1,721,550	0.4546	2,715,028	±	1,891,356	3,436,325	±	2,177,196	<.0001
Age														
≤74	2,604,771	±	2,563,952	2,580,513	±	2,249,334	0.9199	3,056,105	±	2,440,027	3,457,020	±	2,441,986	0.0045
75-79	2,528,754	±	2,001,746	2,607,345	±	1,829,736	0.6704	2,702,898	±	1,983,305	3,435,004	±	2,224,849	<.0001
80-84	2,439,429	±	1,790,448	2,579,759	±	1,631,105	0.2843	2,671,698	±	1,838,442	3,535,172	±	2,381,833	<.0001
≥85	2,286,860	±	1,468,716	2,469,630	±	1,677,074	0.1859	2,525,782	±	1,728,686	3,317,809	±	2,048,066	<.0001
Insurance type														
Self-employed insured	2,420,848	±	1,898,914	2,407,566	±	1,771,907	0.9250	2,837,848	±	2,183,202	3,495,094	±	2,472,051	<.0001
Employee insured	2,467,136	±	1,963,413	2,632,317	±	1,838,608	0.1095	2,686,909	±	1,930,121	3,430,266	±	2,231,671	<.0001
Region														
Metropolitan	2,706,682	±	2,156,552	2,803,424	±	1,913,605	0.5051	2,913,112	±	2,091,265	3,623,952	±	2,344,364	<.0001
City	2,572,683	±	2,012,607	2,519,465	±	1,792,375	0.7818	2,631,546	±	1,928,187	3,431,933	±	2,458,049	<.0001
Rural	2,160,099	±	1,639,906	2,347,665	±	1,714,717	0.1027	2,581,679	±	1,894,272	3,280,399	±	2,095,511	<.0001
Primary caregiver														
Child	2,212,538	±	1,787,425	2,389,200	±	1,702,426	0.1634	2,267,503	±	1,646,506	3,223,133	±	2,205,893	<.0001
Married partner	1,921,630	±	1,936,972	2,248,965	±	1,859,234	0.0503	2,358,101	±	1,887,845	3,170,660	±	2,320,052	<.0001
Paid caregiver	3,930,707	±	2,032,591	3,201,497	±	1,714,185	0.0002	4,374,476	±	2,204,310	4,337,983	±	2,244,253	0.7940
Other ^a	2,158,229	±	1,450,272	2,690,477	±	1,857,732	0.0087	2,763,665	±	1,744,129	3,523,448	±	2,141,337	<.0001
None	2,388,576	±	1,357,186	2,679,513	±	2,099,160	0.3722	2,596,099	±	1,759,949	3,523,738	±	2,330,135	0.0002
LTC grade														
1-2	3,709,167	±	2,862,441	3,134,807	±	2,121,600	0.0392	4,061,326	±	2,561,421	4,133,078	±	2,401,560	0.6495

3-4	2,274,351 ± 1,629,299	2,447,116 ± 1,718,971	0.0415	2,542,582 ± 1,760,946	3,350,737 ± 2,269,659	<.0001
5	1,496,741 ± 983,314	2,434,053 ± 1,900,405	0.0003	1,521,918 ± 1,023,419	2,862,608 ± 1,716,380	<.0001
Type of service						
Institutional care	3,467,183 ± 1,433,718	3,196,297 ± 1,283,370	0.0361	4,084,635 ± 1,155,195	4,310,653 ± 1,533,014	0.0045
HCBS	2,089,846 ± 1,952,418	2,345,313 ± 1,923,322	0.0110	2,330,894 ± 2,011,327	3,162,522 ± 2,374,402	<.0001
Both	3,322,266 ± 1,890,095	2,875,242 ± 1,544,063	0.1983	3,445,300 ± 1,432,017	4,504,212 ± 2,060,240	<.0001
CCI						
0	2,193,669 ± 1,627,843	2,139,658 ± 1,502,960	0.8505	2,138,848 ± 1,496,421	2,753,578 ± 1,795,310	0.0007
1	2,158,142 ± 1,423,842	2,415,305 ± 1,598,201	0.0095	2,466,961 ± 1,676,543	3,284,909 ± 2,022,868	<.0001
≥2	2,763,116 ± 2,321,929	2,744,190 ± 2,022,737	0.8917	2,996,455 ± 2,218,834	3,656,136 ± 2,502,915	<.0001
Disability						
No	2,380,970 ± 158,422	2,537,309 ± 1,618,543	0.0800	2,572,467 ± 1,727,442	3,445,104 ± 2,255,250	<.0001
Yes	2,576,396 ± 2,428,128	2,593,196 ± 2,128,398	0.9204	2,969,900 ± 2,345,578	3,439,090 ± 2,324,871	<.0001

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 36. Changes in total LTC and Medical expenses for each independent variable in the study population to evaluate the effect of LTCI OOPs reduction policy expansion (40% reduction group, control group)

Variable	40%reduction					Control								
	Before (2017)			After (2019)			<i>p</i> -value	Before (2017)			After (2019)			<i>p</i> -value
	Mean	±	SD	Mean	±	SD		Mean	±	SD	Mean	±	SD	
Total	15,276,986	±	9,562,541	20,174,031	±	9,671,210	<.0001	15,237,560	±	9,787,353	20,771,474	±	11,841,729	<.0001
Gender														
Male	15,448,297	±	11,305,685	21,006,009	±	11,445,445	<.0001	15,720,406	±	11,835,489	21,594,432	±	15,166,326	<.0001
Female	15,220,702	±	8,923,513	19,900,682	±	9,004,176	<.0001	15,078,920	±	9,010,804	20,501,087	±	10,512,703	<.0001
Age														
≤74	16,447,258	±	12,186,346	20,687,457	±	11,714,305	0.0004	17,602,296	±	12,632,851	21,742,999	±	13,631,677	<.0001
75-79	15,961,316	±	9,514,026	20,842,149	±	9,538,664	<.0001	15,016,297	±	9,890,589	20,666,177	±	10,952,013	<.0001
80-84	14,947,620	±	8,545,650	19,931,486	±	8,462,838	<.0001	14,827,792	±	8,771,302	21,029,678	±	12,340,175	<.0001
≥85	14,245,470	±	8,431,100	19,545,496	±	9,537,668	<.0001	14,145,554	±	8,036,316	19,775,811	±	10,247,204	<.0001
Insurance type														
Self-employed insured	14,507,695	±	9,606,633	19,441,887	±	9,606,254	<.0001	15,885,778	±	10,771,935	21,797,948	±	14,163,641	<.0001
Employee insured	15,660,501	±	9,524,356	20,539,027	±	9,689,806	<.0001	15,080,249	±	9,528,810	20,522,365	±	11,195,113	<.0001
Region														
Metropolitan	16,956,656	±	10,824,340	22,034,855	±	10,451,661	<.0001	16,286,997	±	10,165,407	22,045,377	±	12,524,025	<.0001
City	15,852,939	±	9,225,525	19,332,313	±	8,026,614	<.0001	14,880,203	±	9,699,549	20,788,603	±	12,840,876	<.0001
Rural	13,457,475	±	8,056,374	18,840,994	±	9,355,112	<.0001	14,464,219	±	9,391,347	19,573,411	±	10,383,951	<.0001
Primary caregiver														
Child	14,216,655	±	9,028,208	19,365,228	±	9,636,256	<.0001	13,208,344	±	8,263,579	19,811,630	±	10,581,657	<.0001
Married partner	12,704,883	±	9,482,319	18,471,598	±	9,840,140	<.0001	13,979,835	±	10,117,999	19,823,568	±	13,412,967	<.0001
Paid caregiver	22,033,768	±	9,524,263	23,570,470	±	7,753,278	0.0905	22,448,986	±	10,356,696	24,700,478	±	11,114,314	0.0009
Other ^a	14,167,170	±	7,981,423	21,034,627	±	10,653,380	<.0001	15,252,951	±	8,682,346	21,014,321	±	12,015,358	<.0001
None	14,902,373	±	7,211,792	20,266,055	±	9,632,410	0.0009	14,038,074	±	8,275,607	19,897,030	±	10,991,313	<.0001
LTC grade														
1-2	21,401,761	±	12,495,376	23,451,438	±	9,402,862	0.0932	21,324,630	±	11,891,660	23,429,556	±	11,692,514	0.0051

3-4	14,437,956 ± 8,514,943	19,513,740 ± 9,649,449	<.0001	14,513,644 ± 8,946,018	20,396,095 ± 12,071,767	<.0001
5	10,353,852 ± 5,778,878	19,834,801 ± 9,095,815	<.0001	9,150,562 ± 5,959,986	18,757,058 ± 8,229,154	<.0001
Type of service						
Institutional care	20,735,791 ± 6,501,258	24,878,094 ± 6,347,521	<.0001	20,803,978 ± 5,191,999	24,240,232 ± 7,361,446	<.0001
HCBS	13,382,059 ± 9,760,704	18,496,814 ± 10,056,985	<.0001	13,650,038 ± 10,217,850	19,599,146 ± 12,560,299	<.0001
Both	19,203,039 ± 7,330,949	24,217,997 ± 7,914,048	0.0014	18,523,674 ± 7,595,165	25,870,930 ± 10,413,522	<.0001
CCI						
0	14,041,636 ± 7,074,873	17,920,988 ± 7,673,021	0.0047	12,684,664 ± 7,825,318	17,298,608 ± 9,265,792	<.0001
1	13,636,819 ± 7,029,329	19,420,903 ± 8,678,730	<.0001	13,949,253 ± 7,995,280	19,847,723 ± 9,902,552	<.0001
≥2	16,991,283 ± 11,452,324	21,167,202 ± 10,643,893	<.0001	16,636,575 ± 11,100,361	21,956,262 ± 13,396,080	<.0001
Disability						
No	14,558,563 ± 7,845,051	19,957,677 ± 8,315,229	<.0001	14,201,136 ± 8,096,712	20,516,378 ± 11,024,989	<.0001
Yes	16,542,504 ± 11,912,168	20,555,143 ± 11,686,349	<.0001	17,063,241 ± 11,997,087	21,220,828 ± 13,150,959	<.0001

^a Other includes grandchild, relative, neighborhood and parent.

LTCI, Long-term care insurance; OOPs, Out-of-pocket expense; SD, standard deviation; CCI, Charlson comorbidity index; HCBS, Home-and community-based services.

Appendix 37. Results of the Generalized Linear Model of additional 10% group for total LTC and medical utilization

Variables	Total LTC & medical OOPs			Total LTC & medical expenses		
	%	95% CI	p-value	%	95% CI	p-value
Intervention						
Before	Ref.			Ref.		
After	33.1	(0.27 – 0.30)	<.0001	40.8	(0.33 – 0.36)	<.0001
Case^a	-30.2	(-0.40 – -0.32)	<.0001	-0.5	(-0.03 – 0.02)	0.6954
Control^b	Ref.			Ref.		
Case*Intervention^c	-11.8	(-0.17 – -0.09)	<.0001	-1.2	(-0.04 – 0.01)	0.3683
Gender						
Male	Ref.			Ref.		
Female	1.1	(-0.02 – 0.05)	0.5401	-0.6	(-0.04 – 0.02)	0.6814
Age						
≤74	Ref.			Ref.		
75-79	-2.9	(-0.07 – 0.01)	0.1573	-5.2	(-0.09 – -0.02)	0.0041
80-84	-5.1	(-0.09 – -0.01)	0.0075	-7.9	(-0.11 – -0.05)	<.0001
≥85	-10.7	(-0.15 – -0.08)	<.0001	-11.8	(-0.16 – -0.09)	<.0001
Insurance type						
Self-employed insured	Ref.			Ref.		
Employee insured	5.5	(0.03 – 0.08)	0.0001	-2.0	(-0.04 – 0.00)	0.0767
Region						
Metropolitan	Ref.			Ref.		
City	-2.1	(-0.05 – 0.01)	0.1673	-1.6	(-0.04 – 0.01)	0.2047
Rural	-5.5	(-0.08 – -0.03)	<.0001	-5.4	(-0.08 – -0.04)	<.0001
Primary caregiver						
Child	Ref.			Ref.		
Married partner	-5.6	(-0.09 – -0.02)	0.0007	-3.9	(-0.07 – -0.01)	0.0102
Paid caregiver	27.2	(0.20 – 0.28)	<.0001	18.0	(0.14 – 0.19)	<.0001
Other ^d	2.3	(-0.01 – 0.06)	0.1751	2.3	(-0.00 – 0.05)	0.0794
None	4.2	(-0.01 – 0.09)	0.0910	2.0	(-0.02 – 0.06)	0.2758
LTC grade						
1-2	Ref.			Ref.		
3-4	-3.1	(-0.08 – 0.02)	0.2499	-2.4	(-0.06 – 0.01)	0.2059
5	-13.8	(-0.22 – -0.07)	<.0001	-12.0	(-0.18 – -0.07)	<.0001
Type of service						
Institutional care	Ref.			Ref.		
HCBS	-22.7	(-0.29 – -0.22)	<.0001	-21.0	(-0.26 – -0.21)	<.0001
Both	4.6	(0.01 – 0.09)	0.0288	-0.3	(-0.03 – 0.03)	0.8593
CCI						
0	Ref.			Ref.		
1	20.4	(0.14 – 0.23)	<.0001	15.6	(0.11 – 0.18)	<.0001
≥2	42.2	(0.30 – 0.40)	<.0001	32.4	(0.25 – 0.32)	<.0001
Disability						
No	Ref.			Ref.		
Yes	1.2	(-0.01 – 0.04)	0.3126	4.6	(0.03 – 0.06)	<.0001
ADL	1.9	(0.02 – 0.02)	<.0001	1.3	(0.01 – 0.02)	<.0001
Cognitive score	-1.3	(-0.02 – -0.01)	0.0004	-0.5	(-0.01 – 0.01)	0.0697
Behavioral problems	0.4	(-0.01 – 0.01)	0.3815	0.4	(-0.01 – 0.01)	0.2645

^a Additional 10% group.

^b Control group selected through additional 10% group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; LOS, Length of stay; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 38. Results of the Generalized Linear Model of 40% reduction group for total LTC and medical utilization

Variables	Total LTC & Medical OOPs			Total LTC & Medical expenses		
	%	95% CI	p-value	%	95% CI	p-value
Intervention						
Before	Ref.			Ref.		
After	33.8	(0.26 – 0.32)	<.0001	41.6	(0.32 – 0.37)	<.0001
Case^a	-10.4	(-0.16 – -0.06)	<.0001	-0.6	(-0.04 – 0.03)	0.7579
Control^b	Ref.			Ref.		
Case*Intervention^c	-17.7	(-0.25 – -0.14)	<.0001	-3.2	(-0.08 – 0.01)	0.1514
Gender						
Male	Ref.			Ref.		
Female	-1.4	(-0.06 – 0.03)	0.5560	-3.8	(-0.08 – 0.00)	0.0578
Age						
≤74	Ref.			Ref.		
75-79	-4.5	(-0.10 – 0.01)	0.1040	-6.1	(-0.11 – -0.02)	0.0093
80-84	-4.7	(-0.10 – 0.01)	0.0762	-7.1	(-0.12 – -0.03)	0.0018
≥85	-10.7	(-0.17 – -0.06)	<.0001	-11.8	(-0.17 – -0.08)	<.0001
Insurance type						
Self-employed insured	Ref.			Ref.		
Employee insured	-0.8	(-0.05 – 0.03)	0.7069	-1.5	(-0.05 – 0.02)	0.3888
Region						
Metropolitan	Ref.			Ref.		
City	-3.4	(-0.08 – 0.01)	0.1289	-4.6	(-0.09 – -0.01)	0.0144
Rural	-8.1	(-0.12 – -0.05)	<.0001	-9.5	(-0.13 – -0.07)	<.0001
Primary caregiver						
Child	Ref.			Ref.		
Married partner	-8.5	(-0.14 – -0.04)	0.0003	-7.9	(-0.12 – -0.04)	0.0001
Paid caregiver	25.3	(0.17 – 0.28)	<.0001	17.5	(0.12 – 0.21)	<.0001
Other ^d	0.5	(-0.05 – 0.06)	0.8621	-0.4	(-0.05 – 0.04)	0.8443
None	5.7	(-0.03 – 0.14)	0.1910	-0.6	(-0.07 – 0.06)	0.8543
LTC grade						
1-2	Ref.			Ref.		
3-4	3.2	(-0.05 – 0.11)	0.4546	-0.1	(-0.07 – 0.06)	0.9627
5	-10.0	(-0.22 – 0.01)	0.0702	-10.6	(-0.20 – -0.02)	0.0148
Type of service						
Institutional care	Ref.			Ref.		
HCBS	-23.8	(-0.32 – -0.22)	<.0001	-19.6	(-0.26 – -0.18)	<.0001
Both	2.1	(-0.04 – 0.08)	0.5058	2.2	(-0.02 – 0.07)	0.3629
CCI						
0	Ref.			Ref.		
1	14.0	(0.06 – 0.21)	0.0006	10.1	(0.04 – 0.15)	0.0009
≥2	35.5	(0.23 – 0.38)	<.0001	27.0	(0.18 – 0.30)	<.0001
Disability						
No	Ref.			Ref.		
Yes	2.3	(-0.01 – 0.06)	0.2278	6.3	(0.03 – 0.09)	0.0002
ADL	2.3	(0.02 – 0.03)	<.0001	1.5	(0.01 – 0.02)	<.0001
Cognitive score	-1.3	(-0.02 – -0.00)	0.0275	-0.7	(-0.02 – 0.00)	0.1676
Behavioral problems	-0.2	(-0.01 – 0.01)	0.7948	0.0	(-0.01 – 0.01)	0.9570

^a 40% reduction group.

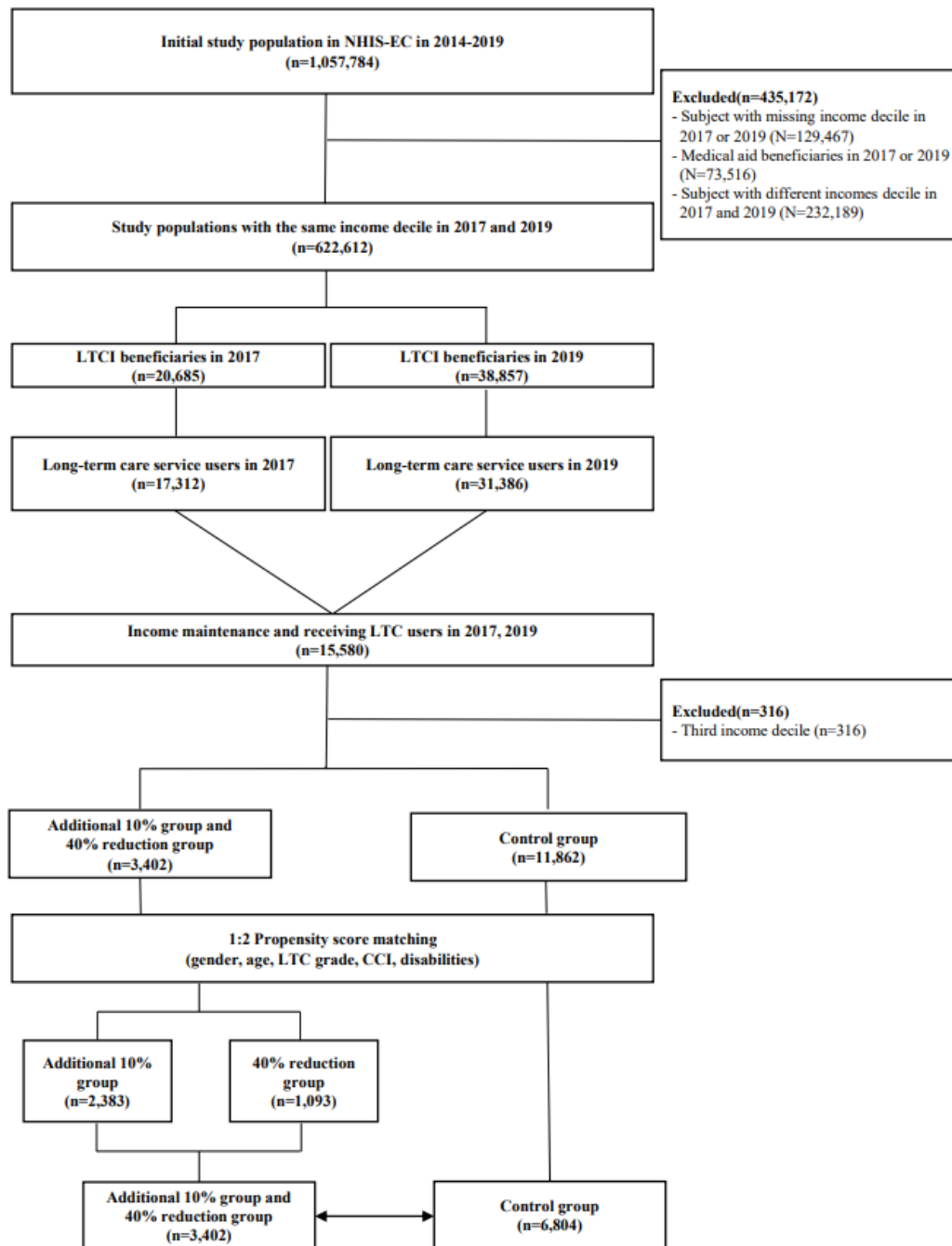
^b Control group selected through 40% reduction group and 1:3 propensity score matching.

^c Difference, case-control.

^d Other includes grandchild, relative, neighborhood and parent.

CI, Confidence interval; OOPs, Out-of-pocket expenses; CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 39. Flowchart of study participants in sensitivity analyses



Appendix 40. General characteristics and distribution of study populations of sensitivity analyses

Variables	Matching separate (1:2)								p-value
	Total subjects		Non-benefit		Benefit				
			Control		Additional 10%		40% reduction		
	n	%	n	%	n	%	n	%	
	10,206	100	6804	100	2383	100	1019	100	
Gender									0.9862
Male	2,090	20.5	1,393	20.5	445	18.7	252	24.7	
Female	8,116	79.5	5,411	79.5	1938	81.3	767	75.3	
Age									1.0000
≤74	1,686	16.5	1,124	16.5	362	15.2	200	19.6	
75-79	1,971	19.3	1,314	19.3	441	18.5	216	21.2	
80-84	3,494	34.2	2,325	34.2	827	34.7	342	33.6	
≥85	3,055	29.9	2,041	30.0	753	31.6	261	25.6	
Insurance type									<.0001
Self-employed insured	3,124	30.6	1,327	19.5	1,458	61.2	339	33.3	
Employee insured	7,082	69.4	5,477	80.5	925	38.8	680	66.7	
Region									<.0001
Metropolitan	3,711	36.4	2,529	37.2	787	33.0	395	38.8	
City	2,173	21.3	1,558	22.9	418	17.5	197	19.3	
Rural	4,322	42.3	2,717	39.9	1,178	49.4	427	41.9	
Primary caregiver									<.0001
Child	3,933	38.5	2,655	39.0	898	37.7	380	37.3	
Married partner	2,434	23.8	1,768	26.0	407	17.1	259	25.4	
Paid caregiver	1,886	18.5	1,180	17.3	522	21.9	184	18.1	
Other ^a	1,389	13.6	864	12.7	388	16.3	137	13.4	
None	564	5.5	337	5.0	168	7.0	59	5.8	
LTC grade									0.9369
1-2	1,698	16.6	1,126	16.5	407	17.1	165	16.2	
3-4	7,845	76.9	5,237	77.0	1,826	76.6	782	76.7	
5	663	6.5	441	6.5	150	6.3	72	7.1	
Type of service									<.0001
Institutional care	2,354	23.1	1,363	20.0	755	31.7	223	21.9	
Home care	7,327	71.8	5,126	75.3	1,500	62.9	746	73.2	
Both	525	5.1	337	5.0	128	5.4	50	4.9	
CCI									0.9867
0	649	6.4	431	6.3	158	6.6	60	5.9	
1	4,743	46.5	3,161	46.5	1,114	46.7	468	45.9	
≥2	4,814	47.2	3,212	47.2	1,111	46.6	491	48.2	
Disability									0.8289
No	6,315	61.88	4,205	61.80	1460	61.3	650	63.8	
Yes	3,891	38.12	2,599	38.20	923	38.7	369	36.2	
ADL		19.3±5.7		19.3±5.7		19.3±5.8		19.2±5.7	0.6889
Cognitive score		3.7±1.7		3.6±1.7		3.8±1.7		3.6±1.7	0.0017
Behavioral problems		0.8±1.3		0.8±1.3		0.9±1.3		0.8±1.3	0.0359

^a Other includes grandchild, relative, neighborhood and parent.

CCI, Charlson comorbidity index; ADL, Activities of daily living; HCBS, Home-and community-based services.

Appendix 41. Parallel trend test results for the dependent variable of study participants in additional 10% group, 40% reduction group and each control group for sensitivity analyses

Variable	Case * Year (interaction effect)					
	"Additional 10% vs Control"			"40% reduction vs Control"		
	β	SE	<i>p</i> -value	β	SE	<i>p</i> -value
Primary dependent variables						
Number of long-term care services	-0.0248	0.0099	0.0129	-0.0148	0.0148	0.3172
OOPs	-0.0530	0.0099	<.0001	-0.0055	0.0147	0.7093
Total expense	0.0020	0.0097	0.8383	0.0019	0.0145	0.8971
Secondary dependent variables						
Medical utilization expenses						
Total medical OOPs	-0.0432	0.0165	0.0087	-0.0186	0.0210	0.3766
Total medical expenses	-0.0423	0.0263	0.1079	-0.0296	0.0222	0.1831
Outpatient services						
Number of outpatient visits	0.0043	0.0095	0.6512	0.0087	0.0134	0.5162
OOPs	0.0043	0.0115	0.7109	0.0145	0.0161	0.3678
Total expenses	-0.0124	0.0117	0.2877	0.0192	0.0166	0.2465
Inpatient services						
LOS	-0.1249	0.0296	<.0001	-0.0708	0.0412	0.0856
OOPs	-0.0641	0.0217	0.0031	-0.0329	0.0296	0.2659
Total expenses	-0.0731	0.051	0.1520	-0.0376	0.0295	0.2019
LTC + Medical utilization						
Total LTC & medical OOPs	-0.0260	0.0082	0.0015	-0.0048	0.0116	0.6788
Total LTC & medical expenses	-0.0009	0.0074	0.9012	-0.0059	0.0110	0.5942

Note : Case included the additional 10% group and the 40% reduction group.

OOPs, Out-of-pocket expense; LOS, Length of stay; SE, Standard error.

All covariates are included in the regression.

Korean Abstract (국문 요약)

노인장기요양보험 본인부담금 감경 확대 전·후 장기요양 및 의료서비스 이용 차이 분석

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정성훈

서론: 2018년 8월부터 노인장기요양보험 저소득층 수급자의 의료서비스 이용 부담을 줄이고 보장성 강화를 위해 노인장기요양보험 본인부담금 감경제도가 확대되었다. 이에 따라 본인부담금 감경율이 보험료 소득분위 25% 이하 군에서 50%에서 60%로 확대되었고, 보험료 소득분위 26-50%군에는 감경율 40%가 새롭게 적용되었다. 이 연구는 노인장기요양보험 본인부담금 감경제도 확대에 따른 장기요양 및 의료서비스 이용과 비용의 변화를 분석하고자 하였다.

연구방법: 이 연구는 국민건강보험공단 노인코호트 데이터베이스 2014-2019년 자료를 활용했다. 연구대상자는 2017년과 2019년의 소득분위가 동일하고 장기요양서비스를 이용한 장기요양보험 수혜자로 제도시행 후 본인부담금 감경율에 따라 2개의 실험군(추가 10% 감경군, 40% 감경군)과 감경받지 않는 대조군으로 구분하였다. 대조군은 각 실험군의 성별, 연령, 장기요양 등급, 동반질환지수, 장애여부를 고려해 1:3 성향점수 매칭으로 선정하였다. 종속변수로는 장기요양서비스 및 의료서비스의 연간 이용량과 비용을 분석하였다.

연구분석 모델은 이중차분법 (difference-in-differences)으로 제도 시행 전·후 실험군과 대조군의 교호작용항을 중심으로 확인하였으며 통계분석 방법으로 Generalized estimation equation model 을 활용하였다.

연구결과: 노인장기요양보험 본인부담금 감경제도 확대는 장기요양서비스 및 의료서비스의 본인부담금과 이용에 영향이 있었고 이러한 변화는 본인부담 감경률에 따라 차이가 있었다. 이중차분법 분석 결과, 장기요양서비스의 경우 추가 10% 감경군은 대조군에 비해 본인부담금이 15.7% 감소($p<.0001$)하였고, 40% 감경군은 대조군에 비해 이용은 5.8% 증가($p=0.0084$), 본인부담금은 14.6% 감소($p<.0001$), 총 비용은 5.5% 증가($p=0.0077$)하였다. 또한 의료서비스는 40% 감경군에서만 대조군에 비해 총 본인부담금이 20.5% 감소($p=0.0021$), 총 비용은 21.4% 감소($p=0.0028$)하였다. 하위 그룹 분석 결과, 각각의 대조군에 비해 추가 10% 감경군에서는 재원일수만 18.9% 감소($p=0.0217$)하였고, 40% 감경군에서는 외래횟수는 9.6% 증가($p=0.0044$), 외래 본인부담금은 11.6% 증가($p=0.0163$), 외래 총비용은 10.9% 증가($p=0.0491$)하였고, 재원일수는 35.3% 감소($p=0.0009$), 입원 본인부담금은 29.3% 감소($p=0.0025$), 입원 총비용은 27.9% 감소($p=0.0043$)하였다. 또한 입원이용의 경우 급성기병원은 변화가 없었으나, 요양병원에서는 각각의 대조군에 비해 추가 10% 감경군은 재원일수가 30.2% 감소($p=0.0182$)하였고, 40% 감경군에서는 45.8% 감소($p=0.0053$)하였다. 나아가 장기요양과 의료를 합한 총 의료비용은 변화가 없었으나, 총 본인부담금은 각각의 대조군에 비해 추가 10% 감경군은 11.8% 감소($p<.0001$), 40% 감경군은 17.7% 감소($p<.0001$)하였다.

결론: 노인장기요양보험 본인부담금 감경제도 확대에 따라 저소득층의 장기요양서비스 뿐만 아니라 의료서비스 본인부담금이 감소하였다. 나아가

장기요양서비스와 외래서비스 이용은 증가한데 비해 입원서비스 이용은 감소하였다. 그러나 이러한 효과는 본인부담금 감경율에 따라 차이가 있을 수 있으므로 다양한 연구를 통해 본인부담 정도에 따른 장기요양 및 의료서비스 반응을 고려할 필요가 있다. 이 연구는 고령화에 따라 장기요양서비스의 역할이 더욱 커질 것으로 예상되는 상황에서 노인장기요양보험 본인부담금 감경제도 확대에 따른 효과를 장기요양 및 의료서비스 이용으로 구분하여 분석함으로써 장기요양보험 보장성 강화정책 설계에 중요한 기초자료가 될 수 있다. 향후 이 연구를 바탕으로 저소득층의 장기요양서비스 이용을 위한 적정 본인부담금 연구를 통해 장기요양 및 의료서비스 이용의 경제적 접근성 향상을 위한 다양한 정책이 마련될 수 있기를 기대한다.

핵심어 : 장기요양서비스, 본인부담금 감경, 장기요양서비스 이용, 의료이용