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# Empirical Analysis on the Effect of Preventive Care Programs in Japan

Evidence from Municipality-level data

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## ABSTRACT

This study examines the effects of the number of preventive care programs on the number of certified less disabled recipients for long-term care insurance. By constituting a municipality-level two-period panel data, we find that the total number of preventive care programs significantly decreases the number of certified less disabled recipients. When looking at the details of preventive care programs, we find the number of physical activities and dining party activities has a negative effect. And we also examine the combination of preventive care activities and find the effects of physical activities and dining party activities are relatively robust. We conclude that the design of preventive care programs should be considered the characteristics of objects, especially the elderly.

Keywords: preventive care, municipality, less disabled, the elderly, long-term care insurance.

JEL classification: I12, I13, I18.

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## 1. Introduction

It is commonly recognized that family members including spouse and adult children provide a vast quantity of long-term care to the disabled elderly in Japan. So it seems an attracting advice that promoting the increase of the quantity of informal care can shrink the medical expenditures owing to the fact that the usage of informal care can substitute for formal care such as home health care use, nursing home care and outpatient surgery (Van Houtven and Norton, 2004). However, as the number of disabled older adults in Japan is growing rapidly, it becomes more and more difficult to satisfy the demand of frail older adults just through the informal care service provided by household members. Especially, when the baby boomers start to deteriorate, they would demand a huge quantity of informal care service. Consequently, the Japanese government introduced the Long-term Care Insurance (LCI) to support the elderly from 2000. Because more and more elderly people become eligible for the long-term care insurance, the number of insured older adults who apply for the benefits of long-term care insurance system is increasing rapidly (P. Olivares-Tirado and N. Tamiya, 2014).

Under such a background, policymakers and economists are both interested in whether or not preventive care programs significantly influences the health status of program participants. The intervention of physical activity is one of the most popular health interventions used in practice. And some of the previous studies show that the intervention of physical activities strengthens the functional ability of the elderly (Lacroix et al, 1993; Groessl et al, 2016). However, there is little evidence that other preventive care behaviors are efficient to maintain mobility in the late life. Although Yoshida and Chen (2016) find that hobby activities and cognitive disorders preventive activities are significantly correlated to the decrease of the number of certified support need level 2 recipients, the results cannot be explained as a causal effect owing to the endogeneity bias of participation behaviors.

The purpose of this study is to conduct an empirical analysis of the effect of preventive care programs on the number of certified recipients. We use municipality-level data to constitute a two-period panel data and apply a standard fixed effects model. The results show that the total number of preventive care programs, dining party activity and hobby activity significantly decreases the number of certified less disabled elderly people, which implies that population-based preventive care programs are effective means to maintain mobility in the late life for less disabled adults. However, the results with respect to other preventive care activities do not give any evidence that they are efficient means to remit the pressure of increasing disabled adults.

The remainder of this study is organized as follows. The background of preventive care programs is stated in Section 2. Section 3 introduces documented previous review on the preventive care programs. Then, Section 4 describes the empirical strategy. Section 5 presents the details of data used in this study. The basic results are presented in Section 6. At last, we make some conclusions and discussions on our research in Section 7.

## 2. Preventive care programs in Japan

### 2.1 Background

The Japanese government introduced long-term care insurance system as a pillar of social security to help household members relieve the burden of caring for disabled adults. With the increase of aging population, the number of insured older adults who apply for the benefits of long-term care insurance system is growing drastically. According to the Report on Long-term Care Insurance (2013 version), the increasing speed of less disabled certified recipients (support need level of 1 and 2) is much higher than that of disabled certified recipients (long-term care need level of 1 to 5).

As to the related social security expenditures, on the basis of estimated results of MHLW in Japan, the long-term care benefit expenditure in 2012 was about 8.4 trillion yen and the estimated expenditure associated with long-term care in 2025 will reach about 19.8 trillion yen. The growth rate of expenditure respect to the long-term care is one of the highest issues among all of the related social security items. The long-term care insurance in Japan is very generous for older disabled adults due to the low ratio of copayment for the expense of long-term care<sup>4</sup>, which is potential to induce the excess demand for long-term care service. Although this result is not identified by the Medicaid generosity, the case of long-term care in Japan may be exist (Grabowski and Gruber, 2007).

As the number of disabled older adults applying for the long-term care insurance is increasing dramatically, the focus of decreasing long-term care spending should be mainly on keeping older adults functional independence. In fact, the Japanese government started to take some actions including the implementation of preventive care programs (Revision of Long-term Care Insurance Act in 2005).

### 2.2 The introduction of preventive care programs

According to the report of “*Kaigo Yobo Jigyo oyobi Kaigo Yobo Nichijyo Sekatsu*

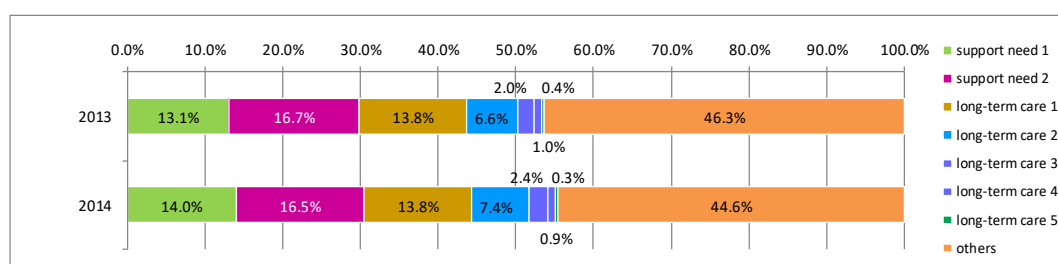
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<sup>4</sup> The ratio of copayment was 10% at the beginning of long-term care insurance. There were some modifications about the ratio of copayment based on the MHLW’s *Kaigo Hokenho no Kaisei [Revision of the Long-term Care Insurance]* in 2014.

*Shien Sogo Jigyo (Chiiki Shien Jigyo) no Jisshi Jyokyo ni Kansuru Tyosha*” (A Survey on Implementation Status of Preventive Long-term Care Projects and Daily Life Supporting Comprehensive Projects (Regional Supporting Projects)) (2014), the ratio of municipalities which are implementing the preventive care programs is 73 % and about 10 percentage points higher than that of 2013. Mainly, there is five kinds of preventive care programs implemented by municipalities including physical activity (PA), tea party activity (TPA), dining party activity (DPA), cognitive disorders preventive activity (CDPA) and hobby activity. The most popular preventive care program is physical activity accounting for 42.8 % in our data. Through promoting radio gymnastics, the elderly are expected to activate their body and keep the independence of functional ability. The expected effects of tea party activity and dining party activity are supposed to make a chance for the elderly to communicate with each other. And the DPA has another purpose to improve the elderly’s nutrition absorption owe to the fact that professional staff are prepared for the food and provide nutritious combinations to the participants. The next one is cognitive disorders preventive activity accounts for 7.1% in our data. Specialists may hold a seminar and pass on knowledge on cognitive disorders prevention. The last one is hobby activity. There are different kinds of hobby activities on the basis of municipalities.

Figure 1 shows the number of Kayoi no Ba based on the most disabled degree. We can see that among the Kayoi no Ba, the percentages of less disabled adults (support need level 1, support need level 2 and long-term care level 1) are higher than that of disabled adults. Especially, with the increment of disabled degree, the composition ratio of certified long-term care need level 5 is close to 0. We should also pay attention to the fact that about half of the number of Kayoi no Ba cannot be categorized by disabled degrees owing to the missing information on participants or just not suitable for categories. From figure 1, we see that the effect of preventive care programs is not only on disabled persons, but also on healthy persons or disabled persons who are not certified. Taking this situation into account, we use the participant rate of preventive care programs to adjust the number of preventive care programs.

Figure 1 The number of Kayoi no Ba based on the most disabled degree (Composition Ratios)



Source: The results of “survey on Implementation Status of Preventive Long-term Care Projects and Daily Life Supporting Comprehensive Projects (Regional Supporting Projects)” (2013&2014) are rearranged by the authors.

### 3. Review of Previous Studies

#### 3.1 Physical programs

A vast quantity of previous studies on the effect of physical activity programs is documented. And this is consistent with the situation that physical activity is most held. Promoting physical activity in diverse settings and utilizing multiple channels of communication can help to alleviate some barriers for older adults who accompany some functional limitations or physical disabilities. Although keeping the motivation of regular physical activity and self-management are very important to accomplish the recommended goals, environmental barriers including weather, lack of equipment for the elderly to have a rest may prevent the elderly from taking part in physical activities (Brawley et al., 2003). As to the effect of physical activity, it seems that there is a consistent conclusion that physical activity intervention significantly affects the functional independence of the older adults. As the benefits of frequent activity in terms of maintaining mobility appeared to be approximately equal for walking, gardening, and vigorous exercise, we should design activities programs for the whole populations of older adults with a variety of capabilities and health concerns (Lacroix et al, 1993). Certainly, strict screening or supervising is necessary for the implementation of physical activity program (Inagaki et al, 2012; Groessl et al, 2016).

#### 3.2 The determinants of preventive care

According to Grossman’s (1972) model, health can be considered as capital stock. On the basis of the definition of this health production function, medical care or healthy behaviors can be considered as inputs. And health information can be also treated as input (Wagner et al, 2001). In their research they find that the intervention on health information is associated with a decreased reliance on health professionals for information. It implies that the increase of health information mainly induced by education attainments may promote the investment on preventive care service. For example, by applying a standard logistic model, Zheng and Kuroda (2010) find that the decline rate of the instrumental activities of daily living (IADL) is high for people with low educational backgrounds, which suggests that in order to prevent the functional

decline among the elderly, it is important to spread knowledge about health to people with low educational backgrounds among developing countries such as China.

There is also a big difference on the use of preventive care between immigrants and natives. Especially, among the insured with continuous private coverage, citizen and non-citizen immigrants are significantly less likely to use preventive care than natives in the United States (Pylypchuk and Hudson, 2009).

### 3.3 The Limitations of Previous Review and Contribution of this Study

Many previous studies use a small-scale micro data to discuss the effects of preventive care programs. For example, Inagaki et al (2012) develop a care prevention exercise called “Ogenki Shan-Shan Taisou” (OSST) with the cooperation of the local government of Oita-city. Community-dwelling people aged 64 to 90 years old (N=130) participated in this program. As the results, more than 80% of subjects continue OSST at home almost every day. Significant improvements are observed in body weight, isometric knee extension strength, shoulder flexibility, 10-m walking time, maximal step length, and stepping. However the estimated results are difficult to show the external validity. At the same time, under strict screening or supervising, the effects of preventive care programs may be overestimated.

In this study, instead of using small-scale micro level data, we use aggregate municipality-level data to constitute a two-period panel data and apply a standard fixed effect model to estimate the causal effect of preventive care programs. There are three merits to use municipality-level data. Firstly, as preventive care programs are mainly implemented by municipalities in Japan, we are interested in the effect of preventive care programs on municipalities, not on individuals. So using municipality-level data is reasonable. Secondly, we can easily obtain a panel data set and control unobservable variables which are time invariant (e.g. the motivation of municipalities) and get causal effects of preventive care programs. At last, using municipality-level data allows us to obtain relative external validity when compared with some previous studies.

## 4. Empirical strategy

The basic model specification for our estimation is as follows:

$$Y_{i,t} = \beta \text{Programs}_{i,t} + \delta X_{i,t} + \eta_i + \lambda_t + \varepsilon_{i,t} \quad (1)$$

where  $i$  represents municipalities,  $t$  is year,  $Y$  represents the number of long-term care recipients per 100,000 population of 65 years old and above by disabled degrees,  $\text{Programs}$  is the number of preventive care programs per 100,000 population of 65 years old and above weighted by the participant rate (The number of participants divided by

the total population of municipality),  $X$  is the set of control variables,  $\eta_i$  and  $\lambda_t$  are municipality and year fixed effects.  $\varepsilon_{i,t}$  represents error term. The  $X$  includes the following variables: aging rate (the number of 65 years old and above accounting for the total population of each municipality), the square of aging rate, the logarithmic form of total population, intervention conditions of the settings of specialist (Specialist) and intervention conditions of the settings of financial support (Financial). We consider that the increase of preventive care programs will significantly decrease the number of certified support need recipients and certified long-term care level 1 recipients on average. As the data used are municipality level data, the assumption of constant variance may fail in this case. To address this concern, we correct the standard errors for heteroscedasticity by using the cluster robust estimator of variance clustering at the municipality level.

## 5. Data

### 5.1 Data

The data used in this study incorporate three categories: 1.municipality-level long-term care insurance related data (Source A), 2.municipality-level preventive care program related data (Source B), 3.municipality-level population related data. Respect to municipality-level long-term care insurance related data (Source C), data by insurer from the “*Kaigo Hoken Jigyo Jokyo Hokoku Geppo*” (*Monthly Report on the Condition of Long-Term Care Insurers*) published by MHLW in Japan are used<sup>5</sup>.

Regard to municipality-level preventive care program related data, we mainly obtain the information from “*Kaigo Yobo Jigyo oyobi Kaigo Yobo Nichijyo Sekatsu Shien Sogo Jigyo (Chiiki Shien Jigyo) no Jisshi Jyokyo ni Kansuru Tyosha*” (*A Survey on Implementation Status of Preventive Long-term Care Projects and Daily Life Supporting Comprehensive Projects (Regional Supporting Projects)*), which is belonging to MHLW in Japan. As our focus is on the effect of preventive care programs, we mainly use the related information from the result sheet of “*Kaigo Yobo ni Shisuru Jyumin Unei no Kayoi no Ba no Tenkai Jyokyo (Shikuchosonbetsu)*” (*the Situation of Public Space for Preventive Care Programs Administrated by Residents*)<sup>6</sup> including the times of total preventive care programs, the times of physical activity, dining party activity, tea party activity, cognitive disorders preventive activity and hobby activity, the

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<sup>5</sup> Available on the website of the Ministry of Health, Labor and Welfare:  
< <http://www.mhlw.go.jp/topics/0103/tp0329-1.html>>.

<sup>6</sup> Available on the website of the Ministry of Health, Labor and Welfare:  
2013 version< <http://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000075280.html>>  
2014 version< <http://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000096350.html>>



intervention on the settings of specialist<sup>7</sup> and the intervention on the settings of financial support. Since municipality-level data are available only for 2013 and 2014, we obtain the two years' data and constitute a two-period panel data.

In terms of population related data, data from “*Jumin Kihon Daityo Nenrei Kaikyu Betsu Jinko (Shikutyosonbetsu)*” (*Basic Resident Register Age-Specific Population*) published by Ministry of Internal Affairs and Communications (MIAC) are used<sup>8</sup>. In order to take demographic characteristics into account, we include aging rate (the proportion of the elderly who are aged 65 and over) and logarithmic form of population for each municipality into account. We also include the square of aging rate to identify the nonlinear effect. In order to match the information of preventive care programs, we choose to use the population related data of years 2013 and 2014.

Since some of municipalities are administrated by long-term care insurance unions, we can only obtain the total number of certified recipients without the detail of each member. We have to exclude the municipalities which are administrated by unions. And we get a final data set with 3080 valid observations.

## 5.2 Dependent variables

Preventive care program is most likely to affect long-term care expenditure through its effect on the certification of less disabled adults. On the basis of figures associated with the number of certified long-term care recipients, we calculate certified support need level 1, support need level 2 and long-term care need level 1 recipients per 100,000 population of 65 years old and older (population related data) of each municipality as dependent variables. The definitions of dependent variables are as follows:

Support 1 = Number of certified support need level 1 recipients / (Number of persons aged 65 and over)\*100,000

Support 2 = Number of certified support need level 2 recipients / (Number of persons aged 65 and over)\*100,000

Longterm 1 = Number of certified long-term care need level 1 recipients / (Number of persons aged 65 and over)\*100,000

As shown in table 1, the average number of certified support need level 2 per 100,000 population of 65 years old and over is similar to that of certified support need

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<sup>7</sup> It includes public health nurse, nursing staff, physical therapist, occupational therapist, speech-language-hearing therapist, nutritionist, registered dietitian and dental hygienist.

<sup>8</sup> Available on the website of the Ministry of Internal Affairs and Communications:  
2014.1.1 [http://www.soumu.go.jp/menu\\_news/s-news/01gyosei02\\_02000062.html](http://www.soumu.go.jp/menu_news/s-news/01gyosei02_02000062.html)  
2015.1.1 <[http://www.soumu.go.jp/menu\\_news/s-news/01gyosei02\\_03000062.html](http://www.soumu.go.jp/menu_news/s-news/01gyosei02_03000062.html)>

level 1 (Support 1: 2,207.412 VS Support 2: 2,299.727) and smaller than that of the number of certified long-term care need level 1.

### 5.3 Key independent variables

The most important explanatory variable is the number of preventive care programs per 100,000 population of 65 years old and over (Programs weighted by participant rate). The average number of the programs executed in one municipality is 12.605 with a big standard deviation of 91.164. There are five categories of preventive care programs in our data set including physical activities (PA), dining party activities (DPA), tea party activities (TPA), cognitive disorders preventive activities (CDPA) and hobby activities (HA). In terms of the means of different preventive care program indicators, we find that PA has the highest mean (5.238) as the most popular preventive care program. The next one is HA (2.644). And the TPA has a very similar mean like HA. As the limitation of specialists, municipalities are unlikely to hold CDPA as often with a small mean (0.890).

We also control the demographic factors including the ratio of the number of 65 years old or older occupying the number of total population (Aging Rate1), the square of aging rate (Aging Rate2), and logarithmic form of the total number of population (Lnpop). As shown in Table 1, the average of Aging rate is 29.9%, which is slightly higher than that of official statistics. By introducing a binary variable representing the intervention conditions about the settings of specialists (Specialist), we find that 55.8 percentages of the regions are associated with the intervention about specialists. Similarly, we also use a binary variable to describe the intervention conditions about financial support (Financial support). And about half of the municipalities implementing preventive care programs receive some kinds of financial supports from the central government, local government or other sponsors. In order to control the year effect, we also constitute Year2014 dummy variable (If the data are from 2014, 1 is assigned, otherwise 0).

Table1. Descriptive statistics

Variables	Observations	Means	Std. Dev	Min	Max	Source
Dependent variable						
Support1	3,080	2,207.412	1,076.276	-1,036.269	9,708,738	
Support2	3,080	2,299.727	784.416	0.000	7,407,407	A&C
Longterm1	3,080	3,488.312	884.199	0.000	8,664.260	

Independent variable						
Lnpop	3,080	10.187	1.480	5.106	15.109	
Aging	3,080	0.299	0.067	0.131	0.580	C
Aging2	3,080	0.094	0.043	0.017	0.336	
Programs	3,080	12.605	91.164	0.000	2,616.293	
PA	3,080	5.238	49.369	0.000	1,744.195	
DPA	3,080	1.192	18.964	0.000	712.524	
TPA	3,080	2.641	14.801	0.000	437.670	B&C
CDPA	3,080	0.890	20.730	0.000	1,132.429	
HA	3,080	2.644	27.814	0.000	875.824	
Specialist	3,080	0.558	0.497	0.000	1.000	
Financial	3,080	0.497	0.500	0.000	1.000	B
Year2014	3,080	0.500	0.500	0.000	1.000	

Note: The details of Source A, B and C are as follows.

A: “Monthly Report on the Condition of Long-Term Care Insurers”

B: “the Situation of Public Space for Preventive Care Programs Administrated by Residents”

C: “Basic Resident Register Age-Specific Population”

## 6. Estimated results

### 6.1 The Results of Preventive Care Programs

Firstly, we estimate the effect of the total number of preventive care programs Reg1 is shown in table 2 representing OLS and Fixed effect model by using Support 1, Support 2, Longterm 1 and Longterm 2 data, respectively. We mainly focus on the estimated results of Fixed effect model and use the results of OLS as comparisons. According to the estimated result of Reg1, we find that the results of OLS1 and OLS2 are significantly positive. The increment of total number of preventive care programs will augment the certified support need level 1 and the certified support need level 2 recipients. However, taking the unobserved variables by using fixed effect model into account, we find the coefficient for support2 turns to be significantly negative indicating the increase of total preventive care programs significantly decreases the certified support level 2 recipients. Because the results of Longterm1 and Longterm2 are insignificantly, we believe that the decreases of the certified support level 2 recipients are unlikely to shift to higher disabled degrees.

According to the results of “*Kaigo Yobo Jigyo oyobi Kaigo Yobo Nichijyo Sekatsu Shien Sogo Jigyo (Chiiki Shien Jigyo) no Jisshi Jyokyo ni Kansuru Tyosha*” (*A Survey on Implementation Status of Preventive Long-term Care Projects and Daily Life Supporting Comprehensive Projects (Regional Supporting Projects)*) (2014), there are

five kinds of preventive care programs implemented by municipalities. The most popular preventive care program is physical activity (PA) accounting for 42.8 % among the preventive care programs. One possible explanation for the popularity of physical activity is that the implementation of physical activity is easier than any other preventive care programs no matter in public space or at home. For example, according to Inagaki et al (2012), they develop a care prevention exercise called “Ogenki Shan-Shan Taisou” (OSST) with the cooperation of the local government of Oita-city. As the results, more than 80% of subjects continued OSST at home almost every day.

According to the result of Reg2 in Table 2, we find that after controlling unobserved variables (E.g. the motivation of municipalities) only the result of Support 2 is significantly negative. In the previous studies, PA is described as an efficient means to extend the functional ability of the elderly. However, the effect of PA needs perseverance (Brawley et al., 2003). The older adults do not obtain obvious effect just by attending PA one time or few times. Consequently, efficient screening also plays an important role in improving the effect of PA. If there is no screening or supervising, the older adults gradually will give up attending PA owing to the shortage of perseverance. The typical adverse selection may happen among PA.

Next, we will discuss the estimated results of DPA shown in Reg3 of Table 2. The DPA is supposed to have two potential channels for influencing the health status of participants. One aspect is by providing an opportunity for communication. The other one is by improving nutrition conditions of the participants. Because these two potential channels are simultaneously influencing the elderly, it is impossible to separate and value each channel. According to the results of Reg3 in Table 2, we find the coefficient of Longterm1 in FIX3 is significantly negative. The increase of DPA significantly decreases the number of certified long-term care need level 1 recipients. However, the effect of TPA is similar to the first potential channel of DPA to promote the communication among participants, there is little evidence for TPA influencing the number of certified recipients from Reg4 in Table 2. It may suggest that the improvement of nutrition condition is more important or the combination of communication and the improvement of nutrition are more efficient for preventive care. The result in Reg5 of Table 2 show that the CDPA decreases the number of certified long-term care need level 1 and 2 recipients. One possible explanation is that less disabled people may prefer to stay away from available health information, fearing the impact that a change of belief could have on their behavior, which is called “strategic ignorance” (Carrillo and Mariotti, 2010). According to “strategic ignorance”, people may be reluctant to obtain related information and give up attending CDPA.

According to the results of Yoshida and Chen (2016), they find that hobby activities are significantly correlated to the decrease of the number of certified support need level 2 recipients. However, the results cannot be explained as a causal effect owing to the endogenous bias of participation rates. The estimated results are shown in reg6 of Table 2. We find little evidence for supporting HA influencing the number of certified recipients.

Table 2 the Results of Total Preventive Care Programs

	OLS1	FIX1	OLS2	FIX2	OLS3	FIX3	OLS4	FIX4
	Support1	Support1	Support2	Support2	Longterm1	Longterm1	Longterm2	Longterm2
Reg1								
Programs	0.511*	0.0162	0.553***	-0.0831*	0.0830	0.00746	-0.264	-0.159
	(0.304)	(0.0829)	(0.205)	(0.0465)	(0.180)	(0.121)	(0.235)	(0.142)
Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Reg2								
PA	0.851*	0.0381	1.070***	-0.205**	0.109	0.218	-0.426	-0.248
	(0.509)	(0.183)	(0.282)	(0.0916)	(0.356)	(0.211)	(0.485)	(0.330)
Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Reg3								
DPA	2.808***	1.677	0.724*	-0.293	0.943**	-2.623***	-1.848	-2.399
	(0.340)	(1.273)	(0.414)	(1.212)	(0.425)	(0.992)	(1.527)	(1.502)
Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Reg4								
TPA	0.377	0.319	0.738	0.106	-1.276	-0.938	-0.220	-0.243
	(0.943)	(0.517)	(1.070)	(0.413)	(1.080)	(0.700)	(0.609)	(0.439)
Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Reg5								
CDPA	-0.582***	0.0648	-0.0393	-0.0200	-0.166	-0.470***	-0.181*	-0.476***
	(0.164)	(0.0469)	(0.158)	(0.0437)	(0.199)	(0.0573)	(0.0964)	(0.0641)
Covariates	YES	YES	YES	YES	YES	YES	YES	YES
Reg6								
HA	1.657*	-0.335	1.979***	-0.320	0.544	0.458	-0.440	-0.281
	(0.926)	(0.619)	(0.542)	(0.216)	(0.624)	(0.344)	(0.797)	(0.578)
Covariates	YES	YES	YES	YES	YES	YES	YES	YES

Note:

\*, \*\*, \*\*\* denotes statistical significance at the 10%, 5%, 1%, respectively. Robust cluster standard errors (clustering at the municipality level) are shown in parentheses.

## 6.2 The Results of Combinations of Preventive Care Programs

Table 3 shows the combinations of preventive care programs. We find about 8.4% of the municipalities implement all of the five kinds of preventive care programs. As the financial resource is limited, executing all kinds of preventive care programs is difficult for most municipalities. Among the 4 activities combinations, the most popular combination of pa, dpa, tpa and ha occupies 12.8%. And among the 3 activities combinations, 20.2% of the municipalities execute the combination of pa, tpa and ha. Since the municipalities can freely choose the combination of preventive care programs, the effect of different combination of preventive care programs is necessary to examine.

Table 3 The combinations of preventive care programs (distribution)

	%	Obs
5 activities combination		
pa & dpa & tpa & cdpa & ha	0.084	258
4 activities combinations		
pa & dpa & tpa & cdpa	0.091	280
pa & dpa & tpa & ha	0.128	395
pa & dpa & cdpa & ha	0.088	270
pa & tpa & cdpa & ha	0.111	342
dpa & tpa & cdpa & ha	0.086	266
3 activities combinations		
pa & dpa & tpa	0.146	449
pa & dpa & cdpa	0.099	305
pa & dpa & ha	0.138	426
pa & tpa & cdpa	0.130	401
pa & tpa & ha	0.202	623
pa & cdpa & ha	0.122	376
dpa & tpa & cdpa	0.094	289
dpa & tpa & ha	0.135	417
dpa & cdpa & ha	0.091	280
tpa & cdpa & ha	0.116	357

Note: pa, dpa, tpa, cdpa and ha are binary variables (if the number of preventive care programs is positive, 1 is assigned; otherwise 0).

Here, we discuss the main combinations of preventive care programs used in practice. The first one is the combination of all five programs. On the basis of estimated results in 6.1, in this part we mainly focus on the effect of PA, DPA and CDPA. Based on column 6 of Table 4, we find PA can reduce the number of certified long-term care recipients. However, as the estimated result of column 8 is significantly positive indicating that the number of certified long-term care need level 1 recipients may shift to long-term care need level 2. As to the effect of DPA, we find the estimated coefficient of column 4 and 8 are significantly negative indicating the implementation of DPA will decrease the number of certified support need level 2 and long-term care need level 2 recipients. Regarding to the results of CDPA, we find the preventive effect appears among less disabled elderly, which is different from the previous results of CDPA. One

possible explanation is that the diversity of preventive care programs may promote the participant rate of CDPA.

Next, let's have a look at the results of 4 activities combination including PA, DPA, TPA and HA. The result of PA is similar to that of 5 activities combination decreasing the number of support 2 and long-term care1 recipients. However, because the result of column 8 is nonsignificant, certified long-term care need level 1 recipients may not shift to the higher level certified recipients.

When estimating the combination of 3 preventive care activities, the effect of PA again is proved. Although the result appears only among certified support need level 2 recipients.

Table 4 The estimated results of preventive care programs combinations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS1	Fix1	OLS2	Fix2	OLS3	Fix3	OLS4	Fix4
	Support1	Support1	Support2	Support2	Longterm1	Longterm1	Longterm2	Longterm2
5 Activities Combination								
PA	-1.933 (3.405)	2.841 (4.232)	-7.580*** (2.535)	2.780 (3.370)	-3.726 (2.682)	-10.605** (4.726)	-4.369* (2.449)	15.57*** (2.875)
DPA	1.932 (5.392)	-25.785 (16.685)	5.347** (2.271)	-41.355*** (10.46)	0.272 (2.096)	-2.946 (15.524)	-3.860 (3.881)	-57.687*** (9.476)
TPA	-3.226 (7.243)	2.729 (3.977)	2.038 (4.532)	-0.890 (2.758)	-3.298 (4.887)	-0.983 (3.495)	0.702 (4.765)	12.495*** (3.363)
HA	5.133 (3.627)	28.55*** (8.457)	4.730 (2.865)	-9.257 (10.096)	3.561 (5.037)	3.871 (7.469)	0.684 (2.659)	-22.91** (9.247)
CDPA	0.038 (2.309)	-56.203*** (18.777)	4.007** (1.670)	6.343 (16.865)	2.171 (1.722)	32.557* (19.635)	3.372** (1.655)	-2.371 (17.901)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	258	258	258	258	258	258	258	258
R-squared	0.221	0.323	0.175	0.299	0.149	0.549	0.129	0.555
4 Activities Combination								
PA	-2.516*** (0.856)	0.104 (1.716)	-2.823** (1.111)	-5.268** (2.038)	-1.618 (1.157)	-3.764** (1.855)	-1.218 (0.914)	0.233 (2.809)
DPA	8.265 (5.282)	-3.776 (6.086)	7.511** (3.010)	0.312 (6.855)	1.561 (3.912)	-5.199 (8.996)	0.827 (3.313)	-17.32* (9.618)
TPA	-3.704 (2.986)	3.285 (3.630)	-1.184 (2.202)	1.160 (4.098)	-2.728 (2.514)	1.395 (5.396)	0.727 (2.153)	10.35* (5.787)
HA	4.744*** (1.497)	-0.796 (2.696)	5.351*** (1.683)	3.402 (3.056)	3.510* (2.001)	7.102*** (2.597)	0.528 (1.269)	-1.866 (4.044)

Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	395	395	395	395	395	395	395	395
R-squared	0.177	0.283	0.133	0.172	0.141	0.328	0.111	0.152
3 Activities Combination								
PA	-1.192 (0.842)	1.750 (1.593)	-1.734* (1.012)	-4.243*** (1.328)	-1.220 (0.846)	0.589 (1.625)	-1.646* (0.941)	-2.105 (2.244)
TPA	-0.099 (1.299)	1.105** (0.447)	1.809 (1.174)	0.913* (0.473)	-1.897 (1.427)	-2.369*** (0.424)	0.753 (1.153)	0.075 (0.538)
HA	3.297** (1.459)	-1.066 (1.435)	4.557*** (1.669)	2.054*** (0.721)	3.120** (1.575)	0.714 (0.949)	1.538 (1.393)	0.001 (1.382)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	623	623	623	623	623	623	623	623
R-squared	0.163	0.147	0.134	0.169	0.151	0.279	0.115	0.127

\*, \*\*, \*\*\* denotes statistical significance at the 10%, 5%, 1%, respectively. Robust cluster standard errors (clustering at the municipality level) are shown in parentheses.

## 7. Conclusions and Discussions

Long-term care expenditure has been growing explosively, exerting huge pressure on local and central governments' budgets. Extending the functional ability of the elderly not only improves personal welfare, but also reduces the burden of long-term care expenditure for government. Consequently, using preventive care programs to relieve the expenditure is an attracting option for policymakers.

In this study, we use a two-period panel data and apply a standard fixed effects model to examine the effect of preventive care programs including physical activities, dining activities, tea party activities and cognitive disorders preventive activities on the number of support need level 1 and support need level 2 recipients. We find that the coefficients of Programs, DPA and HA are statistically significant. One possible explanation is that people may prefer to obey "strategic ignorance" (Carrillo and Mariotti, 2010). For example, if older disabled adults attend the cognitive disorders preventive activities, they will learn much knowledge about cognitive disorders, which may disturb their daily life. According to "strategic ignorance", people may be reluctant to obtain related information and give up attending the cognitive disorders preventive activities. We also examine the combinations of preventive care programs. And we find PA and DPA are relatively robust and efficient means of preventive care programs.

We hope that the results of this study can provide some evidence for designing efficient preventive care programs in the future. As the data used are macro level data, it



is difficult to obtain the exact information for individuals to examine the possibility of shift. In the future, it is necessary for to examine the effect of preventive care programs on the number of disabled older adults by using individual level data.

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