

Suicide Among Older Adults with Dementia: Effect of Korea's Long-Term Care Insurance System

Sungje Moon

Korean Medical Association

Mankyu Choi

Korea University

Minsung Sohn (✉ minsunge@cuk.edu)

The Cyber University of Korea

Research Article

Keywords: Dementia, Long-term care insurance, Survival analysis, Suicide, Older adults

Posted Date: March 22nd, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-148862/v2>

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Abstract

Background: South Korea recently expanded its coverage rate of long-term care insurance (LTCI) by adding a “dementia special grade” in 2014 to improve care service accessibility and extend health life for older adults with dementia. This study proposed a multifaceted policy to reduce the suicide risk among older adults with dementia by evaluating the effectiveness of the using the long-term care services (LTCS) and of the expanded LTCI coverage.

Methods: A sample of 62,282 older adults was selected from the “Older Adults Cohort DB” of the National Health Insurance Service. First, we selected older adults diagnosed with dementia at least once from 2002 to 2015. Second, all causes of death excepted for suicide are deleted. Third, older adults got the LTCS grading is selected after the introduction of the LTCI in 2008. Data were analyzed using the Kaplan-Meier estimator, Cox regression to represent the yearly survival curve from 2002 to 2015 according to individuals’ risk factors. Also, difference-in-differences estimation was conducted to analyze the effect of LTCS on suicide rates by comparing statuses before and after 2014.

Results: There were statistically significant differences in suicide rate by sex, daily living activities, cognitive ability, caregiver type and use of LTCS (Log-rank test $p < 0.001$). The suicide risk of older adults using LTCS was about 0.256 times lower than those who did not use it ($p < .001$), after adjusting controls. Regarding the policy effect of LTCS, the suicide rate increased after the expansion of the dementia grading (OR=2.131, 95% CI=1.061-4.280) but was still lower among LTCS users than non-users (OR=0.296, 95% CI=0.183-0.478).

Conclusions: This study not only identified the parameters affecting suicide rates depending on the sex, ADL, and type of caregiver at the individual level, but also confirmed that access to LTCS could minimize suicide risk. It highlights the importance of national system management to prevent suicide among older adults with dementia and offers effective policy suggestions.

Background

A prolonged lifespan does not necessarily imply an improved quality of life. Although average life expectancy is increasing worldwide, social and health problems such as dementia and suicide have also been on the rise. Considering the rapidly increasing proportion of older adults in the global population, the increasing number of older adults with dementia will soon become a national concern [1]. Dementia is a condition in which individuals’ memory or cognitive functioning deteriorates and progressively interferes with their daily life [2]. The number of patients with dementia worldwide is expected to increase from about 50 million today to 152 million in 2050 [3]. In South Korea, the number of patients with dementia was about 710,000 in 2017, 3.6 times higher than in 2007. These indicators suggest it is necessary to examine not only the medical problems of aging but also the acute public health and sociological problems that older adults face.

Specifically, the risk of suicide increases as dementia progresses, as patients fear the prospect of accelerated physical and mental decline and worry about the emotional and economic burden on their families [4]. In fact, in 2016, the global prevalence, incidence, and years lived with disability (YLDs) of dementia were the highest among all mental diseases [5]. Dementia is also associated with depression, anxiety, suicidal thoughts, and self-harm in the caregivers, including family and neighbors [6, 7]. In 2017, the average age-standardized suicide rate in Organisation for Economic Co-operation and Development (OECD) countries was 11.2 per 100,000 people, with that of South Korea being the highest at 24.6 [8]. Particularly, the suicide rate among older adults in South Korea is the leading problem among OECD countries [9]. The ratio of older adult suicide to total suicide incidence was over 70% in South Korea, while the average in OECD countries was about 22% [9, 10]. Therefore, dementia as a geriatric disease is a pressing concern that requires constant monitoring, prevention, and management from various aspects, as well as continuous research to identify preventive solutions to related social problems such as suicide.

Several studies have verified the relationship between dementia and suicide at the individual level. According to the interpersonal theory of suicidal behavior, the most dangerous aspect of suicidal desire is the coexistence of both a thwarted belongingness—feeling disconnected from a social relationship—and a perceived burdensomeness—perceiving oneself as a burden on others [11]. Patients with dementia feel alienated from social events and conversations concerning family or friends, and think that they are not helpful or are burdensome to others due to their memory loss [12]. In other words, such patients are a vulnerable group exposed to suicidal thoughts and risks due to worries about the characteristics of the disease. The Suicide Prevention Research Center at the University of Aarhus in Denmark conducted a follow-up study on suicide among older adults for a period of 11 years beginning 1990. It found that the largest number of older adults committed suicide after being diagnosed with dementia. Older adults above 70 years with dementia had a three-times higher suicide risk than older adults without dementia [13]. Additionally, the hospitalization rates of older adults with dementia due to self-harm were double those of the rest. Mortality, re-admission, and hospitalization period within 12 months after admission were also higher in this group [14]. Among the older adults who committed suicide due to dementia, the overall suicide attempts and suicide rates were higher among patients with mild dementia who had been recently diagnosed [4, 13, 15]. Similarly, suicide attempts among these patients were higher than among older adults with light cognitive impairment [16–18]. Studies on suicide among older adults with dementia have mainly considered socioeconomic factors at the individual level and are limited in presenting specific guidelines for prevention at the national level. Since dementia is difficult to cure and rarely achieves full recovery, unlike other diseases, institutional help such as early detection and management of disease is essential to lower the suicide rate.

According to the World Health Organization (WHO), suicide is a representative preventable death, requiring appropriate national intervention and management. It can also be prevented through effective health policy and medical services [19]. As a strategy to respond to suicide risk factors, steps should be taken to improve the medical accessibility and mental health for all citizens, along with selective prevention and follow-up measures for suicide-vulnerable groups that do not receive adequate community support. In a report titled “Development of National Strategies for Suicide Prevention,” the

United Nations and WHO recommended that the government pay attention to suicidal behavior, and emphasized comprehensive policies, including social solidarity and responsibility. Dementia, which is a high-risk factor for suicide, causes suffering in both patients and families, and therefore, the government needs to alleviate the pain and burden of the patients and their families by expanding the dementia management policy and the social safety net.

In Korea, the long-term care insurance (LTCI) system was introduced in 2008, and since then, the number of users of the service has grown, increasing by 15.1% compared to the last year to about 770,000 older adults who received grading as of 2019 [20]. In particular, to improve accessibility for older people with dementia, a “dementia special grade” was established in the LTCI system in 2014. Additionally, the expansion of day and night shelters for dementia patients improved accessibility, relieved the burden of care for patients with mild dementia, and improved their quality of life. Further, South Korea announced a “National Responsibility Plan for Dementia” to reduce the out-of-pocket costs for patients with severe dementia, to 10%. These policies aimed to protect patients’ family from the economic and care-giving burdens of dementia and social problems such as suicide.

Some previous studies have researched the association between policies at a national or community level such as long-term care services (LTCS), and suicide rates in older adults with dementia. A study on suicide prevention programs conducted for older adults with mild dementia in South Korea, who received day care services, reported a positive effect on their subjective health level, depression, and suicidal intentions [21]. Additionally, admission to a nursing home was found to lower suicide risk among those with dementia aged above 60 years [4]. According to a study conducted on 634 older adults with dementia for seven years, about 10% of them had thought of suicide [22]. Further, some studies have mainly focused on the caregivers of dementia patients, such as their tendency to develop depression, stress, or murderous behaviors or impulses [6, 23]. Older adults with dementia also have the right to end their lives, even though they may not be able to recognize their suffering because of difficulty of expression. Therefore, this study emphasizes national-level policies to protect older adults with dementia and suggests a direction for suicide-prevention strategies.

For suicide prevention, it might be necessary to approach vulnerable targets that are more exposed to the risk and environmental factors of suicide. Additionally, we need to devise measures that can prevent suicide by supplying appropriate and timely help and institutional assistance. Therefore, this study evaluates whether a national approach through the LTCS can prevent suicide among older adults with dementia, and proposes a multifaceted policy to prevent suicide. First, the status of the risk factors of suicide among Korean older adults with dementia was identified at the individual level. Second, the effect of using LTCS on suicide among older adults with dementia was determined at the national level. Lastly, the effectiveness of policies such as the introduction of LTCI in 2008 and the expansion of the dementia grade in 2014 was evaluated.

Materials And Methods

Research Design and Participants

In 2002, the National Health Insurance Service (NHIS) in South Korea established the “National Health Information Database (NHI DB),” which includes information on patients’ medical records, disease history, prescriptions for health insurance, and medical aid beneficiaries. The DB was systematically sampled and stratified by sex, age, region, and the level of insurance cost, to ensure representativeness. Additionally, the NHIS DB is divided into “Standard Cohort,” “Health Examination Cohort,” “Older Adults Cohort,” and “Infant Cohort” DBs to study specific populations.

This study used data from the “Older Adults Cohort DB” from 2002 to 2015. The full DB includes 558,147 randomly extracted people, who constituted about 10% of the total 5.5 million Korean older adults aged over 60 in December 2002. To obtain a study sample of older adults with dementia, we employed the following four steps. Step 1: We selected 121,235 older adults who were outpatients or inpatients at least once with a disease code related to dementia (F00–F03, Korean standard classification of disease and cause of death, KCD) from 2002 to 2015 (in Figure 1, the “survival period (green box)” refers to the duration of the dementia experience). Step 2: All other causes of death, except suicide (which is a dependent variable in this study), were deleted. Step 3: To meet the baseline of health conditions of older adults in each group according to the type of LTCS, older adults with LTCS grading were selected based on their score for long-term care approval; those who had been judged to need LTCS after the introduction of the LTCS system in 2008 were selected. Step 4: The final sample included 62,282 older adults after creating a balanced panel for 14 years, and excluding individuals with missing values for the main variables used in the analysis.

Figure 1 presents the structure of the sample selected for the study. First, among the older adults who survived until the end of follow-up, Case 1 refers to older adults who had been diagnosed with dementia from the beginning of the observation, while Case 2 comprises older adults diagnosed with dementia during the observation. Second, Cases 3 and 4 had the same criteria for period of dementia diagnosis as Cases 1 and 2; however, the difference was that in the latter cases, the older adults had died before the end of follow-up. Lastly, Case_{n-1} and Case_n are older adults who have the same criteria as Cases 1–4 but represent those who have used services under the LTCS since its introduction.

Measures

Dependent Variable: Suicide

Suicide is the dependent variable in this study, to verify whether the cause of death data included the suicide codes (X60–X84). The binary variable was coded 1 if the older adult had committed suicide and 0 otherwise.

Independent Variable: Long-Term Care Services

This study took the experience of using LTCS as a policy variable, to confirm the effect of LTCS on preventing suicide among the older adults with dementia. The LTCS types were classified into non-user, facility benefits, and in-home benefits. Generally, facility services are used when the disease symptoms are severe. The LTCS provides three types of services (LTCS): facilities, in-home, and cash services. In severe cases or grades of 1 to 3, facility services can be used; by contrast, for grades 4 to 5 and the dementia special grade, patients mainly use in-home services. Therefore, the service type was classified as a facility service if the older adult used both facilities and in-home services. We excluded cash services because the frequency of using cash services is very small.

Control variables: Demographic Characteristics and Health Status

The independent variables in this study included the demographic characteristics of older adults with dementia, that is, sex, age, and income level, as well as caregivers and their health status. Sex comprised male and female, and ages were classified into three categories of 60–69 years, 70–80 years, and above 80 years. The NHI premium for the 10th quantile was used as a proxy for income level because NHI coverage in Korea is subject to compulsory payment of health insurance premiums based on individual income levels. This variable was re-categorized into five quantiles: 1st quantile (medical aid beneficiaries), 2nd quantile (the 1st–2nd quantile, which is the lowest income level), 3rd quantile (3rd–5th), 4th quantile (6th–8th), and 5th quantile (9th–10th). The types of caregivers were categorized into family and neighbors, professional caregivers, and no caregivers. Regardless of what LTCS older people used, they may choose professional caregivers or family caregivers, or they may not use caregivers. The health status included activities of daily living (ADL) and cognitive ability. The ADL was classified into three categories (independent, partially dependent, and fully dependent) by summing the scores for 13 questions (activities): bathing, washing the face, washing hair, brushing teeth, eating, dressing, transfer, sitting up, moving to side sit, going out of the room, going to the toilet, controlling urine, and feces, on the basis of four responses (full independence, incomplete independence, partial dependence, and full dependence). For cognitive ability, the binary variable was divided into “good” and “bad” using the total scores of 10 questions: impairment of long-term or short-term memory, communication, counting, awareness of routines, decline in judgment, inability to recognize instructions, date, place, and age.

Analysis Strategy

The following analysis methods were used. First, we conducted a chi-square test to identify the factors affecting suicide among older adults with dementia. Second, the Kaplan-Meier and Cox regression analyses were conducted to create the yearly survival curve from 2002 to 2015, and the suicide rate was identified by demographic characteristics, health status, and policy. Third, to confirm the effect of reinforcing insurance coverage with the expansion of LTCS’s “dementia special grade,” a difference-in-differences (DID) estimation was conducted to analyze the effect of LTCS on suicide rates by comparing statuses before and after 2014. Model 1 analyzed the effect of the interaction term (before and after expansion x service used or not) on the suicide rate, and model 2 confirmed the effect of the interaction term on the suicide rate after adjusting the control variables. This study used a quasi-experimental design

to evaluate the impact of the expansion of LTCI's "dementia special grade." In addition to DID analysis, we analyzed panel data from 2009 to 2015 after the introduction of the LTCI system. The effect was estimated by calculating the pre (2009 to 2013)-post (2014 to 2015) difference in outcomes for the policy group (LTCS users) and the pre-post difference in outcomes for the reference group (non-LTCS users).

Results

Differences in Suicide Frequency by General Characteristics Among the Older Adults with Dementia

Table 1 shows the results of the chi-square test to compare the difference in suicidal death rates according to the general characteristics of older adults with dementia. The annual average suicidal mortality rate in the study sample was 25.94 older adults per 100,000 populations. The frequency of suicide by males (0.33%) was more than twice that of females (0.14%), and by age, the suicide rate was highest in the 60s (0.41%), followed by the 70s (0.21%), and the above-80s (0.15%). Concerning ADL, suicide frequency was the highest in those who were independent (0.3%), and the lowest in fully dependent older adults (0.05%). Additionally, older adults with good cognitive ability (0.27%) had a higher suicide frequency than those with poor cognitive ability (0.11%). Considering the type of caregiver, older adults with no caregiver had the highest suicide frequency (0.35%), followed by those with family or neighbors as caregivers (0.23%) and those with nurses as caregivers (0.1%). Lastly, LTCS non-users (0.33%) had a higher suicide frequency than users, and in-home service users (0.23%) had a higher suicide frequency than users of facility services (0.06%). The difference in suicide frequency according to income level was not statistically significant.

Table 1
Suicide frequency by general characteristics of the elderly with dementia

Suicide		Yes [†]		No		chi-square
		N	%	N	%	
Sex	Male	56	0.33	17,083	99.67	22.82***
	Female	63	0.14	45,080	99.86	
Age	60–69	14	0.41	3,442	99.59	11.16**
	70–79	55	0.21	26,220	99.79	
	Over 80	50	0.15	32,501	99.85	
Income level ^a	5th quintile (Highest)	37	0.18	21,096	99.82	0.68
	4th quintile	25	0.19	12,860	99.81	
	3rd quintile	11	0.18	6,114	99.82	
	2nd quintile	24	0.21	11,278	99.79	
	1st quintile (Lowest)	22	0.20	10,815	99.80	
ADL ^b	Independent	75	0.30	24,975	99.70	38.27***
	Partially dependent	33	0.21	15,471	99.79	
	Fully dependent	11	0.05	21,717	99.95	
Cognitive ability ^c	Good	86	0.27	31,371	99.73	22.59***
	Bad	33	0.11	30,792	99.89	
Caregivers	None	14	0.35	4,001	99.65	17.99***
	Family/Neighbor	82	0.23	35,367	99.77	

[†]The annual average of suicidal mortality rate in the study data is calculated as 25.94 elderly per 100,000 populations. Whereas, Korea's dementia mortality rate in 2015 was 18.6 per 100,000 populations (Statistics Office), but it is estimated that the study sample is likely to be a health risk group as an LTCS applicant among the elderly with dementia.

^aIncome level: 1st quintile (Medical aid beneficiaries), 2nd quintile (The NHI premium for the 10th quantile: 1st -3rd), 3rd quintile (4th -5th), 4th quintile (6th -8th), 5th quintile (9th -10th)

^bActivity Daily Limitation: Independent (score 13–19), partially dependent (score 20–26), fully dependent (score 27–39)

^cCognitive ability: Good (score 0–5), Bad (score 6–10)

^dLTCS: Long-Term Care Service

Suicide		Yes [†]		No		chi-square
		N	%	N	%	
	Nurse	23	0.10	22,795	99.90	
LTCS ^d	Non-user	55	0.33	16,603	99.67	39.99***
	Facility	14	0.06	23,630	99.94	
	In-home	50	0.23	21,930	99.77	
Total		119	0.19	62,163	99.81	
[†] The annual average of suicidal mortality rate in the study data is calculated as 25.94 elderly per 100,000 populations. Whereas, Korea's dementia mortality rate in 2015 was 18.6 per 100,000 populations (Statistics Office), but it is estimated that the study sample is likely to be a health risk group as an LTCS applicant among the elderly with dementia.						
^a Income level: 1st quintile (Medical aid beneficiaries), 2nd quintile (The NHI premium for the 10th quantile: 1st -3rd), 3rd quintile (4th -5th), 4th quintile (6th -8th), 5th quintile (9th -10th)						
^b Activity Daily Limitation: Independent (score 13–19), partially dependent (score 20–26), fully dependent (score 27–39)						
^c Cognitive ability: Good (score 0–5), Bad (score 6–10)						
^d LTCS: Long-Term Care Service						

Factors Affecting Suicide Among Older Adults with Dementia

Using the Cox proportional hazard model, this study confirmed the hazard ratio of suicide according to the type of LTCS used by older adults with dementia. Table 2 shows the analysis results.

Model 1 is the result of analyzing the suicide hazard ratio according to the type of LTCS without adjusting the control variables. Compared to the older adults who did not use LTCS, the suicide rate among those using facility services was about 0.628 times lower ($p=.017$), while the suicide rate among those using in-home services was about 0.151 times lower ($p<.001$).

Model 2 is the result of adjusting control variables for the suicide hazard ratio according to LTCS types. The hazard ratio of each control variable on suicide was also verified. As a result of adjusting demographic characteristics and health status, the suicide risk of older adults with dementia who used facility services was about 0.256 times lower than those who did not use LTCS ($p<.001$). However, the effect of in-home service on suicide risk was not statistically significant. Among control variables, the hazard ratio according to sex and ADL was significant. The suicide hazard ratio of women was 0.397

times lower than that of men ($p < 0.001$), and the hazard ratio of fully dependent older adults with dementia was 0.29 times lower than that of independent older adults ($p < 0.001$).

Table 2

Cox proportional hazard regression for LTCS

		Model 1			Model 2		
		HR	95% CI	p-value	HR	95% CI	p-value
^a LTCS	Non-user	1			1		
	Facility	0.151	0.084-0.271	<0.001	0.256	0.136-0.482	<0.001
	In-home	0.628	0.428-0.921	0.017	0.732	0.487-1.100	0.133
Sex	Male				1		
	Female				0.397	0.275-0.574	<0.001
Age	60-69				1		
	70-79				0.833	0.458-1.516	0.550
	Over 80				0.991	0.533-1.843	0.978
^b Income level	5 th quintile (Highest)				1		
	4 th quintile				1.146	0.689-1.905	0.600
	3 rd quintile				1.147	0.584-2.250	0.691
	2 nd quintile				1.447	0.864-2.426	0.161
	1 st quintile (Lowest)				1.167	0.675-2.015	0.581
^c ADL	Independent				1		
	Partially dependent				0.981	0.630-1.528	0.933
	Fully dependent				0.290	0.145-0.579	<0.001
^d Cognitive ability	Good				1		
	Bad				0.737	0.474-1.145	0.174
Caregivers	None				1		

Family/Neighbor	0.634	0.348-1.158	0.138
Nurse	0.554	0.276-1.111	0.096

^aLTCS: Long-Term Care Service

^bIncome level: 1st quintile (Medical aid beneficiaries), 2nd quintile (The NHI premium for the 10th quantile: 1st-3rd), 3rd quintile (4th-5th), 4th quintile (6th-8th), 5th quintile (9th-10th)

^cActivity Daily Limitation: Independent (score 13-19), partially dependent (score 20-26), fully dependent (score 27-39)

^dCognitive ability: Good (score 0-5), Bad (score 6-10)

※ facility (reference): non-user (HR=3.910, 95% CI=2.073-7.373), in-home (HR=2.862, 95% CI=1.512-5.417)

The results of the Kaplan-Meier Survival Curve, which estimates the survival rate during the 14 years, are presented in Appendix 1 to show the univariate effect of all variables (i.e., demographic characteristics, health status, and use of LTCS) used in the Cox proportional hazard regression on mortality. Statistically significant differences were found based on sex, ADL, cognitive ability, caregivers, and use of LTCS (Log-rank test $p < 0.001$). By contrast, there was no difference in survival rate by suicide according to age ($p = .673$) and income level ($p = .883$).

Policy Effects of Long-Term Care Services on Suicide among Older Adults with Dementia

Table 3 shows the results of the DID analysis performed to compare the policy effects of the LTCS's coverage expansion of the "dementia special grade" on the suicide rate of older adults with dementia. The suicide rate of older adults with dementia increased in the period after the expansion of dementia grade compared to that before the change (OR=2.131, 95% CI=1.061-4.280, $p = .034$). However, it was lower among LTCS users than among non-users (OR=0.296, 95% CI=0.183-0.478, $p < .001$). The interaction term indicating whether older adults with dementia used LTCS after the expansion of the dementia grading was not statistically significant.

Table 3

DID analysis of expansion of LTCS with dementia special rates

		OR	95% CI	p-value
Expansion of dementia special rates	Before (-2013)	1		
	After (2014-)	2.131	1.061-4.280	0.034
^a LTCS	Non-user	1		
	User	0.296	0.183-0.478	<0.001
Interaction term	After expansion X Use	1.589	0.667-3.788	0.296
Sex	Male	1		
	Female	0.418	0.290-0.603	<0.001
Age	60-69	1		
	70-79	0.488	0.271-0.880	0.017
	Over 80	0.430	0.237-0.781	0.006
^b Income level	5 th quintile (Highest)	1		
	4 th quintile	1.122	0.675-1.866	0.657
	3 rd quintile	1.041	0.530-2.042	0.908
	2 nd quintile	1.283	0.766-2.150	0.343
	1 st quintile (Lowest)	1.095	0.635-1.889	0.744
^c ADL	Independent	1		
	Partially dependent	1.252	0.785-1.999	0.346
	Fully dependent	0.380	0.187-0.774	0.008
^d Cognitive ability	Good	1		
	Bad	0.824	0.527-1.288	0.396
Caregivers	None	1		
	Family/Neighbor	0.812	0.451-1.462	0.488
	Nurse	0.604	0.301-1.212	0.156

^aLTCS: Long-Term Care Service^bIncome level: 1st quintile (Medical aid beneficiaries), 2nd quintile (The NHI premium for the 10th quantile: 1st-3rd), 3rd quintile (4th-5th), 4th quintile (6th-8th), 5th quintile (9th-10th)

^cActivity Daily Limitation: Independent (score 13-19), partially dependent (score 20-26), fully dependent (score 27-39)

^dCognitive ability: Good (score 0-5), Bad (score 6-10)

Discussion

This study verified the risk factors of suicide among older adults with dementia at the individual level, and evaluated whether the national intervention of LTCS could prevent suicide among older adults with dementia in the context of a continuously aging population and the rapidly increasing mortality rate of older adults with dementia. Despite Korea's high and growing suicide rate among people with dementia, there is a lack of empirical research on suicide. This study analyzed the data of 62,282 older adults with dementia from the total population of individuals aged over 60 years in Korea through random sampling, using data from the "Older Adults cohort DB" from 2002 to 2015.

First, at the individual level, the results of the analysis of risk factors affecting suicide in older adults with dementia are as follows: men had a higher suicide rate than women, and the suicide rate among older adults with dementia was higher when their ADL and cognitive functioning were mild rather than severe. Additionally, the suicide rate was the highest where there were no caregivers to help them with daily living. The suicide rate was also higher if family members or acquaintances cared for them instead of professional caregivers.

Regarding ADL and cognitive functioning, the suicide rate among older adults with dementia was higher when their ADL and cognitive functioning were mild rather than severe. This is consistent with recent studies showing that older adults diagnosed with dementia very recently are more likely to attempt suicide [4, 13, 15–18]. In Korea, a study assessing the effects of "a suicide prevention program" for older adults with mild dementia showed positive effects on perceived health conditions, social support, depression, and suicidal intentions over time [21]. Therefore, it is essential to provide interventions to prevent the risk of suicide among older adults with mild dementia and to provide health education and rehabilitation programs for mental health management [24]. Additionally, a non-pharmacological strategy such as multicomponent training may be an important means to enhance ADL functions in older adults with dementia [25]. Recently, the Korean government has also been making efforts to invest in various programs in the LTCS facility and offer customized services according to the severity of diseases.

Regarding the caregivers of older adults with dementia, the rate of suicide risk was lower when professional caregivers were used rather than family members or acquaintances. From the literature, we can infer that the reason for this is that patients' perception of being a burden and stress increase when family members or close neighbors are responsible for caregiving. In Korea, there are several cases of older adults suffering from dementia committing suicide in the early stages because of their inability to overcome the mental distress of being a burden on the family [26]. In addition, care by caregivers can also have a positive effect on the formation of relationships between the patient and the caregiver. Thus, the satisfaction of caregivers' self-care needs and behaviors, including ample sleep, social engagement

and support, and leisure activities, are also essential in the health care of patients with dementia [27, 28]. Systematic support for the formation of a relationship between dementia patients and family caregivers can have a positive effect on both the patients and family caregivers [29]. A Canadian study reported that a positive social relationship alone could reduce intentional self-harm among long-stay home care clients aged over 60 years [30]. Additionally, one reason for the lower risk of suicide when using professional caregivers rather than family members and acquaintances, relates to problems with the caregiver's expertise as well as the burden of support for family or acquaintances. Therefore, it is essential to develop a "specialized curriculum" focused on staff delivery standards and ensure mandatory training for unskilled nurses, as in Japan, to provide standardized services and establish the infrastructure for ascertaining the role of caregivers [31, 32]. Moreover, older adults with dementia and their caregivers can expect targeted improvements such as clinical knowledge of the disease, better communication between dementia patients and service providers, and more proactive care plans through systematic counseling and education for an acknowledged cognitive decline [33].

Second, an examination of the effects of LTCS intervention at the national level revealed that, among older adults with LTCl grading who need LTCS, the suicide rate of non-users was higher than that of LTCS users. Among users, by the type of LTCS, the suicide rate of home-service users was higher than that of facility service users. In other words, LTCS provided by the government had a positive effect on the prevention of suicide among older adults with dementia. This is consistent with the results of previous studies that the effects of a national system or community program could contribute to the mental health of dementia patients [34, 35]. Older people also experience depression as they age and feel isolated, especially when they perceive themselves as being burdensome to others [11, 12]. Thus, they have a lower suicide rate when they are protected in a facility and cared for in a space where communication with the people around them is relatively high.

Additionally, DID analysis of the effects of the LTCl system on older adults with dementia showed that the suicide rate among users of the system was significantly lower than that of non-users, depending on the services used. In other words, the use of LTCS has a positive effect on lowering the suicide rate among older adults with dementia. Therefore, the country's policy direction to increase access to LTCS might be the most appropriate direction. Furthermore, efforts are required to establish various programs and a care service culture within the LTCl system, as well as a quantitative increase in nursing facilities, to prevent suicide among older adults with dementia. Particularly, as in-home service users had the highest suicide rate, it is necessary to develop measures to ensure continuous management and protection by recognizing problems with long-term home care and establishing in-home monitoring systems by utilizing various apps and chatbots that have recently emerged.

Further, the suicide rate was higher after the expansion of the LTCS grading (after 2014) compared to that before the expansion (before 2014). Thus, there were no significant results regarding the relation between suicide rates before and after the expansion of the grading and whether the LTCS was used. The LTCl system has increased the accessibility of services for older adults with dementia by introducing a special dementia grade since 2014; however, no change in the suicide rate was observed in this study. This may

be caused by an increase in the inflow of older patients with dementia at high risk of suicide, who entered the system in the early stages of enhanced system security. In fact, in order to observe policy effects, in many policy studies, analysis is not conducted at the time when the scheme is introduced, to exclude the effect of amplified change due to the introduction [36]. There may be limitations due to the shorter observation duration of the system; therefore, continuous monitoring and research are needed to develop measures to prevent and manage patients with dementia in the future.

This study has several implications. It is meaningful as it is the first empirical study on suicide among older adults with dementia in South Korea. This study found that at the individual level, suicide rates were more statistically significant among men, older adults with mild dementia symptoms, no caregivers, or family/neighbor caregivers. It also confirmed that the use of LTCS could reduce the suicide rate of older adults with dementia, on the basis of longitudinal data from the NHIS's representative "Older Adults cohort DB," comprising data for about 14 years from 2002 to 2015.

However, the effect of enhancing the coverage by expanding the "dementia special grade" of LTCI was limited to a short-term observation over only two years, because the comparison is based on the situation in 2014, when the policy was expanded. As confirmed by individual-level analysis, a higher suicide rate was observed after strengthening the coverage of LTCI in 2014, due to improved accessibility for beneficiaries who are older adults with mild dementia and are, thus, at a high risk of suicide. Therefore, future research should undertake a continuous assessment of the plan from a long-term perspective. Nevertheless, the use of LTCS has strengthened the accessibility of the service for older adults with dementia and contributed to the prevention of suicide by providing care services, indicating the future policy direction. The study recognized the importance of management at the national level for the prevention of suicide among older adults with dementia and has made effective policy suggestions such as linking the LTCI system with the suicide prevention program.

Abbreviations

LTCI: Long-Term Care Insurance; LTCS: Long-Term care Service

Declarations

Acknowledgements

Not applicable.

Authors' contributions

Sungje Moon: Writing- Original draft preparation, Methodology, Data curation, Visualization. **Mankyu Choi:** Writing- Reviewing and Editing, Supervision. **Minsung Sohn:** Conceptualization, Writing- Original draft preparation, Supervision

Funding

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2018S1A5A8028924).

Availability of data and materials

The data that support the findings of this study are available from the National Health Insurance Service in South Korea but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the National Health Insurance Service.

Ethics approval and consent to participate

This population-based observational study was conducted and reported according to the Reporting of Observational Studies in Epidemiology guidelines. The study protocol was approved by the Institutional Review Board of Korea University (IRB No. KUIRB-2018-0014-01) and the Health Insurance Review and Assessment Service. The need for informed consent was waived because the data analyses were performed retrospectively using anonymized data derived from the South Korean National Health Insurance Service (No. NHIS-2018-2-060) database.

Consent for publication

Not applicable.

Competing interests

The Authors declare that there is no conflict of interest.

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Figures

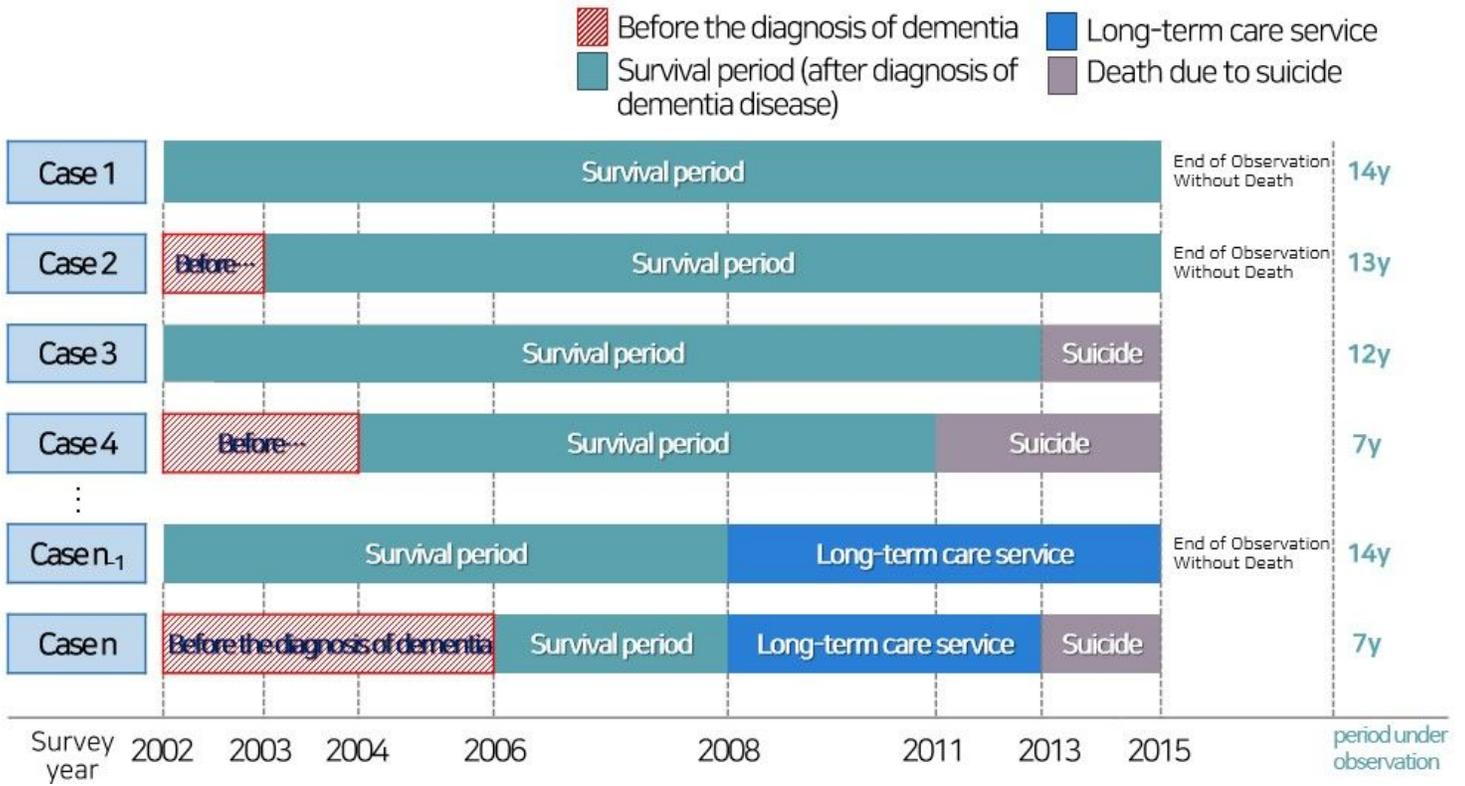


Figure 1

The structure of study sample

Supplementary Files

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- [Appendix1.docx](#)