



Incidence Rates of Disability and Its Associated Factors among Korean Community-Dwelling Older Adults

*Seonho KIM¹, *Myoungsuk KIM², *Dallong HAN³*

1. Department of Nursing Science, College of Medicine, Chungbuk National University, Cheongju-Si, Republic of Korea

2. College of Nursing, Kangwon National University, Chuncheon-Si, Republic of Korea

3. Department of Nursing, College of Health & Medical Sciences, Cheongju University, Cheongju-Si, Republic of Korea

*Corresponding Authors: Emails: cellylife@gmail.com; dhan@cju.ac.kr

(Received 11 Jan 2019; accepted 20 Mar 2019)

Abstract

Background: We aimed to identify incidence rates of disability and its associated factors among Korean community-dwelling older adults.

Methods: The sample included 1,739 Koreans aged over 65 yr from the Korean Longitudinal Study of Aging (2006-2016) who reported no limitations in activities of daily living (ADL) or instrumental activities of daily living (IADL) at baseline (2006) and had complete data for other covariates. ADL, IADL, socio-demographic, lifestyle, and health-condition data were collected and analyzed using multiple logistic regression models.

Results: The 10-yr incidence rates of ADL and IADL disability in subjects with no disability at baseline were 11.6% and 21.6%, respectively. After adjusting for socio-demographic, lifestyle, and health-condition factors, the incidence of ADL disability was higher in women (odds ratio [OR] =1.418, 95% confidence interval [CI]=1.102-2.613) and increased with age (OR=1.170, 95% CI=1.133-1.208), multi-morbidity (OR=1.194, 95% CI=1.015-1.406), and obesity (OR=1.563, 95% CI=1.057-2.311). It decreased in subjects living alone (OR=0.531, 95% CI=0.328-0.856). The incidence of IADL disability increased with age (OR=1.131, 95% CI=1.102-1.161), multi-morbidity (OR=1.199, 95% CI=1.054-1.365), and cognitive disability (OR=1.422, 95% CI=1.083-1.866) and decreased for subjects living alone (OR=0.484, 95% CI=0.328-0.715) and with overweight (OR=0.725, 95% CI=0.532-0.988).

Conclusion: Incidence rates of disability differed considerably based on socio-demographic, lifestyle, and health-condition factors. These results suggest the importance of identifying factors that can decrease the risk of disability in this group and of prevention efforts in populations with a higher disability risk.

Keywords: Disability; Older adults; Korea

Introduction

The population of elderly individuals is increasing worldwide due to the development of medical technology and the consequent extension of longevity (1). In Korea in 2000, the elderly population accounted for >7% of the total population; in 2017, this value rose to over 14% and is expected to be over 20% in 2026. This is the fastest rate of increase of any national elderly population in the

world (2). This increase in the proportion of the elderly population ratio has resulted from a decrease in birthrate and an increase in life expectancy (3). At the same time, the risk of disability with increased old age, from both chronic degenerative disease and the aging process itself, is also increasing (4).

Disability in elderly individuals not only inhibits



human independence but also increases dependence on others' help for survival, which is the main reason for older individuals' decreasing quality of life (5). This also causes significant social burdens, such as the need for family support and increasing medical costs (6). In the case of Korea facing rapid aging, an increase in human and financial support is required with an increase in older individuals with disabilities.

The countermeasure to the social burden of elderly disability is preemptive prevention of long-term disability and dependence on others by rapid recovery from temporary functional disability and maintenance of activity of daily living (ADL) (4). Comprehensive support before the incidence of disability and prevention of deterioration, as well as rehabilitation after the incidence of disability, are necessary (7). A study on risk factors related to the incidence of disability in the older population should be conducted in detail.

Elderly disability is known to be correlated to exercise (8, 9), smoking (10), drinking (11), chronic disease and multi-morbidity (12, 13), obesity (14, 15), sex (16, 17), age (4, 15), and living arrangements (15, 18, 19). Modifiable risk factors, such as exercise and obesity, are important for the development of interventions for the prevention of elderly disability (8), and unmodifiable risk factors are very important for selecting subjects for intervention and for developing a policy for disability prevention.

For these reasons, studies on the factors affecting the incidence of elderly disability have been actively conducted in Western countries. However, Korean studies have been based on surveys on the actual conditions of elderly disability (ADL and instrumental activities of daily living [IADL]) (20, 21) and cross-sectional studies about elderly disability and depression, subjective health status, and quality of life (22-24); there have been very few studies on the incidence of elderly disability in Korea. These have been short-term longitudinal studies (about 2 yr) (4, 9), which were not extended to longer terms. Thus, a Korean study on the factors affecting the incidence of elderly disability is urgently necessary, as the rate of incidence has been shown to differ by race (25).

Thus, we aimed to provide basic data for future prevention of the incidence of elderly disability. We performed this study through examination of the incidence rates of disability and factors that affect the incidence of disability in older Korean individuals by using the Korean Longitudinal Study of Aging (KLoSA) database.

Methods

Sample and design

Participants were selected from KLoSA, an ongoing longitudinal panel survey. KLoSA conducted a multistage stratified cluster sampling based on 15 geographical areas and housing types across the nation to create a national representative sample of Koreans aged 45 yr and older. The survey began in 2006, and follow-up interviews were conducted every 2 years (in 2008, 2010, 2012, 2014, and 2016). KLoSA is a national public database; before data collection, all participants provided written informed consent. Detailed information on the sampling design and survey approach can be found at the KLoSA website.

Our study included participants aged above 65 yr who reported no limitations in ADL or IADL at baseline (2006) and had complete data on other covariates. Of the 4,164 initially selected participants, 884 reported one or more ADL or IADL limitations, and 2,937 had missing information on covariates. The final sample size was 2,937. Over the follow-up period, there were 704 deaths, and 494 participants did not provide follow-up data. Thus, our analytic sample comprised 1,739 participants. Compared with the analytic sample, those who did not follow up were significantly more likely to be older, male, living alone, less well-educated, current smokers, not regularly exercising, and in poor subjective health and to have more chronic diseases, cognitive and visual impairment, and an unhealthy body mass index (BMI) state (underweight or obesity).

Measurement

This study extracted factors from data that were collected by KLoSA known to affect ADL in Korean and foreign studies. Disability, the dependent

variable in this study, was defined by ADL and IADL using techniques developed (26). To reflect older Korean individuals' environment and culture. ADL consisted of seven items, including dressing, washing, bathing, eating, ambulating, toileting, and sphincter control. IADL includes 10 items: grooming, housework, preparing meals, laundry, going outside, using public transport, shopping, managing money, using the telephone, and taking medicine. When "dependent" was the answer to any one of the items, the patient was defined as having a disability.

The independent variables were used socio-demographic variables, lifestyle variables, and health condition. Socio-demographic variables included age (year), sex (men vs. women), living arrangements (living alone vs. with family), residential area (rural vs. urban), and education level (0-6 yr of schooling vs. 7 or more yr of schooling). Lifestyle variables assessed four health behaviors, including smoking (never smoked vs. ex-smoker vs. current smoker), current alcohol drinking (yes vs. no), regular exercise (yes vs. no), and BMI. BMI was calculated as the ratio of weight in kilograms to height in meters squared (kg/m^2). Four BMI categories were defined according to Asian criteria (27): underweight ($\text{BMI} < 18.5 \text{ kg}/\text{m}^2$), normal ($18.5 \leq \text{BMI} < 23.0 \text{ kg}/\text{m}^2$), overweight ($23.0 \leq \text{BMI} < 25.0 \text{ kg}/\text{m}^2$), and obesity ($25.0 \text{ kg}/\text{m}^2 \leq \text{BMI}$). Health conditions included subjective health status (good vs. poor), number of chronic diseases, cognitive impairment (yes vs. no), visual impairment (yes vs. no), and depressive symptoms (yes vs. no). Subjective health status was assessed using responses to the question, "How do you regard your health status?" These were classified into "good" (including responses of "very good," "somewhat good," and "fair") and "poor" (including responses of "poor," "somewhat bad," and "very bad") categories. Chronic diseases included hypertension, diabetes, cancer, chronic pulmonary disease, liver disease, heart disease, cerebrovascular disease, and arthritis. Cognitive impairment was classified into normal and cognitive disability groups by standards according to sex, age, and education level of the subject by using the mini-mental state examination in the Korean version of the Consortium to Establish a Registry for

Alzheimer's disease (CERAD) assessment packet (MMSE-KC) (28). Ten of 20 items of Radloff's (1977) Center for Epidemiological Studies Depression Scale (CES-D) were used to measure depression, and those with a score over 7 points were classified into the depression group (29).

Statistical analysis

SPSS Version 22.0 (IBM Corp., Armonk, NY, USA) was used for all statistical analyses. We conducted *t*-tests and chi-square tests to examine the statistical significance of the increase in the incidence of disability from baseline (2006) to 10-yr follow-up (2016) characteristics. A multiple logistic regression analysis was conducted to examine the factors affecting the incidence of disability by setting 2016 disability events as the dependent variable and related variables as independent variables. The statistical significance was set at $P < 0.05$.

Results

Table 1 shows the baseline characteristics of the subjects in our sample. Mean age was 70.5 ± 4.6 yr, 59.2% were women, 14.0% lived alone, 31.9% lived in a rural area, 68.4% had 0-6 yr of schooling, 76.0% never smoked, 29.9% were current alcohol drinkers, 36.2% were exercising regularly, 63.3% were in subjective good health, 33.3% had cognitive impairment, 9.8% had visual impairment, 12.2% had depressive symptoms, and 22.7% had obesity. At the 10-yr follow-up point, 202 (11.6%) and 376 (21.6%) participants were certified as having disability with ADL and IADL, respectively. ADL had a significant differences by age, sex, education level (all $P = 0.001$), subjective health status ($P = 0.014$), number of chronic diseases ($P = 0.027$), cognitive impairment ($P < 0.001$), visual impairment ($P = 0.002$), and BMI ($P = 0.022$). IADL incidence had significant differences by age ($P < 0.001$), sex ($P = 0.040$), living arrangements ($P = 0.035$), education level ($P = 0.014$), subjective health status ($P = 0.004$), cognitive impairment ($P < 0.001$), visual impairment ($P = 0.019$), and BMI ($P = 0.028$).

Table 1: Incidence of disability by baseline characteristics (n=1,739)

Variables	Baseline ADL			P*	10-year follow-up IADL		
	Non disability (n=1,537)	Disability (n=202)			Non disability (n=1,363)	Disability (n=376)	P*
	Mean \pm standard deviation or %				Mean \pm standard deviation or %		
Total	100.0	88.4	11.6	-	78.4	21.6	-
Age (years)	70.5 \pm 4.6	70.0 \pm 4.2	73.8 \pm 5.7	<0.001	69.9 \pm 4.1	72.7 \pm 5.4	<0.001
Women	59.2	57.6	71.3	<0.001	58.0	63.8	0.040
Live alone	14.0	14.2	12.4	0.486	14.9	10.6	0.035
Rural residence	31.9	31.7	33.2	0.671	32.3	30.3	0.470
0-6 years of schooling	68.4	67.1	78.2	0.001	67.0	73.7	0.014
Smoking status							
Never smoked	76.0	75.1	82.2	0.057	75.0	79.5	0.179
Ex-smoker	10.7	11.3	6.4		11.3	8.8	
Current smoker	13.3	13.6	11.4		13.7	11.7	
Current alcohol drinking	29.9	31.2	29.8	0.101	30.7	26.9	0.146
Regular exercise	36.2	36.8	31.7	0.153	37.1	33.2	0.174
Subjective good health status	63.3	64.3	55.4	0.014	65.1	56.9	0.004
Number of chronic diseases**	0.97 \pm 0.99	0.94 \pm 0.98	1.20 \pm 1.05	0.027	0.92 \pm 0.98	1.15 \pm 1.01	0.119
Cognitive impairment	33.3	31.7	45.5	<0.001	30.2	44.7	<0.001
Visual impairment	9.8	9.0	15.8	0.002	9.0	13.0	0.019
Depressive symptoms	12.2	12.0	13.4	0.587	12.2	12.2	0.977
Body mass index							
Underweight	4.5	4.4	5.4	0.022	4.4	4.8	0.028
Normal weight	45.4	45.7	43.1		44.6	48.6	
Overweight	27.4	28.2	21.3		29.1	21.3	
Obesity	22.7	21.7	30.2		21.9	25.3	

ADL, activities of daily living; IADL, instrumental activities of daily living

* Chi-square test or t-test comparing the non (I)ADL disability and (I)ADL disability groups

** Chronic diseases include hypertension, diabetes, cancer, chronic pulmonary disease, liver disease, heart disease, cerebrovascular disease, arthritis

Table 2 presents the results of the logistic regression model for the incidence of disability. ADL incidence increased among women (odds ratio [OR]=1.418, 95% [CI]=1.002-2.613) and by higher age (OR=1.170, 95% CI=1.133-1.208), number of chronic diseases (OR=1.194, 95% CI=1.015-1.406), and obesity (OR=1.563, 95% CI=1.057-2.311), and it decreased for subjects living alone (OR=0.531, 95% CI=0.328-0.856).

IADL incidence increased with age (OR=1.131, 95% CI=1.102-1.161), number of chronic diseases (OR=1.199, 95% CI=1.054-1.365), and cognitive impairment (OR=1.422, 95% CI=1.083-1.866), and it decreased for subjects who lived alone (OR=0.484, 95% CI=0.328-0.715) or were overweight (OR=0.725, 95% CI=0.532-0.988).

Table 2: Influencing factors on incidence of disability, as tested by multiple logistic regression analysis

<i>Variables</i>	<i>ADL disability incidence</i>			<i>IADL disability incidence</i>		
	<i>OR</i>	<i>95% CI</i>	<i>P</i>	<i>OR</i>	<i>95% CI</i>	<i>P</i>
Age (yr)	1.170	1.133-1.208	<0.001	1.131	1.102-1.161	<0.001
Women	1.418	1.002-2.613	0.049	1.124	0.790-1.600	0.516
Living alone	0.530	0.328-0.856	0.010	0.484	0.328-0.715	<0.001
Rural residence	1.153	0.813-1.635	0.425	0.877	0.666-1.155	0.349
0-6 years of schooling	1.037	1.679-1.583	0.868	0.976	0.713-1.337	0.881
Smoking status (ref=never smoked)						
Ex-smoker	0.822	0.408-1.656	0.583	0.776	0.480-1.254	0.300
Current smoker	1.537	0.869-2.719	0.139	1.051	0.686-1.611	0.818
Current alcohol drinking	0.751	0.486-1.160	0.197	1.069	0.782-1.462	0.676
Regular exercise	1.049	0.734-1.500	0.792	0.981	0.745-1.290	0.889
Subjective good health status	1.007	0.705-1.439	0.969	0.917	0.694-1.211	0.542
Number of chronic diseases	1.194	1.015-1.406	0.033	1.199	1.054-1.365	0.006
Cognitive impairment	1.104	0.779-1.565	0.577	1.422	1.083-1.866	0.011
Visual impairment	1.577	0.985-2.522	0.058	1.258	0.850-1.861	0.252
Depressive symptoms	1.041	0.646-1.677	0.869	0.948	0.648-1.387	0.785
Body mass index (ref=normal weight)						
Underweight	1.114	0.535-2.318	0.773	0.900	0.498-1.626	0.729
Overweight	0.931	0.617-1.404	0.732	0.725	0.532-0.988	0.042
Obesity	1.563	1.057-2.311	0.025	1.035	0.758-1.414	0.827

OR, odd ratio; CI, confidence interval

ADL, activities of daily living; IADL, instrumental activities of daily living

Discussion

This study is the first longitudinal study to investigate the incidence and influencing factors of elderly disability that are necessarily accompanied by the increase in the elderly population in Korea, the fastest aging population in the world.

The results of this study showed that 11.6% and 21.6% of elderly individuals had ADL and IADL disabilities, respectively, after 10 yr from a baseline without any disability. This disability incidence was similar to or a little bit lower than the results of previous studies (4,9). These differences could have resulted from differences in race, age, follow-up period, and socio-demographic factors.

There have been several studies about the prevalence of disability in the case of Korea, but direct comparison between these and our study is limited, as the prior studies lack data on the incidence

of disability through long-term follow-up. The risk of incidence of disability has been known to increase with aging (3,4,15), suggesting the necessity for further studies on the trends regarding the incidence of disability in elderly individuals. Such studies can be used for policy and resource allocation for the prevention of disability at the national and community levels.

We found that factors affecting the incidence of ADL disability incidence included age, sex, living arrangement, number of chronic diseases, and BMI; and it found that age, living arrangement, number of chronic diseases, cognitive impairment, and BMI affected IADL disability incidence. We found that, at the 10-yr follow-up point, older individuals and those with multi-morbidity were more likely to have experienced an onset of ADL and IADL disabilities. The increase of disability incidence risk at an advanced age corresponded to

previous studies' results (4,8,19), suggesting that an active, national-level effort to prevent elderly disability incidence is necessary in Korea, where the elderly population is increasing at the fastest rate in the world. Many previous studies (12,13) reported chronic disease as a risk factor for disability incidence, since both chronic disease itself and its consequent physical and social activity restrictions can result in disability. A favorable prognosis can be expected if chronic disease is prevented in the early stages or if it is well managed after its occurrence, which increases the importance of chronic disease management in elderly individuals. Furthermore, chronic disease increases depression, and it negatively affects subjective health status and quality of life. This suggests the importance of chronic disease management for the maintenance of the quality of life in elderly individuals. Thus, interventions to prevent chronic disease itself or methods such as home visit services and exercise programs to prevent serious illness arising from chronic disease should be devised to reduce the social burden arising from elderly disability incidence (30,31).

There is disagreement among the results of prior studies into the relationship between living arrangements and disability. Some studies reported that older individuals living alone had a higher risk of disability compared to those living together (18,19,32), but other studies reported that either living alone is not related to disability incidence risk or it even reduces the risk (33,34). In our study, subjects living alone showed decreased disability incidence risk compared with those living with others. This result is assumed to have resulted from the fact that individuals who are more independent with regard to personal finances and physical function also showed a greater tendency to live alone than with family (such as spouses). Furthermore, our study only divided living arrangements into "living alone" and "living with others"; it is necessary to study disability incidence risks according to various family compositions, which might raise important implications especially for policy makers working on the social support system.

According to this study, women had a 1.418-times

higher ADL disability incidence risk than men, which corresponded to the results of previous studies (16,17,35). A follow-up study with subjects over 60 yr old over a 6-yr period, reported that women had a higher ADL disability incidence risk, but not a higher IADL disability incidence risk (35). Older women had a higher ADL disability incidence risk than older men (17). These results may have resulted from the fact that women usually live longer than men, have more chronic diseases, and are more socially vulnerable in general (36), all of which increase the disability incidence risk compared with men.

In this study, poor cognitive function disability at baseline was linked to a higher IADL disability incidence risk. The relationship between cognitive function disability and disability incidence has been suggested by many previous studies. The better the MMSE score was at baseline, the lower the disability incidence was after follow-up (37,38). However, future sex-difference studies are necessary, since a six-year follow-up study with subjects over 60 yr old, reported that there was a relationship between cognitive function and disability incidence only in men (35). Furthermore, future replicatory studies are necessary, as prior studies have reported that cognitive impairment is linked to an increase in ADL disability incidence, despite no significant relationship between cognitive function and ADL disability incidence risk in our study.

Most longitudinal studies have found that older adults with obesity are more likely to have experienced incidences of ADL disability in the follow-up period than those with normal weight (4,38,39), and our study confirmed these findings. In our study, BMI was positively correlated to ADL and IADL disability incidence risk. Obesity showed the highest odds ratio of factors affecting ADL incidence, and elderly adults with obesity showed a 1.563-times higher ADL disability incidence risk than subjects of normal weight, corresponding to the results of prior studies (4,35,39,40). The reason why obesity increases ADL disability incidence risk is that obesity is a chronic disease risk factor for conditions including cardiovascular disease, stroke, arthritis, and other degenerative diseases; these chronic diseases can increase the risk

of disability (41). Thus, obesity management for elderly individuals is important to reduce ADL disability incidence risk, and intervention programs for older individuals with obesity should be considered necessary. However, according to this study, overweight individuals had a decreased risk of IADL disability incidence. This did not correspond to prior studies (35,42), which reported that being overweight did not correlate to disability incidence. Future studies should identify the reasons for this, which are not clear despite hypothesis of racial differences corresponding to different BMI cutoff points.

There were some limitations to our study. First, this study was a secondary analysis from existing data; thus, not all variables that were known to affect disability incidence risk for older individuals were included in our analysis. In particular, this study could not include various socio-demographic and health-related attitude variables that have been known to affect disability incidence risks of older individuals in previous studies conducted inside and outside Korea. Future study should include variables (possible confounding factors) that can affect disability incidence. Second, the disability measures that were used in this study were self-reported, raising the possibility of differences in actual measured data. However, there should be no problem in analyzing the results of our study, as a previous study reported a concurrence between self-reported data and medical diagnosis (35). Despite these limitations, our study has great significance, as it is the first 10-yr longitudinal follow-up study for older Koreans without any disability at baseline. In contrast, most prior studies about elderly disability in Korea were cross-sectional.

Conclusion

Incidence rates of disability are considerably different based on socio-demographic and health-related behavioral factors, including age, sex, living arrangement, cognitive impairment, chronic diseases, and BMI. Our results suggest that populations with higher disability incidence risks should

concentrate on prevention efforts as well as on efforts to improve factors that increase the risk of disabilities in the older population.

Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

No external funding was used for this study.

Conflicts of interest

The authors declare no conflicts of interest.

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