The association between community social supports and onset of dementia in older Japanese:

A multilevel analysis using the JAGES cohort data

（高齢者における地域レベルの社会的サポートと認知症発症との関連：

JAGES 縦断データを用いたマルチレベル分析）

千葉大学大学院医学薬学府

先端医学薬学専攻

（主任：岩間　厚志教授）

宮國　康弘

Abstract

Background

There has been an increase in the number of people with dementia in recent times. However, no study has examined the association between community-level social support and the onset of incident dementia using multilevel survival analysis.

Methods

We analyzed data from 15,313 community-dwelling adults aged 65 years or older without long-term care needs. The association between community-level social support and onset of incident dementia was examined using the Japan Gerontological Evaluation Study, a prospective cohort study established in 2003 in Japan. Incident dementia was assessed on the basis of Long-term Care Insurance records, spanning 3436 days from the baseline survey.

Results

During the 10-year follow-up, onset of incident dementia was seen in 1,776 adults. Among older people, a 1 percentage point increase in community-level social support in the form of receiving emotional support was associated with about a 4% reduction in the risk of incidence of onset of dementia regardless of socio-demographic variables and health conditions.

Conclusions

Community-level social support in the form of receiving emotional support was associated with lower level of incident dementia.

Key words: Cognitive decline, Population Health, Social Epidemiology

Introduction

Dementia is one of the most important health problems, especially in older populations. The number of people with dementia across the world is expected to increase to 66 million by 2030, and to 131 million by 2050.[1] In Japan, the number of dementia patients was estimated to be 4.62 million in 2012, and the number is expected to be about 7 million in 2025, suggesting that one in about five persons aged 65 or older may become afflicted with dementia.[2]

Currently, no effective treatment is available to cure dementia. Therefore, identification of modifiable risk factors and prevention measures are important to delay or prevent the onset of dementia.[3] Previous studies indicated that risk factors for dementia include genetic, vascular, and lifestyle-related factors,[4-9] such as advanced age, being female, low education level, poor health conditions, smoking, and heavy drinking. Another potentially important modifiable risk factor for incident dementia is absence of good social relationships. A previous study suggested that social activity engagement and a rich network of activity within close relationships in elderly people would protect them from dementia.[6]

The definition and operationalization of social relationships differs across studies. Social relationships may include social participation, social networks, social support, and so on. With regard to social relationships, social support activity might be a significant protective factor with respect to patterns of cognitive aging.[10] Social support has been

categorized as four types: receiving and providing emotional support, and receiving and

providing instrumental support.[11] These types of individual-level social supports were

associated with better health. For example, providing (giving) emotional and instrumental

social support to people who are not family members was associated with fewer depressive

symptoms compared with no social support.[12] Providing emotional support to friends,

relatives, and neighbors and instrumental support to spouses was associated with lower risk

of mortality.[13] Receiving emotional support was associated with cognitive function.[10]

Moreover, social support exchanges with co-resident family members were associated with

incident dementia.[14]

In addition to individual-level social factors, community-level social relationships such as

social capital had also been investigated to assess the risk of incident functional disability.

Social capital was defined as "resources that are accessed by individuals as a result of their

membership of a network or a group" in a community.[15] In a previous study, lower

community-level social capital (i.e., rate of mistrust) was associated with a higher incidence

of functional disability among older women.[16] However, as far as we know, no studies have

examined the effects of community-level social supports on the risk of incident dementia.

Our objective of the study was to examine prospectively the association between community-

level social supports and dementia, using multilevel survival analysis.

Methods

Sample

The data were obtained from the Japan Gerontological Evaluation Study (JAGES), a prospective cohort established in 2003 in Japan by the Center for Well-being and Society of Nihon Fukushi University in Aichi.[17] The study was conducted in six municipalities that covered the entire southern part of the Chita peninsula in Aichi Prefecture, Japan. On October 1, 2003, there were 276,208 people living in the six municipalities, 18.0% of whom were aged 65 years or older.[15] The average number of residents in the 44 school districts in our analysis was thus around 6300. The sample was restricted to those aged 65 years or older and not receiving public long-term care insurance benefit because of physical or cognitive disability at baseline. From the municipalities, 33,152 community-dwelling people aged 65 years or older were selected randomly. From this sample population, 15,313 people responded to the baseline survey (response rate =52.1%)[14]. In this study, respondents who had difficulty in performing basic activities of daily living due to disabilities, or provided no information at baseline (n=579), no information on social support (n=1359), and no school district code (n=2,343) were excluded. Finally, 11,032 subjects (5,405 men and 5,627 women) were included in the analysis. The JAGES protocol was reviewed and approved by the ethics committee on Research of Human Subjects at Nihon Fukushi University.

Follow-up

The JAGES Project focused on factors associated with health status, functional decline, or cognitive impairment among non-institutionalized older individuals in Japan. In Japan, there is a long-term care insurance system. The system covers both institutional and community-based caregiving. Individuals aged 65 years or older are eligible for benefits based strictly on physical and mental disability. The follow-up started on November 1, 2003. Data on onset of dementia until the end of follow-up (28 march 2013) were obtained from all six municipalities.

Outcome Variable

Dementia is ranked from I to IV and M through categorization under the Activities of Daily Living Independence Assessment Criteria for Elderly Individuals with Dementia. The Degree of Autonomy in the Daily Lives of Elderly Individuals with Dementia Scale, developed by the Ministry of Health, Labour and Welfare of Japan, measures the degree of interference in one's ability to perform daily living activities because of symptoms, behaviors, or communication difficulties caused by dementia on a scale that is scored as I to IV and M.

This scale was validated by demonstrating its high correlation with the Mini Mental State Evaluation.[14,18] Rank I means that the patient suffers from a certain cognitive decline but is able to carry out activities of daily living almost independently in the domestic and

social spheres. Rank II means that the patient displays some symptoms/behaviors and communication difficulties that may hinder their daily activities, but can be independent if someone takes care of them. Rank III means that the patient occasionally displays communication difficulties or symptoms/behaviors that hinder daily activities, thus requiring care. Rank IV means that the patient frequently manifests difficulties communicating or symptoms/behaviors that hinder their daily activities and constantly requires care. Rank M means that the patient displays significant mental symptoms, problematic behaviors, or severe physical illnesses and requires specialized medical care.[19,20]

Explanatory variable

To measure community social supports, individual-level baseline data were aggregated for each of the 44 school-based districts. A community social support indicator was created by aggregating individual-level social support responses among each school district. In Japan, a school district (primary school) is defined as the primary residential spatial unit of people in rural areas. In a general way, a school district represents a geographical scale in which the older people can travel easily by foot or bicycle.[21]

Individual-level social supports were assessed on the basis of four dimensions using the Two-Way Social Support Scale.[12] The four types included (a) receiving emotional support, (b) providing emotional support, (c) receiving instrumental support, and (d)

providing instrumental support.

A single item measured each support: "If you or others needed extra help in daily life, whom could you count on to help or to be helped by? (a) Receiving emotional support was defined as a person who hears a respondent's complaints or worries (Question: "Do you have someone who listens to your concerns and complaints? Circle all that apply. Options include family living together, separated children and relatives, acquaintance/friends/neighbors"). (b) Providing emotional support was defined as a person who shares his/her complaints or worries with the respondent (Question: "Do you listen to someone's concerns or complaints? Circle the numbers of all the answers that apply. Options include family living together, separated children and relatives, acquaintance/friends/neighbors"). (c) Receiving instrumental support was defined as a person who would nurse or take care of the respondent were the respondent ill in bed for several days (Question: "Do you have someone who looks after you when you are sick and confined to a bed for a few days? Circle the numbers of all the answers that apply. Options include family living together, separated children and relatives, acquaintance/friends/neighbors"). (d) Providing instrumental support was defined as a person whom the respondent would nurse or take care of were he/she ill in bed for several days (Question: "Do you look after someone when he/she is sick and confined to a bed for a few days? Circle the numbers of all the answers that apply. Options include family living together, separated children and relatives,

acquaintance/friends/neighbors").

The percentage of individuals who answered each item was considered when ascertaining levels of social support. Responses to survey items on the four dimensions social supports were aggregated for each of the 44 local districts and used as our indicators for community social supports.[12]

Covariates

Other explanatory variables included the following: sex (male, female), age (65-69 years, 70-74 years, 75-79 years, 80-84 years, and 85 years or older), living alone (no, yes), marital status (married, widowed or divorced, never married, other/missing), education (more than 13 years, 10-12 years, 6-9 years, less than 6 years, other/missing), present illness (no, yes, missing), depressive symptoms measured by the Geriatric Depression Scale (GDS-15) (no depression 0-4 point, mild depression 5-9 point , depression 10-15 point, missing), smoking status (never, former, current, missing), alcohol consumption (no, do not drink every day, drink every day $\leqq$ 35 g/day, drink every day $>$35 g/day, missing), individual social supports.

Statistical analysis

The data included 11,032 individuals (first level) nested in 44 local districts (second level).

The multilevel analysis framework assumes that an individual health outcome is partly

dependent on the districts where individuals live. Multilevel models estimate the variation in

the outcome between districts (random effects) and the effects of community-level variables

on the outcome, adjusting for individual compositional characteristics (fixed effects). We

used multilevel survival analysis to calculate the hazard ratio (HR) and 95% confidence

interval (CI) for the onset of dementia during the follow-up period. HR of social support

variables was estimated for a 1% change in the percentages of aggregated social supports. All

four community-level social support indicators were concurrently adjusted in the analyses.

Furthermore, three sensitivity analyses were conducted, excluding (i) the one year after

baseline, (ii) the two years, and (iii) the three years similarly. All analyses were performed

using STATA SE version 13 (Stata Corp., College Station, TX, USA).

Results

During 9.4 years of follow-up (mean=7.9 person-years; standard deviation (SD) =2.5 person-

years), onset of dementia was observed in 1,776 individuals (16.1%).

Table 1 shows the baseline characteristics and incidence rate of dementia per 1,000

person-years. The incidence rate of dementia was higher in those who were female, older,

living alone, widowed or divorced, having less than 6 years of education, having present

illness, having a higher score on GDS-15, who were non-alcohol consumers, who were not

receiving emotional support, not providing emotional support, and not providing instrumental support compared with each counterpart category.

Table 2 shows the mean (SD), median, range, and correlation matrix of the community-level social support indicators among 44 districts. Correlation coefficients ranged from -0.11 to 0.44. The average proportion of community level receiving emotional support was 89.9%, with a range from 82.7% to 93.5%. The proportion of community level receiving emotional support was moderately correlated with the proportion receiving instrumental support (0.44).

Table 3 shows the results of multilevel survival analyses (model 1) for the onset of incident dementia with three sensitivity analyses models (model 2, 3, and 4). Regarding community-level social supports, in model 1, significant association was observed between onset of incident dementia and community level receiving emotional support (HR=0.96; 95% CI=0.94-0.99). In contrast, there were no significant associations between onset of incident dementia and other community-level social supports. In model 2 of a sensitivity analysis (excluding 1 year after baseline), there remained significant associations between the onset of incident dementia and community level receiving emotional support (HR=0.97; 95% CI=0.94-0.99). Model 3 (excluding 2 years after baseline) and model 4 (excluding 3 years after baseline) showed almost the same results as models 1 and 2. Regarding individual-level social supports, in model 1, the incidence of dementia was significantly associated with community-level

emotional support (HR=0.83; 95% CI=0.73-0.94) and instrumental support (HR=0.83; 95% CI=0.73-0.94).

Discussion

To our knowledge, this is the first study to assess community-level social supports using multilevel survival analysis for the onset of dementia in a large sample of older community-living adults. Living in a community with higher community-level social supports was prospectively associated with lower incidence of onset of dementia within about 10 years, although only one of the four community-level social support indicators showed significant association with dementia. The results of this study may have public health implications. Among older people, a 1 percentage point increase in community-level receiving emotional support was associated with about a 4% reduction in the risk of incidence of onset of dementia regardless of socio-demographic variables and health conditions.

As for individual-level social supports, providing social supports was significantly associated with a lower risk for incident dementia compared with not providing social support. A previous study indicated that individual-level providing (emotional and instrumental) social supports might be a risk factors for depression.[12] People who were providing social supports might be less likely to become dementia.

In the present study, among the four community social supports, only community-

13

level emotional support affected the onset of incident dementia even after adjustment for individual-level social supports. It is thought that there are two possibilities as to whether the association of only community-level emotional receiving support was accepted. First, a community where people received high emotional support from each other might be a place where elderly people were not likely to feel lonely. A previous study indicated that feelings of loneliness predicted the onset of dementia.[22]

Second, in areas rich in community-level emotional receiving support, there may be elderly people with good relations with their children. A previous study indicated that positive experiences social supports from children predicted the onset of dementia.[23] In this study, social support was assessed on the basis of three questions: 'How much do they really understand about the way you feel about things?' 'How much can you rely on them if you have a serious problem?' and 'How much can you open up to them if you need to talk about your worries?' A place where many people are receiving emotional support may have good human relationships. Therefore, a community-level indicator of receiving emotional support may be only associated with onset of incident dementia.

Community social support may be an element of social capital or community-level social relationships. For this reason, several plausible pathways between community-level receiving emotional support and onset of incident dementia were shown in a present study.

First, community level social support may affect individual health by influencing health-related behaviors through the promotion of more rapid diffusion of health information, or by increasing the probability that healthy norms of behaviors are adopted, and by exerting social control over health-compromising behaviors. Second, social supports may affect health by improving access to local service and amenities. Access to services, such as transportation, parks and recreation spaces, and community centers, could positively promote social participation among older people and thereby limit or delay the onset of disability. Third, community social supports may promote mental health by reducing psychological distress. Fourth, communities with higher community level social support produce more egalitarian patterns of political participation, resulting in the implementation of policies ensuring the security of all members.

Several limitations to the present study warrant mention. First, The 52.1% response rate to the survey may have reduced the generalizability of our findings. Second, no information was available as to the kind of dementia (e.g. Alzheimer's disease, dementia with Lewy bodies, or cerebrovascular dementia). Third, study subjects were all taken from a prefecture in Japan. That is, our sample was not a representative sample of older people in Japan. Our findings may not generalize to urban areas or neighborhoods with different population characteristics. Fourth, we did not focus on other community-level social relationships, such as social capital, in the present study. We will assess further wider range of

community-level factors in the future study.

Conclusions

This prospective cohort study found that a higher level of community-level social

support was associated with a lower onset of incident dementia after adjustments for

individual-level social supports in older adults, although only one community-level social

support indicator, which is a community aggregated value of receiving emotional support,

showed significant association with the onset of dementia. The present study might suggest

that community-level social support receiving emotional support was associated with lower

level of incident dementia.

Acknowledgements

References

1. Prince MJ. *World Alzheimer Report 2015: The Global Impact of Dementia: An Analysis of Prevalence, Incidence, Cost and Trends.* Alzheimer's Disease International; 2015.

2. Ministry of Health Law. 2017; http://www.mhlw.go.jp/file/06-Seisakujouhou-12300000-Roukenkyoku/0000183161.pdf. Accessed November 18, 2017.

3. Middleton LE, Yaffe K. Promising Strategies for the Prevention of Dementia. *Arch Neurol.* 2009;66(10):1210-1215.

4. Patterson C, Feightner JW, Garcia A, Hsiung G-YR, MacKnight C, Sadovnick AD. Diagnosis and Treatment of Dementia: 1. Risk Assessment and Primary Prevention of Alzheimer Disease. *CMAJ.* 2008;178(5):548-556.

5. Gao S, Hendrie HC, Hall KS, Hui S. The Relationships between Age, Sex, and the Incidence of Dementia and Alzheimer Disease: A Meta-analysis. *Arch GenPsychiatry.* 1998;55(9):809-815.

6. Fratiglioni L, Paillard-Borg S, Winblad B. An Active and Socially Integrated Lifestyle in Late Life Might Protect Against Dementia. *Lancet Neurol.* 2004;3(6):343-353.

7. Santini ZI, Koyanagi A, Tyrovolas S, Mason C, Haro JM. The Association Between Social Relationships and Depression: A Systematic Review. *J Affect Disord.* 2015;175:53-65.

8. Norton MC, Dew J, Smith H, et al. Lifestyle Behavior Pattern is Associated with

Different Levels of Risk for Incident Dementia and Alzheimer's Disease: The Cache County Study. *J Am Geriatr Soc.* 2012;60(3):405-412.

9.   Livingston G, Sommerlad A, Orgeta V, et al. Dementia Prevention, Intervention, And Care. *Lancet.* 2017.

10.   Seeman TE, Lusignolo TM, Albert M, Berkman L. Social Relationships, Social Support, and Patterns of Cognitive Aging in Healthy, High-Functioning Older Adults: Macarthur Studies Of Successful Aging. *Health Psychol.* 2001;20(4):243.

11.   Berkman LF, Kawachi I, Glymour MM. *Social Epidemiology.* Oxford University Press; 2014.

12.   Tsuboi H, Hirai H, Kondo K. Giving Social Support to Outside Family May Be a Desirable Buffer Against Depressive Symptoms in Community-Dwelling Older Adults: Japan Gerontological Evaluation Study. *Biopsychosocl Med.* 2016;10(1):18.

13.   Brown SL, Nesse RM, Vinokur AD, Smith DM. Providing Social Support May Be More Beneficial Than Receiving It: Results from a Prospective Study of Mortality. *Psychol. Science.* 2003;14(4):320-327.

14.   Saito T, Murata C, Saito M, Takeda T, Kondo K. Influence of Social Relationship Domains and Their Combinations on Incident Dementia: A Prospective Cohort Study. *J Epidemiol Community Health.* 2017.

15.   Aida J, Kondo K, Kawachi I, et al. Does Social Capital Affect the Incidence of

Functional Disability in Older Japanese? A Prospective Population-Based Cohort Study. *J Epidemio Community Health.* 2012:jech-2011-200307.

16. Berkman LF, Kawachi I, ScD MG. *Social Epidemiology.* Oxford University Press; 2014.

17. Nishi A, Kondo K, Hirai H, Kawachi I. Cohort Profile: The Ages 2003 Cohort Study in Aichi, Japan. *J Epidemiol.* 2011;21.

18. Hisano S. The Relationship between Revised Hasegawa Dementia Scale (HDS-R), Mini-Mental State Examination (MMSE) and Bed-fast Scale, Dementia Scale. *Jpn J Geriatr Psychiatry.* 2009;20:883-891.

19. Hikichi H, Tsuboya T, Aida J, et al. Social Capital and Cognitive Decline After a Natural Disaster–Authors' Reply. *Lancet Planet Health.* 2017;1(6):e219.

20. Yamamoto T, Kondo K, Hirai H, Nakade M, Aida J, Hirata Y. Association Between Self-Reported Dental Health Status and Onset of Dementia: A 4-Year Prospective Cohort Study Of Older Japanese Adults from the Aichi Gerontological Evaluation Study (AGES) Project. *Psychoso Med.* 2012;74(3):241-248.

21. Takagi D, Kondo K, Kawachi I. Social Participation and Mental Health: Moderating Effects of Gender, Social Role and Rurality. *BMC public health.* 2013;13(1):701.

22. Holwerda TJ, Deeg DJ, Beekman AT, et al. Feelings of Loneliness, But Not Social Isolation, Predict Dementia Onset: Results from the Amsterdam Study of the Elderly (AMSTEL). *J Neurol Neurosurg Psychiatry.* 2014;85(2):135-142.

23.   Khondoker M, Rafnsson SB, Morris S, Orrell M, Steptoe A. Positive and Negative Experiences of Social Support and Risk of Dementia in Later Life: An Investigation Using the English Longitudinal Study of Ageing. *J. Alzheimer's Dis.* 2017(Preprint):1-9

Table 1 Descriptive characteristics of the respondents (n = 11,032)

Individual level variables	n	%	IR	95% CI		Patients with Dementia [n = 1,776 (16.1%)] n	%
					Incidence rate(IR) per 1000 person-years		
Sex							
Male	5,405	49.0	0.049	0.045	0.052	746	13.8
Female	5,627	51.0	0.062	0.058	0.066	1,030	18.3
Age (years)							
65-69	4,065	36.9	0.016	0.014	0.018	207	5.1
70-74	3,280	29.7	0.044	0.040	0.048	428	13.1
75-79	2,228	20.2	0.090	0.083	0.098	548	24.6
80-84	1,012	9.2	0.158	0.143	0.175	376	37.2
85+	447	4.1	0.289	0.253	0.330	217	48.6
Living alone							
No	9,959	90.3	0.054	0.051	0.057	1,558	15.6
Yes	1,073	9.7	0.073	0.064	0.083	218	20.3
Marital status							
Married	7,905	71.7	0.044	0.042	0.047	1,038	13.1
Widowed or divorced	2,745	24.9	0.089	0.082	0.096	658	24.0
Never married	190	1.7	0.063	0.033	0.121	41	21.6
Other/Missing	192	1.7	0.071	0.052	0.097	39	20.3
Education (years)							
≧13	455	4.1	0.046	0.039	0.053	171	37.6
10-12	6,002	54.4	0.048	0.044	0.052	963	16.0
6-9	3,341	30.3	0.055	0.052	0.059	470	14.1
<6	1,132	10.3	0.156	0.134	0.181	149	13.2

Other/Missing	102	0.9	0.081	0.054	0.121	23	22.6
Present illness							
No	2,906	26.3	0.040	0.036	0.045	354	12.2
Yes	7,679	69.6	0.062	0.059	0.065	1,348	17.6
Missing	447	4.1	0.058	0.046	0.072	74	16.6
GDS-15							
0-4	6,737	61.1	0.043	0.040	0.045	857	12.7
5-9	2,234	20.3	0.073	0.067	0.080	450	20.1
10-15	644	5.8	0.106	0.091	0.123	170	26.4
Missing	1,417	12.8	0.076	0.068	0.085	299	21.1
Smoking status							
Never	6,501	58.9	0.059	0.056	0.063	1,129	17.4
Former	2,757	25.0	0.047	0.042	0.052	367	13.3
Current	1,396	12.7	0.055	0.048	0.063	213	15.3
Missing	378	3.4	0.063	0.050	0.080	67	17.7
Alcohol consumption							
Non	7,094	64.3	0.063	0.059	0.066	1,268	17.9
Not drink every day	1,513	13.7	0.042	0.036	0.048	188	12.4
Drink every day $\leqq$ 35 g/day	1,769	16.0	0.045	0.039	0.051	233	13.2
Drink every day $>$ 35 g/day	495	4.5	0.033	0.025	0.044	49	9.9
Missing	161	1.5	0.085	0.062	0.117	38	23.6
Social supports							
Receiving emotional support							
No	1,089	9.9	0.070	0.061	0.080	208	19.1
Yes	9,943	90.1	0.054	0.052	0.057	1,568	15.8
Providing emotional support							
No	1,836	16.6	0.085	0.077	0.094	409	22.3

Yes	9,196	83.4	0.051	0.048	0.053	1,367	14.9
Receiving instrumental support							
No	868	7.9	0.063	0.053	0.076	112	18.1
Yes	10,164	92.1	0.055	0.053	0.058	1,664	16.0
Providing instrumental support							
No	619	5.6	0.113	0.100	0.128	250	28.8
Yes	10,413	94.4	0.051	0.049	0.054	1,526	15.0

Table 2 Characteristics of community level and Spearman's correlation coefficient matrix for community level social support indicators (n=44 school districts)

	%	SD	Min	Max	Spearman's Rank Correlation Coefficient			
					i	ii	iii	iv
ⅰ) Community level receiving emotional support	89.9	2.0	82.7	93.5	1			
ⅱ) Community level providing emotional support	83.1	2.2	76.1	88.6	-0.1149*	1		
ⅲ) Community level receiving instrumental support	94.0	1.6	91.3	97.6	0.4426*	0.0786*	1	
ⅳ) Community level providing instrumental support	91.9	2.1	85.6	97.9	-0.0017	0.4132*	0.2573*	1

* statistically significant at the 0.05 level

Table 3 Results of multilevel survival analyses for onset of incident dementia

	Model 1	Model 2 (1 year)	Model 3 (2 year)	Model 4 (3 year)
	n = 11,032	n=10,780	n = 10,440	n = 10,071
Fixed effect	HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)
Community level variables				
Rate of receiving emotional support*	0.96 (0.94-0.99)	0.97 (0.94-0.99)	0.97 (0.94-0.99)	0.97 (0.94-0.988)
Rate of providing emotional support*	0.99 (0.96-1.01)	0.99 (0.96-1.01)	0.98 (0.95-1.01)	0.98 (0.95-1.01)
Rate of receiving instrumental support*	1.01 (0.97-1.04)	1.01 (0.97-1.04)	1.01 (0.97-1.05)	1.01 (0.97-1.06)
Rate of providing instrumental support*	1.00 (0.97-1.03)	1.00 (0.97-1.02)	1.00 (0.97-1.03)	1.00 (0.97-1.04)
Individual level variables				
Social supports				
Receiving emotional support				
No	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Yes	1.04 (0.88-1.22)	1.03 (0.87-1.22)	1.03 (0.87-1.23)	0.99 (0.83-1.19)
Providing emotional support				
No	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Yes	0.83 (0.73-0.94)	0.88 (0.77-0.997)	0.91 (0.80-1.04)	0.91 (0.79-1.05)
Receiving instrumental support				
No	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Yes	1.22 (0.99-1.51)	1.18 (0.95-1.47)	1.13 (0.90-1.42)	1.15 (0.91-1.47)
Providing instrumental support				
No	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Yes	0.76 (0.66-0.89)	0.82 (0.70-0.96)	0.85 (0.72-1.01)	0.89 (0.74-1.07)
Sex				
Male	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Female	1.01 (0.87-1.18)	1.03 (0.88-1.20)	1.06 (0.90-1.24)	1.08 (0.91-1.28)
Age (years)				

65-69	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
70-74	2.64 (2.23-3.12)	2.67 (2.25-3.16)	2.65 (2.22-3.16)	2.71 (2.26-3.25)
75-79	5.42 (4.60-6.38)	5.59 (4.73-6.61)	5.84 (4.93-6.93)	5.97 (5.00-7.13)
80-84	9.85 (8.24-11.78)	10.08 (8.40-12.10)	10.30 (8.53-12.43)	10.31 (8.46-12.56)
85+	19.01 (15.38-23.50)	19.32 (15.52-24.06)	19.32 (15.33-24.34)	18.64 (14.52-23.92)
Living alone				
No	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Yes	0.94 (0.80-1.11)	0.94 (0.79-1.12)	0.98 (0.82-1.17)	1.03 (0.86-1.24)
Marital status				
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Widowed or divorced	1.09 (0.96-1.24)	1.09 (0.96-1.24)	1.06 (0.92-1.21)	1.00 (0.86-1.15)
Never married	1.28 (0.92-1.78)	1.22 (0.87-1.73)	1.24 (0.87-1.76)	1.25 (0.87-1.79)
Other/Missing	1.12 (0.80-1.56)	1.13 (0.80-1.58)	1.09 (0.77-1.56)	1.09 (0.76-1.57)
Education (years)				
≧13	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
10-12	0.89 (0.74-1.08)	0.89 (0.74-1.08)	0.89 (0.73-1.08)	0.92 (0.75-1.13)
6-9	0.96 (0.80-1.15)	0.95 (0.79-1.14)	0.95 (0.79-1.15)	0.96 (0.79-1.16)
<6	1.29 (1.02-1.63)	1.24 (0.97-1.57)	1.22 (0.95-1.57)	1.23 (0.95-1.61)
Other/Missing	0.89 (0.57-1.40)	0.82 (0.51-1.33)	0.80 (0.48-1.33)	0.86 (0.51-1.45)
Present illness				
No	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Yes	1.15 (1.02-1.30)	1.13 (1.00-1.28)	1.13 (1.00-1.28)	1.10 (0.96-1.26)
Missing	0.96 (0.75-1.24)	0.98 (0.75-1.27)	0.99 (0.75-1.29)	1.01 (0.76-1.33)
GDS-15				
0-4	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
5-9	1.54 (1.37-1.73)	1.54 (1.37-1.74)	1.48 (1.31-1.68)	1.49 (1.30-1.69)
10-15	2.33 (1.96-2.77)	2.18 (1.82-2.62)	2.16 (1.79-2.62)	2.17 (1.78-2.66)
Missing	1.47 (1.28-1.68)	1.43 (1.25-1.64)	1.41 (1.22-1.63)	1.41 (1.22-1.64)

Smoking status				
Never	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Former	0.99 (0.85-1.16)	1.00 (0.86-1.18)	0.99 (0.84-1.17)	1.02 (0.86-1.21)
Current	1.34 (1.12-1.60)	1.32 (1.10-1.59)	1.39 (1.15-1.68)	1.40 (1.15-1.71)
Missing	0.86 (0.65-1.15)	0.90 (0.67-1.20)	0.85 (0.63-1.15)	0.91 (0.67-1.24)
Alcohol consumption				
Non	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Does not drink every day	0.96 (0.82-1.13)	0.96 (0.81-1.13)	0.97 (0.82-1.15)	0.96 (0.80-1.15)
Drinks every day $\leqq$ 35 g/day	0.98 (0.84-1.15)	0.99 (0.84-1.16)	1.02 (0.86-1.20)	1.03 (0.87-1.22)
Drinks every day $>$ 35 g/day	0.86 (0.64-1.17)	0.90 (0.66-1.21)	0.92 (0.68-1.26)	0.91 (0.66-1.26)
Missing	1.14 (0.78-1.66)	1.14 (0.78-1.67)	1.24 (0.84-1.83)	1.22 (0.82-1.83)
Random effects				
Community level variance (SE)	0.06 (0.05)	0.04 (0.06)	0.04 (0.07)	0.09 (0.04)

*HR for one point increment of community social support (range: 0-100)