ORIGINAL ARTICLES

Positive affect and incident dementia among the old

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ABSTRACT

Background: We investigated the association between positive affect and incident dementia among the old. Studies have reported the role positive affect has on maintaining health. Still, no longitudinal studies have assessed the association between positive affect and incident dementia.

Methods: We used the Aichi Gerontological Evaluation Study (AGES) data. Participants were older adults (65 +) who did not receive benefits from Japan's public Long-Term Care Insurance System at baseline (N = 14,286) in 6 municipalities. They were followed from 2003 to 2007 for dementia onset. Dementia onset was determined according to the criteria used in the Long-Term Care Insurance System. Positive affect was assessed by sub-scales of the Geriatric Depression Scale (GDS-15). Cox hazard proportional models stratified by sex were employed to calculate hazard ratios for incident dementia.

Results: Of 14,286 participants (6,813 men and 7,473 women), 333 men (4.9%) and 468 women (6.3%) developed dementia during the 4 year follow-up. In age adjusted Cox models, positive affect was significantly associated with lower risk of dementia both among men and women. Even after adjusting for health status, health behaviors, social engagement, and low education, positive affect persisted as a significant protector against dementia.

Conclusions: We observed a protective role of positive affect against cognitive decline. Factors associated with higher positive affect scores were healthier life style, social engagement, and physical health. This implies the importance of maintaining such activities to promote cognitive health among the old. In doing so, the role of positive affect merits attention.

Key Words: Dementia, Positive affect, Cohort study

1. INTRODUCTION

Our society is aging and dementia is a major cause of disability among older adults. In more developed nations, over 1 in 5 people are 60 years or older, and the proportion of older adults is predicted to increase in developing nations in the future as well.[1] Similarly, the estimated number of those suffering from dementia will rise worldwide. In Japan, the number of older adults suffering from dementia in 2012 was estimated to be 2.8 million (9.5% of the 65+ population). In 2025, that number is projected to be about 4.7 million.[2] According to the World Alzheimer Report published in 2009, an estimated 35.6 million people were living with dementia in 2010. The number is expected to increase to 65.7 million by 2030, and to 115.4 million by 2050. Moreover, approximately 63.4% of all people with dementia are expected to live in low- to middle income nations such as Brazil, India, and

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Nigeria in 2030, and that rate will rise to 70.5% by 2050.[3] Dementia is therefore a worldwide concern.

A well-known risk factor for dementia is advanced age, with prevalence doubling roughly every five years for those over the age of 65.[3] Low socio-economic status such as low education is also a risk factor for dementia.[3–5] Moreover, illnesses and poor health conditions such as hypertension or type 2 diabetes are risk factors for dementia,[5–7] as are lifestyle factors such as smoking, heavy drinking, or being sedentary.[8,9] These modifiable factors are important since they are amenable to intervention. Researchers demonstrated the positive effect promotion of social or physical activities has against cognitive decline among the old.[10–12] However, studies have reported that the effect of conventional behavior modification programs is disappointing, especially in terms of their long-term effect.[13] Recently, the role of positive affect has been considered as part of a more effective behavior modification program. In fact, a recent study suggested that laughter had a positive effect on dementia prevention.[14] Hirosaki *et al*. reported that an enjoyable exercise program with laughter sessions was effective for motivating older participants.[15] In another randomized controlled trial in medical care settings, researchers demonstrated that patient education intervention enhanced with positive-affect induction and self-affirmation was more effective than patient education alone in improving medication adherence and blood pressure reduction among 256 hypertensive African Americans.[16]

Positive affect is also associated with better health. For example, Hirosaki *et al*. demonstrated the effect of positive affect against functional decline.[17] Using data from the North Carolina EPESE study, Ostir *et al*. demonstrated that stroke incidence is lower for individuals with a high positive affect score.[18] However, as far as we know, no studies have investigated the association between positive affect and incident dementia. The purpose of this study is to investigate such an association using 4-year follow-up data of community-living older adults in Japan.

2. METHODS

2.1 Data and subjects

The present study is a part of the Aichi Gerontological Evaluation Study (AGES) Project. This is a community-based prospective cohort study in Japan, in which investigators evaluated factors associated with incident functional disability or dementia among non-institutionalized older people aged 65 years or above. A detailed description of the study population and the baseline survey has been published elsewhere.[19] Briefly, the initial cohort included a representative sample of 6 municipalities in Chita Peninsula of Aichi Prefecture. In October 2003, self-administered questionnaires were mailed to community-living older adults aged 65 years or older with no dementia, and thus did not receive benefits from public long-term care insurance (LTCI) services. LTCI is Japan's long-term care insurance system, introduced in April 2000, to entitle every Japanese person aged 65 and older with functional limitations or dementia to care in activities of daily living.[20] Questions on the survey were about health status, lifestyles, and social networks. The researchers used random sampling of 2 larger municipalities and a complete census of 4 smaller cities (N = 29,374). Of these, 14,286 individuals (6,813 men and 7,473 women) provided valid responses (response rate of 48.6%) and were introduced to the AGES Cohort. They were followed for four years from November 2003 to October 2007.

2.2 Incident dementia

We defined people with dementia as those who became eligible for Japan's public LTCI System, Level II or higher, on the index for the evaluation of care needs for the demented. The scale was developed by the Ministry of Health and Welfare, based on observations of symptoms and behaviors that cause daily life impediment and degradation of intellectual functions that causes communication difficulty. This index was validated using MMSE (Mini-Mental State Examination) and HDS-R (Revised Hasegawa Dementia Scale). The correlation coefficients with each scale were -0.744 and -0.735, respectively, indicating strong correlations with a clinically used instrument.[21] Certification of long-term care needs was based on an evaluation of the need for care, a home-visit interview, and a written opinion from the primary care physician. We obtained information regarding certification of long-term care needs, death, and dropping out of subjects (*e.g*. moving out of the study area) from the long-term care insurance database maintained by municipalities. The study protocol and informed consent procedure were approved by the Ethics Committee in Research of Human Subjects at Nihon Fukushi University (# 10-05).

2.3 Explanatory variable

Positive affect was measured using the 15-item Geriatric Depression Scale (GDS-15). In most studies, positive affect was measured using the CES-D (Center for Epidemiological Studies Depression Scale), which includes four positive affect items. GDS is a widely used measure for screening depression among older populations in the community and includes questions regarding both positive and negative affect.[22] As our study participants were older people in community settings, we used GDS-15. Recent studies have used GDS in this manner to assess the predictive power of positive affect on older person's health, such as functional

decline or cognitive impairment.[17,23] The five GDS items for measuring positive affect are "feeling satisfied with life," "feeling happy most of the time," "feeling full of energy," "feeling wonderful to be alive," and "being in good spirits most of the time." The answer was dichotomized as yes/no. The code "1" was assigned to a "yes" answer, and the sum score of these five items was used in the analysis.

2.4 Covariates

Information on smoking, physical activity and alcohol consumption was obtained from a self-report baseline survey. Smoking was dichotomized as yes (current smoker) or no (former or never smoker). Physical activity was assessed by asking "How long do you walk a day on average?" Alcohol consumption was divided into two categories as drinker or non-drinker. Since older adults often experience chronic illnesses that can affect their lifestyle, we also asked for their health status. Diagnosed illnesses and conditions were ascertained by asking if they were currently receiving treatment for any of the following: cancer, heart disease, stroke, hypertension, diabetes, obesity, hyperlipidemia, osteoporosis, arthritis, trauma, respiratory illness, gastrointestinal illness, liver disease, mental illness, visual/hearing impairment, dysphagia, incontinence, and others. Also, we incorporated limitations in basic activities of daily living into the model. Although benefits under LTCI were provided based on an application, a small percentage of people with functional limitations were not receiving LTCI services although they were eligible for the application. We asked them if they needed assistance in performing any of the following activities: bathing, walking, and using the toilet.

As social isolation is also a well-known risk factor for dementia, we asked about marital status and social engagement. Marital status was dichotomized into married/single (never married/widowed/divorced). Social engagement was elicited by asking "Do you belong to the following organizations or groups?" The answer categories were political organizations or groups, industrial or trade associations, volunteer groups, citizen or consumer groups, religious organizations, sports groups, neighborhood associations/senior citizen clubs/fire-fighting teams, and hobby groups. The answer was dichotomized as yes/no. The code "1" was assigned to a "yes" answer and the un-weighted sum of the count was used in the analysis.

Socioeconomic status was evaluated based on the total years of formal education, and was divided into primary (<9 years) and secondary or above (≥ 10 years). We evaluated negative affect using ten negative affect items in GDS-15.[17]

2.5 Statistical analyses

The incident rates of dementia were calculated by dividing the number of new cases by the number of follow-up years (person-years). Differences in covariates, along with positive and negative affect scores between people with incident dementia and no dementia were assessed using general linear regression models. Since age is an important confounder when assessing the relationship between positive affect and incident dementia, all mean values were adjusted for years of age by means of multiple general linear regression models.

Cox hazard proportional model stratified by sex was employed to calculate the hazard ratios for dementia onset. Those who died or moved away from the study site during the follow-up period were considered censored. To test if the effects of each factor were independent of the influence of others, we used hierarchical regression modeling procedures. First, we constructed a crude model which demonstrated the crude effect of positive affect on incident dementia. Then, to test which factors accounted for incident dementia besides positive affect, we added age, biological/ physiological, social, and socio-economic factors sequentially to each model from Model 2 to Model 5, and inspected changes in the hazard ratios to estimate associations with incident dementia. Lastly, to test if the effect of positive affect is independent of negative affect, we added negative affect scores in the Model 6.

Table 1. Incident dementia during the 4-year follow-up by positive affect score (n = 14,286)

Additive positive affect score	Study population (n)	Dementia cases (%)	Person-years*	Incidence/1000 person-years
Men (6,813)				
Missing	707	67(9.5)	2,543	26.3
0	147	8(5.4)	535	15.0
1	295	20(6.8)	1,046	19.1
2	403	22(5.5)	1,461	15.1
3	861	60(7.0)	3,124	19.2
4	1,769	77(4.4)	6,603	11.7
5	2,631	79(3.0)	10,055	7.8
Total	6,813	333(4.9)	25,367	13.1
Women (7,473)				
Missing	1,091	98(9.0)	4,054	24.2
0	168	23(13.7)	594	38.7
1	239	26(10.9)	875	29.7
2	417	28(6.7)	1,564	17.9
3	885	71(8.0)	3,300	21.5
4	2,066	135(6.5)	7,839	17.2
5	2,607	87(3.3)	10,124	8.6
Total	7,473	468(6.3)	28,350	16.5

*Person years in the table were calculated by adding the number of follow-up years of study population in the row.

We used SPSS 21.0J (SPSS, Chicago, IL, USA) for statis-

tical analysis. A *p*-value of less than .05 was considered statistically significant.

3. Results

Table 1 shows the cumulative incidence and incidence of dementia per 1,000 person-years. Of 14,286 subjects, 333 men (4.9%) and 468 women (6.3%) developed dementia during follow-up. Table 2 shows personal characteristics of those demented and not demented during the follow-up. In Cox models (see Table 3), even after adjustment for age (model 2), a higher positive affect score (range: 0-5) was significantly associated with lower risk of dementia with a hazard ratio of 0.80 ($P < .001$) for a one point increment. Among women, such a hazard was 0.75 ($P < .001$). Positive affect persisted as a significant protector from dementia throughout the models. Such association diminished after adding negative affect scores (model 6) among men, but not among women. Among women positive affect remained a marginally significant protector against dementia.

Table 2. Differences in baseline characteristics between dementia cases and non-dementia cases during the 4-year follow-up

		Men (n = 6,813)		Women (n = 7,473)	
	Range	Not demented	Demented	Not demented	Demented
Demographics					
Age	65-102	72.0(.072)	77.6(.316)	72.9(.069)	80.2(.267)
80 years or older (%)		13.9	17.1	14.0	25.2
Health behavior					
Current smoker (%)		23.8	25.8	2.3	3.7
Drinker (%)		38.4	30.5	3.2	5.8
Sedentary (< 30 min walk a day) (%)		35.6	44.4	37.8	47.9
Health status					
Illnesses or conditions	0-19	1.6(.018)	1.7(.079)	1.7(.017)	1.9(.068)
Functional limitation (%)		2.4	7.8	2.6	10.1
Social factors					
Low education (< 9y) (%)		67.6	79.3	74.3	76.0
Social engagement	0-8	1.5(.019)	1.2(.090)	1.4(.019)	1.0(.076)
Single (%)		18.8	21.9	48.3	56.6
Total GDS score	0-15	3.5(.044)	5.0(.209)	37(.045)	5.4(.188)
Positive affect	0-5	3.9(.017)	3.6(.078)	4.0(.016)	3.4(.067)
Negative affect	0-10	2.5(.032)	3.5(.149)	2.7(.032)	3.9(.133)

Note. Figures in the table are adjusted for years of age by means of multiple general linear regression models; Figures in parentheses are standard errors.

Table 3. Hazard ratios for incident dementia by Cox proportional hazard models by positive affect

Variables	Category/ range	M1	M2	M3	M4	M5	M6
		HR (95% CI) *P* value	HR (95% CI) *P* value	HR (95% CI) *P* value	HR (95% CI) *P* value	HR (95% CI) *P* value	HR (95% CI) *P* value
Men							
*P*ositive affect (continuous)	0-5	0.82(0.75-0.89) $P < .001$	0.80(0.74-0.87) $P < .001$	0.85(0.78-0.92) $P < .001$	0.87(0.80-0.95) $P < .01$	0.87(0.80-0.95) $P < .01$	0.95(0.85-1.06) $P = .952$
Women							
*P*ositive affect (continuous)	0-5	0.76(0.71-0.81) $P < .001$	0.75(0.70-0.81) $P < .001$	0.77(0.72-0.83) $P < .001$	0.79(0.73-0.85) $P < .001$	0.79(0.73-0.85) $P < .001$	0.91(0.82-1.00) $P = .052$

Note. Model 1: Crude;
Model 2: Adjusted for age;
Model 3: Model 2 + diagnosed illnesses, functional limitation (walking, bathing, or using the toilet), and health behaviors (smoking, drinking, walking);
Model 4: Model 3 + marital status, living arrangement, and social engagement;
Model 5: Model 4 + years of education;
Model 6: Model 5 + negative affect score;
HR = hazard ratio; CI = confidence interval.

4. DISCUSSION

We assessed the association between positive affect and dementia. To the best of our knowledge, this is the first large-scale cohort study conducted in Japan to investigate the association between positive affect and dementia onset among community-dwelling old people. Cumulative incidence of dementia in our study was 4.9% for men and 6.3% for women, and 33.0 per 1,000 person years for those 75 years or older. This is slightly higher but comparable to results in another study which reported the five-year incidence of 3.9% among non-demented (Clinical Dementia Rating: CDR = 0) older people.[24] Also, our results are in accordance with international data. The cumulative incidence rate of dementia was 36.60 per 1000 person years in a population of community-living old people aged 75-80 in Belgium,[25] and 34.6 to 105.9 per 1000 person years in a Swedish three-year follow-up study with non–demented (MMSE > 23) people aged 75 years or older at baseline.[12]

In our study, older adults with a higher positive affect score were significantly less likely to develop dementia. This is in agreement with the study result in which researchers demonstrated the independent association of positive affect in lowering the risk of functional decline.[17] Several explanations have been proposed for the mechanisms underlying the link between positive affect and cognitive health. For example, favorable health behaviors such as not smoking are more prevalent among happier people.[26] Positive affect was also associated with better mental and physical health.[27] Since doing physical activities and not smoking also protect against incident dementia,[28,29] this may partly explain the protective role of positive affect on maintaining cognitive health.

We found that men with a higher positive affect score were more likely to be intellectually and socially active, and to be married. Studies report that social engagement is associated with maintenance of cognitive function.[30] Social activities such as gardening, playing music, traveling, and meeting with friends reduce the risk of dementia.[10,31,32]

Although studies in Western nations have consistently found that the prevalence of dementia is high among people of lower income or education,[3] in our study, educational attainment was not a strong predictor for dementia. Low education was associated with a slightly higher risk of dementia among women but not among men (data not shown). Education may influence health in a complex way. Educational attainment protects against dementia through cognitive functional reserve or maintenance.[5,28] A variety of processes may play a role in such associations. One such process might be the direct adverse health effects of poor living conditions. Another is the indirect effect of negative affect such as depression. Physiological processes related to stress may favor neurodegenerative processes in the hippocampus, which plays an important role in memory processes in the brain.[30] Social isolation such as being single, living alone, and having a smaller social network is also prevalent among individuals with a low socio-economic status.[30] Unhealthy lifestyles such as smoking, heavy alcohol consumption and sedentary lifestyle are also more prevalent among people with low educational attainment or income.[33] These factors explain in part the higher prevalence of dementia among people having low educational attainment. However, among our population, such an association was weak. Since our population consisted of older adults, survival effect may in part explain that result.

4.1 Strengths and limitations

The present study adds several new findings to earlier studies. First, the effect of positive affect on dementia is independent of other confounders. Second, positive affect is more strongly associated with dementia than health behaviors or social engagement. The major strength of our study is that we used insurance data maintained by municipalities with very few missing cases. Dementia is often under-diagnosed among community populations,[34] therefore, use of insurance data enables us to better estimate factors associated with dementia onset. Given the fact that the long-term effect of behavior modification programs is disappointing,[13] this study adds evidence that interventions targeting positive affect among participants might be promising.

However, we must be cautious when interpreting the results. First, the association between positive affect and dementia could be confounded by other unknown factors, although in our data, positive affect was independently associated with incident dementia among women even after controlling for negative affect, as seen in the model 6. In addition, we performed sub-analyses excluding those with depression at baseline. Results did not change. Second, we cannot deny that people who already had mild cognitive impairment were included in this study since it was based on self-report. To consider possible reverse causality, we employed a series of analyses excluding subjects who developed dementia within one year from the baseline. However, the result did not change. Third, the diagnosis of dementia was based solely on observed symptoms. This might have led to misclassification of dementia cases.

Another limitation is that the data came from a self-administered survey. This might have led to selection bias. Studies have indicated a higher non-response rate among individuals with poorer mental health and/or lower income or education.[35] We previously assessed the difference between

respondents and non-respondents and found that those who refused to participate were more likely to be older and to have lower income.[36] Thus, the low response rate might contribute to an underestimation of the incidence of dementia, since dementia is more prevalent among people with low income or education.[3]

5. CONCLUSIONS

Despite the above limitations, our results suggest the protective role of positive affect against dementia. Overall, positive affect had a strong effect on cognitive health of older adults. In fact, happier people are healthier and live longer.[27] Psychological well-being and/or life-satisfaction are all associated with low risks of morbidity and mortality, as well as functional decline.[36] Possible pathways connecting positive affect and health are health behaviors,[15] stronger social networks and positive human interactions.[27] Further studies are needed to see if promoting positive affect is beneficial in terms of preventing cognitive decline among the old, and to assess the pathways by which a positive affect influences health among the old.

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CONFLICTS OF INTEREST DISCLOSURE

The authors declare that they have no competing interests.

KEYPOINTS

- There have been reports regarding the role of positive affect on maintaining health. Still, few longitudinal studies are available which established an association between positive affect and incident dementia.
- Even in consideration of health status, health behaviors, social engagement, and low education, positive affect persisted as a significant protector against dementia.
- Although reverse causation cannot be ruled out, our results suggest the protective role of positive affect against cognitive decline among older adults.

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