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Types of Elder Abuse and Dementia Onset among Older Adults in Japan: A 6-year Longitudinal Study from the Japan Gerontological Evaluation Study

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ABSTRACT

Objectives: Elder abuse is a growing global public health concern. Previous studies have reported that elder abuse increases the risk of dementia; however, to the best of our knowledge, no studies have investigated the association between different types of abuse and dementia onset yet. This study, therefore, investigated the association between physical, psychological, and financial abuses and dementia onset in independent older adults in Japan.

Methods: A 6-year prospective cohort data from the Japan Gerontological Evaluation Study (JAGES) were collected in 2010 through a mail survey conducted among 5,674 men and 6,562 women aged ≥65 years across Japan. Dementia was assessed using the nationally standardized dementia scale proposed by the Ministry of Health, Labor and Welfare. Poisson regression analysis was performed separately for each type of abuse to calculate the incidence rate ratios and 95% confidence intervals.

Results: During follow-up, 552 (9.7%) men and 728 (11.1%) women developed dementia. After adjusting for potential confounders, participants who experienced financial abuse were 1.53 (1.09–2.16) times more likely to develop dementia than those who did not. On the other hand, participants who experienced physical abuse were 1.53 (0.92–2.56) times more likely and those who experienced psychological abuse were 0.98 (0.82–1.17) times less likely to develop dementia than participants who did not experience such abuses. However, the difference was not significant.

Conclusion: Financial abuse may promote dementia among older adults in Japan, suggesting that preventing this abuse may help prevent dementia onset. However, further studies with larger data sets are warranted.

Introduction

Elder abuse is a growing global public health concern.(Pillemer, Burnes, Riffin, & Lachs, 2016; Yon, Mikton, Gassoumis, & Wilber, 2017) The United Nations has published a policy brief that warns of the disturbing increase in the abuse of older adults during the coronavirus pandemic (COVID-19).(United Nations, 2020) Thus, evaluating the impact of elder abuse on the health of older adults is an urgent issue, given that identifying the underlying factors may help develop preventive strategies against such abuse. Although longitudinal studies on this subject are limited, previous evidence suggests that elder abuse increases the risks of negative health outcomes such as depression and suicide.(Koga, Tsuji, Hanazato, Suzuki, & Kondo, 2020; Lee & Atteraya,

2019) Moreover, another study reported that financial abuse was associated with decline in physical and psychological health.(Waite, 2017) Elder abuse has been classified into several types: physical, sexual, financial, and emotional/psychological abuses as well as neglect. (Johannesen & Logiudice, 2013) However, studies investigating the association between elder abuse and health have combined all types of abuse, with very few studies investigating each type of abuse separately. Furthermore, limited studies have included independent older adults as the target population and used longitudinal data to evaluate the association of elder abuse with health outcomes such as dementia.

Dementia is one of the various causes of disability and dependency among older adults, with estimates showing that 50 million individuals already have dementia and nearly 10 million new cases are reported

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Table 1
Characteristics of study participants.

	Total		Dementia, n	Cumulative incidence
Physical abuse				
No abuse	8,331	68.1%	859	10.3%
Abuse	109	0.9%	16	14.7%
Missing	3,796	31.0%	405	10.7%
Psychological abuse				
No abuse	7,169	58.6%	733	10.2%
Abuse	1,239	10.1%	135	10.9%
Missing	3,828	31.3%	412	10.8%
Financial abuse				
No abuse	8,500	69.5%	880	10.4%
Abuse	224	1.8%	34	15.2%
Missing	3,512	28.7%	366	10.4%
Depression				
No depression	7,524	61.5%	614	8.2%
Mild or severe depressives	2,701	22.1%	375	13.9%
Missing	2,011	16.4%	291	14.5%
Sex				
Male	5,674	46.4%	552	9.7%
Female	6,562	53.6%	728	11.1%
Age				
65–69	3,374	27.6%	81	2.4%
70–74	3,679	30.1%	192	5.2%
75–79	2,829	23.1%	347	12.3%
80–84	1,630	13.3%	390	23.9%
≥85	724	5.9%	270	37.3%
Education attainment				
≤9	5,911	48.3%	694	11.7%
≥10	6,014	49.2%	507	8.4%
Missing	311	2.5%	79	25.4%
Equivalent income				
Low(<199)	4,982	40.7%	510	10.2%
Mid(200–399)	3,901	31.9%	334	8.6%
High(>400)	1,157	9.5%	87	7.5%
Missing	2,196	17.9%	349	15.9%
Living arrangement				
Living with someone	9,933	81.2%	973	9.8%
Living alone	1,382	11.3%	158	11.4%
Missing	921	7.5%	149	16.2%
Marital status				
Married	8,601	70.3%	718	8.3%
Widowed	2,676	21.9%	440	16.4%
Separated	396	3.2%	36	9.1%
Unmarried	249	2.0%	31	12.4%
Missing	314	2.6%	55	17.5%
BMI				
<18.5	884	7.2%	142	16.1%
18.5–24.9	8,251	67.4%	762	9.2%
25.0–29.9	2,338	19.1%	197	8.4%
≥30	763	6.2%	179	23.5%
Longest job held				
Professional/technical	1,619	13.2%	138	8.5%
Administrative	640	5.2%	41	6.4%
Clerical	1,629	13.3%	153	9.4%
Sales/service	1,577	12.9%	131	8.3%
Skilled/labor	1,383	11.3%	116	8.4%
Agriculture/forestry/fishery	1,181	9.7%	128	10.8%
Others	1,426	11.7%	170	11.9%
No occupation	619	5.1%	93	15.0%
Missing	2,162	17.7%	310	14.3%
Alcohol consumption				
Drinker	3,869	31.6%	309	8.0%
Stop drinking	398	3.3%	62	15.6%
Non-drinker	7,066	57.7%	797	11.3%
Missing	903	7.4%	112	12.4%
Smoking				
Never smoker	6,524	53.3%	673	10.3%
Former smoker	2,560	20.9%	271	10.6%
Smoker	1,762	14.4%	156	8.9%
Missing	1,390	11.4%	180	12.9%
Frequency of meeting friends				
4 times or more than a week	1,661	13.6%	152	9.2%

Table 1 (*continued*)

	Total		Dementia, n	Cumulative incidence
2–3 times a week	2,638	21.6%	245	9.3%
Once a week	1,969	16.1%	200	10.2%
1–3 times a month	2,321	19.0%	188	8.1%
Few times a year	1,805	14.8%	181	10.0%
Not meeting	902	7.4%	154	17.1%
Missing	940	7.7%	160	17.0%
Occupational status				
Worker	2,604	21.3%	123	4.7%
Retired	6,428	52.5%	654	10.2%
Never worked	1,375	11.2%	216	15.7%
Missing	1,829	14.9%	287	15.7%
Daily walking time(minutes)				
<30	3,884	31.7%	537	13.8%
30–59	3,883	31.7%	370	9.5%
60–89	1,785	14.6%	136	7.6%
≥90	1,862	15.2%	115	6.2%
Missing	822	6.7%	122	14.8%
Hypertension				
No	4,579	37.4%	555	12.1%
Yes	4,728	38.6%	475	10.0%
Missing	2,929	23.9%	250	8.5%
Stroke				
No	9,149	74.8%	999	10.9%
Yes	158	1.3%	31	19.6%
Missing	2,929	23.9%	250	8.5%
Diabetes				
No	7,814	63.9%	856	11.0%
Yes	1,493	12.2%	174	11.7%
Missing	2,929	23.9%	250	8.5%
Hearing				
No	8,393	68.6%	874	10.4%
Yes	914	7.5%	156	17.1%
Missing	2,929	23.9%	250	8.5%
Instrumental activities of daily living				
Independent	8,963	73.3%	703	7.8%
Dependent	2,290	18.7%	451	19.7%
Missing	983	8.0%	126	12.8%

annually.(World Health Organization, 2020) Several studies have found an association between elder abuse or intimate partner violence and dementia onset, whereas others have investigated elder abuse toward patients with dementia.(Johannesen & Logiudice, 2013) For instance, one study showed that older patients with dementia have a higher risk of abuse.(Fang & Yan, 2018) Because functional disability is a known risk factor for elder abuse, patients with dementia have a higher risk of abuse.(Johannesen & Logiudice, 2013; Lachs, Williams, O'Brien, Hurst, & Horwitz, 1997) The risk of dementia incidence associated with elder abuse has been scarcely evaluated, and previous studies on dementia have reported inconsistent findings. A case-control study showed that women with Alzheimer's disease reported a history of interpersonal violence (IPV) four times more frequently than their healthy counterparts (Leung, Thompson, & Weaver, 2006). Furthermore, a longitudinal study that investigated the association between IPV and dementia incidence in older women revealed no association between violence, such as being pushed, grabbed, hit, and forced to participate in unwanted sexual activity, and dementia.(Cations, Keage, Laver, Byles, & Loxton, 2020)

Dementia has strongly associated with depression (Bennett & Thomas, 2014; Diniz, Butters, Albert, Dew, & Reynolds, 2013). Because depression and elder abuse have a bidirectional relationship, the association between elder abuse and dementia is worth investigating (Koga, Tsuji, et al., 2020). Our hypothesis was that elder abuse is a risk factor for dementia onset. Because studies that investigated the association between different types of elder abuse and dementia onset are sparse, we investigated the association between different types of elder abuse (i.e., physical, psychological, and financial abuses) and dementia onset in independent older adults in Japan.

Table 2
Results of Poisson regression analysis between the types of elder abuse and dementia onset.

		Dementia onset within <500 days of follow-up (n = 12,236)				Dementia onset within <1,000 days of follow-up (n = 12,236)				Dementia onset within <1,500 days of follow-up (n = 12,236)				Dementia onset within <2,000 days of follow-up (n = 12,236)				Dementia onset within the entire follow-up period (n = 12,236)			
		n	IRR	p	95%CI	n	IRR	p	95%CI	n	IRR	p	95%CI	n	IRR	p	95%CI	n	IRR	p	95%CI
Physical abuse																					
	No abuse	319	1.00			684	1.00			1057	1.00			1903	1.00			8331	1.00		
	Abuse	5	1.71	0.37	0.53 5.59	9	1.11	0.84	0.41 3.00	14	1.12	0.77	0.52 2.43	33	1.59	0.09	0.94 2.69	109	1.53	0.10	0.92 2.56
Psychological abuse																					
	No abuse	274	1.00			598	1.00			923	1.00			1654	1.00			7169	1.00		
	Abuse	48	1.06	0.75	0.73 1.56	94	1.01	0.94	0.77 1.32	146	0.99	0.91	0.79 1.24	277	0.98	0.80	0.81 1.18	1239	0.98	0.84	0.82 1.17
Financial abuse																					
	No abuse	319	1.00			692	1.00			1081	1.00			1945	1.00			8500	1.00		
	Abuse	14	2.11	0.04	1.03 4.33	26	1.91	0.01	1.15 3.17	42	2.02	<0.01	1.38 2.96	57	1.54	0.02	1.07 2.20	224	1.53	0.02	1.09 2.16

IRR: incidence rate ratio
CI: confidence interval

Methods

Study design and respondents

This study used longitudinal cohort data from the Japan Gerontological Evaluation Study (JAGES) collected through a mail survey. (Kondo & Rosenberg, 2018) The baseline survey was conducted in 2010 and involved participants from 16 municipalities across Japan. This population-based study included independent older adults aged ≥65 years who had no physical or cognitive disabilities. The participants were not eligible for public long-term care insurance benefits. The municipalities included in JAGES data were urban, suburban, and rural communities from the northern- to southernmost prefectures in Japan. Although the municipalities were not selected randomly, the data covered a wide range and size of community populations. However, participants within a municipality were selected randomly. Among the 56,587 eligible participants, 54,539 (96.2%) were successfully associated with the records of dementia over a follow-up period of 6 years from August 2010 to December 2016. Among the 54,539 respondents, 52,061 had valid information regarding identification number, sex, age, and dependence status in terms of activities of daily living (ADL). For the present study, the abuse item was randomly sampled from one-fifth of the JAGES participants in 2010, covering the data of 12,236 individuals.

Measurements

Dementia Outcome

Dementia incidence during the follow-up period from 2010 to 2016 was ascertained through associating the participants with the standardized in-home assessment and medical examination data obtained from the public long-term care insurance registry in Japan.(Tamiya et al., 2011) Under this system, the certification board of each municipality sends trained surveyors to the applicant's home to assess (1) physical function, (2) ADL, (3) cognitive function, (4) mental and behavioral disorders, (5) adaptation to social life, and (6) previous medical treatment(Ministry of Health, 2009) and the applicant's eligibility to receive the benefits of long-term care insurance, such as home assistance or day care. Moreover, their primary care physician also submitted a written judgment. After the assessment, the investigators classified the applicants into one of the eight dementia categories according to the severity of their cognitive impairment.(Hikichi, Kondo, Takeda, & Kawachi, 2017) A validation study has revealed strong associations with the Mini Mental State Examination.(Hisano, 2009) Our study defined patients with dementia as those who obtained Level II or higher scores on the dementia scale.(Takasugi, Tsuji, Nagamine, Miyaguni, & Kondo, 2019; Tani, Fujiwara, & Kondo, 2020)

Elder Abuse

Elder abuse based on three dimensions, namely, physical, psychological, and financial abuses, was measured at baseline using a self-reported questionnaire.(Koga, Hanazato, Tsuji, Suzuki, & Kondo, 2020; Koga, Tsuji, et al., 2020) For physical abuse, the respondents answered the following question: *In the past year, did you ever experience physical violence such as being hit, kicked, having objects thrown at you, or being shut in a room?* For psychological abuse, they answered the following question: *In the past year, did you ever experience an act that harmed your self-esteem such as verbal abuse, cutting remarks, or being ignored for long periods?* Answers to both questions were rated on a 4-point scale: 1, never; 2, once or twice; 3, occasionally; and 4, frequently. Those who answered 1 (never) were considered nonabused, whereas those who answered 2–4 were considered abused. Concerning financial abuse, the respondents answered the following question: *"Does anyone, including your family members, take or use your savings or pension benefits without your consent?* Answers were recorded as either yes or no, with the former indicating abuse and the latter indicating nonabuse. These questionnaires were designed through the collective effort of

several researchers, including medical doctors, social epidemiology researchers, and social workers. Owing to the lack of an official and established definition, clarifying the criteria for determining the type, frequency, and duration of behaviors that constitute elder abuse remains challenging. Questionnaires were designed to identify specific actions that respondents had endured, such as being hit, harm to their self-esteem, and being prevented from accessing their savings/pension benefits, to verify the presence or absence of abuse.

Covariates

In accordance with previous studies that investigated elder abuse and dementia, the present study included basic demographic information such as sex (men or women), age (65–69, 70–74, 75–79, 80–84, or ≥85 years), education level (≤9 or ≥10 years), equivalent income (low, ≤1,999,999 yen; middle, 2,000,000–3,999,999 yen; or high, ≥4,000,000 yen), marital status (married, widowed, divorced, unmarried, or others), and living arrangements (living alone, with family members, or other facilities).(Koga, Hanazato, et al., 2020; Kondo & Rosenberg, 2018; Takasugi et al., 2019) Depressive symptoms were also measured using the 15-item Geriatric Depression Scale, which defines mild and severe depression as ≥5 and ≥10 points, respectively.(Haseda et al., 2017; M. Saito et al., 2017) The following factors were also included based on previous studies investigating the risk of dementia: body mass index (<18.5, 18.5–24.9, 25.0–29.9, and ≥30), job they had for the longest duration (professional/technical, administrative, clerical, sales/service, skilled/labor, agriculture/forestry/fishery, others, and no occupation), alcohol consumption (drinker, stopped drinking, or nondrinker), smoking (smoker, former smoker, or never smoker), frequency of meeting friends (≥4 times a week, 2–3 times a week, once a week, 1–3 times a month, few times a year, or not at all), occupational status (worker, retired, or never worked), daily walking time (<30, 30–59, 60–89, or ≥90 min), hypertension (yes or no), stroke (yes or no), diabetes (yes or no), and hearing (yes or no).

To measure instrumental ADL (IADL) independence, the five-item Tokyo Metropolitan Institute of Gerontology Index of Competence was used.(Koyano, Shibata, Nakazato, Haga, & Suyama, 1991) Five functions that people perform in daily life were considered to be (1) using public transportation, (2) shopping for daily necessities, (3) preparing meals, (4) paying bills, and (5) managing deposits at a bank or post office. Each item was scored 1 for *yes*, and participants with a total score of 4 were considered independent and those with a total score of ≤4 were considered dependent.(Tanimoto et al., 2012)

Statistical analysis

Descriptive analysis was used to summarize the characteristics of the participants. Furthermore, owing to that lack of some variables in this analysis, such as abuse, multiple imputations were performed. A total of 20 multiple imputed datasets, including all measurement variables, were created using the multivariate normal imputation method under a "missing at random" assumption, after which the estimated parameters were combined using Rubin's combination methods. Because proportional hazard assumption was not permitted on the basis of Kaplan–Meier curve, Cox proportional-hazards model was not used. We performed Poisson regression analysis separately for each type of abuse to calculate the incidence rate ratios (IRRs) and 95% confidence intervals (CIs) for dementia onset after adjusting for all covariates. The analysis was performed by increasing the follow-up period every 500 days, which resulted in the following follow-up points: <500 days, <1,000 days, <1,500 days, <2,000 days, and the entire follow-up period. All statistical analyses were performed using Stata 16/IC (StataCorp, College Station, TX, USA).

Results

Table 1 presents the characteristics of the 12,236 respondents.

Among all included respondents, 5,674 (46.4%) and 6,562 (53.6%) were men and women, respectively; among them, 552 (9.7%) men and 728 (11.1%) women had dementia. A total of 109 (0.9%) participants experienced physical abuse; among participants who experienced physical abuse, 16 (14.7%) developed dementia during the follow-up period. In total, 1239 participants experienced psychological abuse, and 135 (10.9%) developed dementia during the follow-up period. Furthermore, 224 (1.8%) participants experienced financial abuse; among them, 34 (15.2%) developed dementia during the follow-up period.

Table 2 presents the IRRs with 95% CIs for the association between the types of elder abuse and dementia onset in Japanese older adults. After adjusting for potential confounders and analyzing according to the time points of <500 days, <1,000 days, <1,500 days, <2,000 days, and the entire follow-up period, participants who experienced financial abuse were, respectively, 2.11 (95% CI = 1.03–4.33), 1.91 (95% CI = 1.15–3.17), 2.02 (95% CI = 1.38–2.96), 1.54 (95% CI = 1.07–2.20), and 1.53 (95% CI = 1.09–2.16) times more likely to develop dementia than those who did not. On the other hand, participants who experienced physical abuse were, respectively, 1.71 (95% CI = 0.53–5.59), 1.11 (95% CI = 0.41–3.00), 1.12 (95% CI = 0.52–2.43), 1.59 (95% CI = 0.94–2.69), and 1.53 (95% CI = 0.92–2.56) times more likely to develop dementia than those who did not. Furthermore, participants who experienced psychological abuse were, respectively, 1.06 (95% CI = 0.73–1.56), 1.01 (95% CI = 0.77–1.32), 0.99 (95% CI = 0.79–1.24), 0.98 (95% CI = 0.81–1.18), and 0.98 (95% CI = 0.82–1.17) times less likely to develop dementia than those who did not. The differences observed for both physical and psychological abuses were, however, not significant. Results that show all covariates are in appendix.

Discussion

The present study investigated the association between types of abuse, such as physical, psychological, and financial abuses, and dementia onset among independent older adults in Japan. Our results showed that financial abuse is significantly associated with a higher risk of developing dementia during the follow-up period, whereas physical and psychological abuses showed no such association. To the best of our knowledge, this is the first longitudinal study to investigate the association between different types of elder abuse and dementia onset in older adults in Japan.

The present study found a positive association between financial abuse and dementia onset in older adults in Japan. This might be because of the level of involvement in social relationships. A previous study revealed an association between a lower risk of elder abuse and the higher levels of social capital.(Koga, Hanazato, et al., 2020) Some studies have also reported an association between a lower perceived social support and a higher risk of financial exploitation.(Beach & Schulz, 2016; Liu, Wood, Xi, Berger, & Wilber, 2017) Moreover, social relationship or social participation is known to potentially protect against dementia.(Fujihara et al., 2019; Nemoto et al., 2017; T. Saito, Murata, Saito, Takeda, & Kondo, 2018) For example, a study on dementia pathway by a previous study stated that cognitive stimulation by social relationship may prevent cognitive decline and, eventually, dementia onset.(Fratiglioni, Wang, Ericsson, Maytan, & Winblad, 2000) Financial abuse may also result in reduced social activities because of economic restrictions. Thus, low social relationships may be attributed to an increased risk of dementia onset. However, a study on dementia-free participants reported that decreased scam awareness is associated with the incidence of Alzheimer's disease. Older age, lower cognitive functioning, and lower literacy skills have also been reported to be associated with a higher susceptibility to scam. (Boyle, Yu, Schneider, Wilson, & Bennett, 2019; Peter A. Lichtenberga, Grossb, & Fickerc, 2020) Although we did not measure the scam perception, our analysis targeted independent older adults and included a question on whether paying bills was possible as part of the IADL questionnaire. We

found a significant association, and even after excluding these effects at baseline, the association remained. Therefore, dementia onset due to cognitive decline at baseline may not in this case.

This study found no association between physical abuse and dementia onset. One of the reasons might be the small number of cases that occurred. During the 6-year follow-up period, only 109 participants had dementia onset. In a previous study, no association was noted between physical violence such as being pushed, grabbed, kicked, or hit and dementia.(Cations et al., 2020) However, physical abuse might have led to brain damage if the violence was targeted at the face or head. Our analysis included a question on whether the respondents had ever been hit, kicked, or been thrown at with any objects. Although this study did not specify the body part that was hit, previous studies have suggested that brain damage from being hit during boxing or traumatic brain injury can cause dyskinesia, cognitive impairment, and behavioral disorders in later life.(Barnes et al., 2018; Jordan, 2000) In future, studies with large samples are necessary to ascertain the impact of physical abuse on dementia.

Similarly, no significant association was found between psychological abuse and dementia onset in our study population, suggesting that psychological abuse itself does not directly contribute to the development of dementia. A previous study reported that psychological interpersonal violence is significantly associated with mental health consequences, including depression, in both men and women,(Coker et al., 2002) whereas an observational study suggested that older adults with poor psychological conditions had a higher risk of dementia. (Takeda, Kondo, & Hirai, 2010) In our study, participants who had mild or severe depression were 1.23 (95% CI = 1.08–1.39) times more likely to develop dementia for the entire follow-up period. Hence, although depression resulting from continued psychological abuse may possibly increase the risk of dementia, it is unlikely that psychological abuse directly contributes to the risk of developing dementia. The content of the cutting remarks cannot be mentioned in this study, but it may have affected to refrain activities of the older adults, for example, if a participant is told that they see their friends too often or go out too much, that cause them to refrain from social interaction. Furthermore, in psychological abuse, whether it is considered abuse or not may vary depending on the perception of the individual, and there may be more variability in its measurement than in that of physical or financial abuse.

The present study has some limitations. First, this study did not assess dementia using clinical diagnostic criteria, which might have introduced misclassification of dementia among the participants. However, the scale criteria utilized herein had been validated to be in accordance with other assessments such as the Mini Mental State Examination.(Hisano, 2009) Second, missing data of nonrespondents might have introduced selection bias. Moreover, participants suffering from severe abuse might not have responded to the questionnaire, and this might have led to underestimating the results. Third, we excluded participants with marked ADL dysfunction and those on public long-term care insurance benefits because evidence suggests that ADL-dependent respondents are more likely to be abused.(Johannesen & Logiudice, 2013) Fourth, abuse in this study was measured using a self-administered questionnaire that had not been validated previously; therefore, its validity in accurately measuring elder abuse should be investigated in future studies. In addition, given that our sample targeted only Japanese older adults, studies on other populations should be conducted to confirm reproducibility. At present, studies that investigated the association between elder abuse and dementia onset are limited. To promote policy interventions, multifaceted analyses should be performed using cohort data as such as that used in the present study. Fifth, the body parts of the victims that were hit during physical abuses could not be determined. Finally, because the outcome is less likely to occur, validation with a larger sample should to be conducted. Despite the aforementioned limitations, this study provides important insights into the association between various types of elder abuse and dementia onset in older adults in Japan.

Conclusions

The present study investigated the association between physical, psychological, and financial abuses and dementia onset in independent older adults in Japan. The results showed a significant association between financial abuse and dementia onset over the 6-year follow-up period. Thus, preventing financial abuse may help prevent dementia. However, more studies with larger data sets are warranted.

Statement of Ethics

The Japan Gerontological Evaluation Study protocol was reviewed and approved by the Ethics Committee on Human Research of the Nihon Fukushi University (approval No. 10-05) and the Ethics Committee at the Chiba University Faculty of Medicine (approval No. 2493). Informed consent was obtained from all participants.

CRediT authorship contribution statement

Chie Koga: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft. **Taishi Tsuji:** Writing – review & editing, Funding acquisition. **Masamichi Hanazato:** Funding acquisition, Writing – review & editing, Resources. **Tomo Takasugi:** Writing – review & editing. **Katsunori Kondo:** Data curation, Funding acquisition, Resources, Supervision, Project administration.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Appendix

appendix

Appendix

Results of Poisson regression analysis between types of elder abuse and dementia with all variables.

	n	Dementia onset within <500 days of follow-up (n = 12,236)				Dementia onset within <1,000 days of follow-up (n = 12,236)				Dementia onset within <1,500 days of follow-up (n = 12,236)				Dementia onset within <2,000 days of follow-up (n = 12,236)				Dementia onset within the entire follow-up period (n = 12,236)			
		IRR	p	95%CI		IRR	p	95%CI		IRR	p	95%CI		IRR	p	95%CI		IRR	p	95%CI	
Physical abuse																					
No abuse	8,331	1.00				1.00				1.00				1.00				1.00			
Abuse	109	1.71	0.37	0.53	5.59	1.11	0.84	0.41	3.00	1.12	0.77	0.52	2.43	1.59	0.09	0.94	2.69	1.53	0.10	0.92	2.56
Psychological abuse																					
No abuse	7,169	1.00				1.00				1.00				1.00				1.00			
Abuse	1,239	1.06	0.75	0.73	1.56	1.01	0.94	0.77	1.32	0.99	0.91	0.79	1.24	0.98	0.80	0.81	1.18	0.98	0.84	0.82	1.17
Financial abuse																					
No abuse	8,500	1.00				1.00				1.00				1.00				1.00			
Abuse	224	2.11	0.04	1.03	4.33	1.91	0.01	1.15	3.17	2.02	<0.01	1.38	2.96	1.54	0.02	1.07	2.20	1.53	0.02	1.09	2.16
Depression																					
No depression	7,524	1.00				1.00				1.00				1.00				1.00			
Mild or severe depressives	2,701	1.42	0.02	1.06	1.91	1.36	<0.01	1.11	1.66	1.21	0.02	1.03	1.41	1.22	<0.01	1.07	1.39	1.23	<0.01	1.08	1.39
Sex																					
Male	5674	1.00				1.00				1.00				1.00				1.00			
Female	6562	1.49	0.07	0.96	2.31	0.98	0.90	0.74	1.31	1.07	0.55	0.85	1.35	1.07	0.46	0.89	1.29	1.05	0.57	0.88	1.26
Age (years)																					
65–69	3,374	1.00				1.00				1.00				1.00				1.00			
70–74	3,679	4.78	<0.01	1.83	12.45	2.56	<0.01	1.48	4.46	2.02	<0.01	1.42	2.87	2.02	<0.01	1.53	2.65	2.07	<0.01	1.59	2.68
75–79	2,829	9.72	<0.01	3.82	24.71	7.07	<0.01	4.22	11.87	4.78	<0.01	3.44	6.65	4.38	<0.01	3.38	5.67	4.52	<0.01	3.53	5.79
80–84	1,630	21.75	<0.01	8.60	54.99	13.01	<0.01	7.74	21.87	8.38	<0.01	6.00	11.70	7.74	<0.01	5.95	10.06	7.89	<0.01	6.14	10.16
≥85	724	41.12	<0.01	15.95	106.02	23.07	<0.01	13.49	39.46	13.45	<0.01	9.45	19.14	11.39	<0.01	8.60	15.09	10.92	<0.01	8.32	14.33
Education attainment																					
≤9	5,911	1.00				1.00				1.00				1.00				1.00			
≥10	6,014	0.90	0.49	0.66	1.22	1.08	0.47	0.88	1.33	0.96	0.63	0.82	1.13	1.00	0.95	0.88	1.13	0.97	0.60	0.85	1.09
Equivalent income																					
Low (<199)	4,982	1.00				1.00				1.00				1.00				1.00			
Mid (200–399)	3,901	1.09	0.60	0.79	1.51	0.99	0.92	0.79	1.24	0.93	0.39	0.78	1.10	0.96	0.60	0.84	1.11	0.96	0.59	0.84	1.10
High (>400)	1,157	1.08	0.77	0.64	1.83	0.98	0.90	0.67	1.42	0.86	0.34	0.63	1.18	0.88	0.35	0.69	1.14	0.90	0.41	0.71	1.15
Living arrangement																					
Living with someone	9,933	1.00				1.00				1.00				1.00				1.00			
Living alone	1,382	1.08	0.74	0.69	1.69	1.01	0.94	0.74	1.38	0.97	0.80	0.76	1.24	0.99	0.90	0.81	1.20	0.97	0.73	0.80	1.17
Marital status																					
Married	8,601	1.00				1.00				1.00				1.00				1.00			
Widowed	2,676	0.93	0.69	0.64	1.34	1.03	0.79	0.81	1.32	1.10	0.33	0.91	1.33	1.12	0.15	0.96	1.32	1.13	0.12	0.97	1.31
Separated	396	0.99	0.99	0.39	2.51	0.99	0.98	0.52	1.91	1.15	0.56	0.72	1.83	1.31	0.13	0.92	1.88	1.25	0.22	0.88	1.77
Unmarried	249	1.33	0.55	0.52	3.41	1.55	0.15	0.86	2.81	1.64	0.03	1.05	2.58	1.46	0.05	1.00	2.14	1.40	0.07	0.97	2.03
BMI																					
<18.5	884	1.00				1.00				1.00				1.00				1.00			
18.5–24.9	8,251	0.66	0.04	0.45	0.97	0.79	0.10	0.60	1.05	0.78	0.03	0.63	0.97	0.86	0.10	0.71	1.03	0.89	0.20	0.74	1.06
25.0–29.9	2,338	0.57	0.03	0.34	0.95	0.72	0.07	0.51	1.03	0.74	0.03	0.57	0.97	0.86	0.18	0.68	1.07	0.86	0.19	0.69	1.08
≥30	763	<0.01	0.98	0.00	.	0.16	0.06	0.02	1.06	0.54	0.09	0.26	1.11	0.74	0.28	0.43	1.27	0.74	0.25	0.44	1.24
Longest job held																					
Professional/technical	1,619	1.00				1.00				1.00				1.00				1.00			
Administrative	640	0.61	0.23	0.28	1.35	0.64	0.14	0.36	1.15	0.68	0.09	0.43	1.07	0.69	0.05	0.47	1.00	0.71	0.06	0.50	1.01
Clerical	1,629	0.95	0.84	0.56	1.60	0.98	0.93	0.66	1.45	1.05	0.75	0.77	1.43	1.12	0.37	0.87	1.44	1.12	0.33	0.89	1.42
Sales/service	1,577	0.89	0.68	0.51	1.55	1.05	0.82	0.70	1.56	1.13	0.44	0.83	1.54	1.18	0.20	0.92	1.52	1.09	0.51	0.85	1.39
Skilled/labor	1,383	0.55	0.05	0.30	1.00	0.76	0.19	0.50	1.15	0.82	0.23	0.60	1.13	0.86	0.25	0.66	1.12	0.85	0.21	0.66	1.10
Agriculture/forestry/fishery	1,181	0.58	0.06	0.32	1.03	0.67	0.07	0.44	1.03	0.76	0.10	0.55	1.06	0.85	0.22	0.65	1.10	0.85	0.23	0.66	1.10
Others	1,426	0.46	0.01	0.25	0.83	0.85	0.42	0.58	1.26	0.97	0.82	0.72	1.30	1.12	0.35	0.88	1.43	1.09	0.46	0.87	1.38

Appendix (*continued*)

	n	Dementia onset within <500 days of follow-up (n = 12,236) IRR	p	95%CI		Dementia onset within <1,000 days of follow-up (n = 12,236) IRR	p	95%CI		Dementia onset within <1,500 days of follow-up (n = 12,236) IRR	p	95%CI		Dementia onset within <2,000 days of follow-up (n = 12,236) IRR	p	95%CI		Dementia onset within the entire follow-up period (n = 12,236) IRR	p	95%CI	
No occupation	619	0.63	0.07	0.38	1.03	1.09	0.62	0.77	1.54	1.10	0.52	0.83	1.44	1.05	0.68	0.83	1.32	1.07	0.54	0.86	1.33
Alcohol consumption																					
Drinker	3,869	1.00				1.00				1.00				1.00				1.00			
Stop drinking	398	1.19	0.54	0.68	2.07	1.18	0.41	0.80	1.76	1.19	0.26	0.88	1.61	1.20	0.16	0.93	1.54	1.16	0.25	0.90	1.48
Non-drinker	7,966	0.82	0.27	0.57	1.17	0.94	0.61	0.73	1.20	0.94	0.53	0.78	1.14	0.97	0.70	0.83	1.13	0.98	0.83	0.85	1.14
Smoking																					
Never smoker	6,524	1.00				1.00				1.00				1.00				1.00			
Former smoker	2,560	1.42	0.12	0.92	2.18	1.01	0.93	0.76	1.35	1.08	0.51	0.86	1.35	1.13	0.20	0.94	1.36	1.10	0.27	0.92	1.32
Smoker	1,762	1.28	0.35	0.77	2.12	0.98	0.91	0.70	1.38	1.08	0.57	0.83	1.41	1.08	0.48	0.87	1.35	1.08	0.48	0.87	1.33
Frequency of meeting friends																					
4 times or more than a week	1,661	1.00				1.00				1.00				1.00				1.00			
2–3 times a week	2,638	1.39	0.27	0.77	2.49	1.10	0.61	0.76	1.59	0.95	0.73	0.73	1.25	0.99	0.91	0.80	1.22	0.98	0.85	0.80	1.20
Once a week	1,969	1.56	0.13	0.87	2.80	1.27	0.21	0.87	1.84	1.14	0.37	0.86	1.50	1.10	0.39	0.88	1.38	1.07	0.52	0.87	1.32
1–3 times a month	2,321	1.20	0.58	0.63	2.27	0.98	0.93	0.66	1.45	0.91	0.51	0.69	1.20	0.88	0.26	0.71	1.10	0.86	0.16	0.70	1.06
Few times a year	1,805	1.62	0.12	0.88	2.95	1.34	0.14	0.91	1.96	1.06	0.70	0.79	1.41	1.04	0.71	0.83	1.32	1.01	0.96	0.81	1.25
Not meeting	902	1.41	0.29	0.75	2.63	1.26	0.24	0.85	1.88	1.16	0.31	0.87	1.55	1.07	0.58	0.84	1.36	1.04	0.76	0.83	1.30
Occupational status																					
Worker	2,604	1.00				1.00				1.00				1.00				1.00			
Retired	6,428	1.70	0.10	0.91	3.17	1.45	0.04	1.02	2.06	1.21	0.15	0.94	1.57	1.27	0.03	1.03	1.57	1.29	0.02	1.05	1.58
Never worked	1,375	2.43	0.01	1.24	4.76	1.44	0.09	0.94	2.21	1.31	0.09	0.96	1.80	1.40	0.01	1.08	1.82	1.40	0.01	1.09	1.80
Daily walking time(minutes)																					
<30	3,884	1.00				1.00				1.00				1.00				1.00			
30–59	3,883	0.87	0.40	0.64	1.20	0.80	0.05	0.64	1.00	0.86	0.09	0.73	1.02	0.90	0.17	0.79	1.04	0.92	0.22	0.80	1.05
60–89	1,785	0.58	0.05	0.34	1.01	0.63	0.01	0.44	0.89	0.75	0.02	0.59	0.95	0.82	0.04	0.67	0.99	0.82	0.04	0.68	0.99
≥90	1,862	0.66	0.14	0.38	1.14	0.72	0.07	0.51	1.03	0.66	<0.01	0.50	0.87	0.75	0.01	0.61	0.94	0.77	0.01	0.62	0.95
Hypertension																					
No	4,579	1.00				1.00				1.00				1.00				1.00			
Yes	4,728	0.77	0.08	0.58	1.03	0.84	0.09	0.69	1.03	0.80	<0.01	0.68	0.93	0.83	<0.01	0.73	0.94	0.83	<0.01	0.74	0.94
Stroke																					
No	9,149	1.00				1.00				1.00				1.00				1.00			
Yes	158	2.15	0.04	1.04	4.46	1.59	0.10	0.91	2.80	1.50	0.08	0.95	2.39	1.55	0.02	1.07	2.26	1.52	0.02	1.06	2.19
Diabetes																					
No	7,814	1.00				1.00				1.00				1.00				1.00			
Yes	1,493	1.30	0.18	0.88	1.93	1.23	0.14	0.94	1.60	1.24	0.03	1.02	1.52	1.20	0.03	1.02	1.42	1.21	0.02	1.04	1.41
Hearing																					
No	8,393	1.00				1.00				1.00				1.00				1.00			
Yes	914	0.97	0.89	0.64	1.47	1.09	0.54	0.83	1.43	0.99	0.93	0.80	1.23	1.03	0.73	0.86	1.23	1.02	0.85	0.85	1.21
Instrumental activities of daily livingIADL																					
Independent	8963	1.00				1.00				1.00				1.00				1.00			
Dependent	2290	2.03	<0.01	1.49	2.77	2.06	<0.01	1.68	2.54	1.86	<0.01	1.58	2.18	1.63	<0.01	1.43	1.87	1.56	<0.01	1.37	1.77

IRR: incidence rate ratio
CI: confidence interval

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