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Evaluation of Risk Factors for Dementia Incidence Based on Previous Questionnaire Results of Specific Health Checkups in Japan

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Abstract: The prevalence of dementia is rapidly increasing worldwide, and its treatment and prevention are a health concern. The prevention of dementia requires the identification of risk factors through longitudinal studies of lifestyle. In this study, we aimed to identify the risk factors for the development of dementia in Japan and to clarify their primary care strategies. We analyzed the relationship between the cognitive ability level determined by the survey of long-term care certification and the past questionnaire results of a specific health examination in Japan 10 years ago. To analyze the risk factors for developing dementia, multivariate analysis was used, which showed that residents who gained more than 10 kg since reaching 20 years of age had a significantly lower risk of developing dementia. Regarding the "start of lifestyle modifications" question, those who answered "already started" had a significantly lower risk than those who answered "no plan to improve". Conversely, residents receiving insulin injections or oral hypoglycemic agents were at a significantly higher risk of developing dementia based on the results of the questionnaire of the health checkups surveyed 10 years prior.

Keywords: dementia; weight loss; long-term care; risk factor; checkups; exercise

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1. Introduction

The prevalence of dementia is rapidly increasing worldwide, and its treatment and prevention are a health concern [1]. According to the WHO, the number of people with dementia was estimated at 36 million in 2012 [2]. In addition, the G8 dementia summit reports that the number of patients afflicted with dementia worldwide will double in 20 years, from 66 million in 2030 to 115 million in 2050 [3]. According to a general research report on the future estimates of the elderly population with dementia by a research group of the Ministry of Health, Labor, and Welfare (MHLW) of Japan, 4.62 million people suffered from dementia in 2013, with a future estimate of 6.75 million in 2025 and 8.2 million in 2030 [4].

The risk of developing dementia increases with age and increases in people over the age of 70–75. Dementia imposes a heavy burden on both the patients and their families. Therefore, there is an urgent need to establish effective and standard preventive measures for dementia. As with other adult diseases, risk factors for dementia must first be identified in order to establish effective preventive measures. Disease prevention can be divided into three stages: "primary prevention", "secondary prevention", and "tertiary prevention". In order to decrease the incidence of dementia, it is necessary for society as a whole to work on "primary prevention" and "secondary prevention". This requires longitudinal cohort studies of people's lifestyle and health status to identify risk factors. Among lifestyle-related diseases, metabolic syndrome in middle-aged individuals and diabetes

in the elderly are known to be risk factors for dementia. Metabolic syndrome has been reported to be associated with an increased incidence of dementia progression [5]. In addition, diabetes has been reported as a risk factor for cognitive impairment [6–11]. There are several different studies on the association between middle-aged obesity and the development of dementia. A meta-analysis also reported an increased risk of dementia due to middle-aged obesity; however, the correlation between being underweight and dementia is controversial [12]. A meta-analysis further suggested that middle-aged obesity is positively associated with subsequent dementia. However, the effect of weight loss among middle-aged people on the risk of developing cognitive ability is unclear [13].

Weight loss in cases of dementia begins before cognitive decline and accelerates the pace of weight loss at the time of definitive diagnosis [14]. Previous epidemiological studies have suggested that dementia can cause involuntary weight loss before the onset of its clinical symptoms, and that weight loss may appear to be a risk factor for dementia [15–17]. However, the covariates in the statistical models of past studies differed significantly between studies. Consequently, some factors, such as diabetes, depression, high blood pressure, and stroke, can confound or disrupt the link between body mass index (BMI) and dementia [13]. Therefore, in order to analyze whether weight loss is a risk factor for dementia, multivariate analysis including medical records should be performed. In Japan, Yokomichi et al. suggested that being underweight and having diabetes are risk factors among the elderly for the incidence of dementia, and that lower BMI is also associated with the incidence of dementia [18]. In our previous study, abdominal circumference was a risk factor for dementia in an analysis that considered body weight, BMI, medical records, and various biochemical test results as confounding factors [19]. Therefore, it is important to analyze the effect of body weight on the incidence of dementia based on ethnicity and food culture [18].

On the other hand, it has been reported that dementia may also occur due to a potentially correctable risk factor, namely, lack of exercise [20], and disease prevention can be achieved through engaging in exercise. From human and animal studies, it was found that exercise may stimulate improvements in cerebrovascular function, perfusion, and neuroplasticity in the brain and may prevent progressive loss of cognitive function [21,22]. However, the causal relationship between cognitive function and exercise remains ambiguous in the elderly [23,24]. In addition, some randomized controlled trials analyzing the effects of exercise on dementia have shown inconsistent results [25–32]. Although studies on the effects of exercise on dementia patients have been reported, there are few studies on whether lack of exercise is a risk factor for the incidence of dementia in healthy subjects.

In 2008, the MHLW of Japan launched a specific health checkup policy to screen high-risk groups for metabolic syndrome. This health checkup/guidance policy is a national health program to prevent metabolic syndrome, encourage lifestyle-related interventions, and reduce medium- to long-term social security costs [33]. This specific health check consists of 30 items, including biochemical tests and a 24-item questionnaire. In addition, all people over the age of 40 are obliged to take out long-term care insurance in Japan. Residents in need of long-term care are provided with long-term care services at home and in institutions [34]. Municipalities provide various long-term care services with insurance to residents in need of long-term care [35]. When residents apply for nurse care, the Municipal Needs Certification Committee promptly investigates more than 70 functions, such as daily living function, cognitive function, physical function, living function, adaptation to society, and behavioral disorder. The level of care required is classified into seven tiers (support needs two stages, care needs five stages) [36]. The data from this Municipal Care Certification Survey include items related to dementia, where doctors measure the cognitive ability level in the subject.

The purpose of this study was to analyze the correlation between the cognitive ability level of the municipal investigation and the results of the past questionnaire on specific health checkups, and to evaluate risk factors for the development of dementia in Japan.

2. Materials and Methods

2.1. Study Population

The subjects included in this survey were insured individuals (population: 107,000) in Mishima City, Japan. A total of 606 people (207 men and 399 women; average age: 79.53 ± 4.27 years, 55–84 years) who received long-term care services, including a doctor's diagnosis of dementia in 2018 and a standard health examination program in 2008, were included. Individuals who were already diagnosed with dementia in 2008 were excluded from this study. The study's screening program was offered to people belonging to the insured community, over the age of 40, in 2008. The test consisted of 28 physical examinations, a laboratory examination, and a 24-item questionnaire.

2.2. Classification of Cognitive Ability Level

Doctors examine the core and the peripheral symptoms of dementia. To assess short-term memory, for example, they show patients three things that are very familiar to them. The things are put away, and five minutes later, the doctors ask questions about the three things to evaluate the patient's short-term memory ability. The ability to communicate intentions is evaluated on a four-point scale: can be communicated, can be communicated with some difficulty, only specific requests can be communicated, and cannot be communicated. In addition, doctors assess the peripheral symptoms of dementia for hallucinations, auditory hallucinations, delusions, day/night reversals, abuse, assault, resistance to long-term care, and wandering behavior. At the same time, the long-term care specialist evaluates the patient's cognitive function (9 items), mental/behavioral disorders (15 items), and adaptation to social life (6 items). Based on these diagnoses, doctors evaluate the cognitive ability level of patients in making daily decisions on a four-point scale: (1) can make on their own, (2) have some difficulty, (3) need support, and (4) have little ability.

2.3. Statistical Analysis

Lifestyles affecting the incidence of dementia were evaluated using a logistic regression analysis. To exclude confounding factors, multiple logistic regression analysis was performed and adjusted odds ratios (OR) were calculated. Prior to the analysis, individuals were divided into two categories, (I, II) and (III, IV), on the basis of their cognitive ability. Multivariate logistic regression analysis included cognitive ability levels (III-IV/I–II) as the dependent variable and the results of a specific health questionnaire as the independent variable (age, gender, medical history, drug intake status and lifestyle, and outpatient medical expenses). The above statistical analysis was based on SPSS ver26 (IBM Corp., Armonk, NY, USA) and Modeler ver 18.2 (IBM Corp., Armonk, NY, USA). This study was approved by the Institutional Review Board (NIPH-IBRA # 12137) of the National Institute of Public Health in Japan and the Mishima City Council. This study was conducted in accordance with the International Epidemiological Ethics Guidelines [37], Guidelines for Using the National Health Insurance Claim Database, Specific Health Examinations/Guidance [38], and Health Information System Security Guidelines [39]. Following the steps in these guidelines, researchers performed the analysis after individual data were anonymized by the municipality.

3. Results

Figure 1 shows the classification results of cognitive ability level in daily life (2018). Approximately 36.3% of residents were classified as cognitive ability level III or higher.

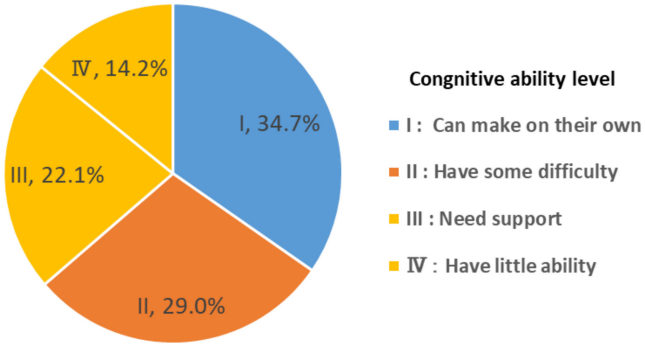

Figure 1. Result of cognitive level in making daily decisions (2018).

Table 1 shows the results of the cross-tabulation of the questionnaires conducted in 2008 and the cognitive ability level. As a result of the cross tabulation, significant differences were found in the items "heart disease history" and "anemia history".

Table 1. The results of the cross-tabulation of questionnaires conducted in 2008 and the cognitive ability level in daily life.

		Cognitive Ability Level in Daily Life					
		Can Make on Their Own	**Have Some Difficulty**	**Need Support**	**Have Little Ability**	**Total**	***p*-Value**
A medicine to lower blood pressure	Yes	113	96	68	41	318	0.704
		35.5%	30.2%	21.4%	12.9%	100.0%	
	No	97	80	66	45	288	
		33.7%	27.8%	22.9%	15.6%	100.0%	
Insulin injections or a medicine to lower blood glucose	Yes	27	26	28	13	94	0.243
		28.7%	27.7%	29.8%	13.8%	100.0%	
	No	183	150	106	73	512	
		35.7%	29.3%	20.7%	14.3%	100.0%	
A medicine to lower cholesterol	Yes	64	49	43	19	175	0.399
		36.6%	28.0%	24.6%	10.9%	100.0%	
	No	146	127	91	67	431	
		33.9%	29.5%	21.1%	15.5%	100.0%	
Stroke history	Yes	27	20	13	11	71	0.824
		38.0%	28.2%	18.3%	15.5%	100.0%	
	No	183	156	121	75	535	
		34.2%	29.2%	22.6%	14.0%	100.0%	
Heart disease history	Yes	23	22	19	2	66	0.037
		34.8%	33.3%	28.8%	3.0%	100.0%	
	No	187	154	115	84	540	
		34.6%	28.5%	21.3%	15.6%	100.0%	
Chronic renal failure history	Yes	0	1	0	0	1	0.485
		0.0%	100.0%	0.0%	0.0%	100.0%	
	No	210	175	134	86	605	
		34.7%	28.9%	22.1%	14.2%	100.0%	

Table 1. *Cont.*

		Cognitive Ability Level in Daily Life					
		Can Make on Their Own	**Have Some Difficulty**	**Need Support**	**Have Little Ability**	**Total**	***p*-Value**
Anemia history	Yes	38	18	17	6	79	0.033
		48.1%	22.8%	21.5%	7.6%	100.0%	
	No	172	158	117	80	527	
		32.6%	30.0%	22.2%	15.2%	100.0%	
Current regular smoker	Yes	27	17	19	8	71	0.521
		38.0%	23.9%	26.8%	11.3%	100.0%	
	No	18,300.0%	15,900.0%	11,500.0%	7800.0%	53,500.0%	
		34.2%	29.7%	21.5%	14.6%	100.0%	
Weight gained more than 10 kg since 20 years old	Yes	77	66	38	23	204	0.136
		37.7%	32.4%	18.6%	11.3%	100.0%	
	No	133	110	96	63	402	
		33.1%	27.4%	23.9%	15.7%	100.0%	
Exercising for 30 min or more, 2 days or more every week	Yes	92	78	59	35	264	0.995
		34.8%	29.5%	22.3%	13.3%	100.0%	
	No	118	98	75	51	342	
		34.5%	28.7%	21.9%	14.9%	100.0%	
Walking more than 1 h everyday	Yes	108	92	68	41	309	0.916
		35.0%	29.8%	22.0%	13.3%	100.0%	
	No	102	84	66	45	297	
		34.3%	28.3%	22.2%	15.2%	100.0%	
Walk faster than people of your age and sex	Yes	85	59	57	38	239	0.259
		35.6%	24.7%	23.8%	15.9%	100.0%	
	No	125	117	77	48	367	
		34.1%	31.9%	21.0%	13.1%	100.0%	
Weight gain or loss of more than 3kg over the last year	Yes	45	57	39	21	162	0.089
		27.8%	35.2%	24.1%	13.0%	100.0%	
	No	165	119	95	65	444	
		37.2%	26.8%	21.4%	14.6%	100.0%	
Eating pace	Faster	18	20	19	9	66	0.546
		27.3%	30.3%	28.8%	13.6%	100.0%	
	Normal	152	119	86	64	421	
		36.1%	28.3%	20.4%	15.2%	100.0%	
	Slower	40	37	29	13	119	
		33.6%	31.1%	24.4%	10.9%	100.0%	

Table 1. *Cont.*

		Cognitive Ability Level in Daily Life					
		Can Make on Their Own	**Have Some Difficulty**	**Need Support**	**Have Little Ability**	**Total**	***p*-Value**
Evening meal within 2 h before going to bed	Yes	26	24	15	9	74	0.870
		35.1%	32.4%	20.3%	12.2%	100.0%	
	No	184	152	119	77	532	
		34.6%	28.6%	22.4%	14.5%	100.0%	
Have snack after the evening meal	Yes	16	17	14	5	52	0.584
		30.8%	32.7%	26.9%	9.6%	100.0%	
	No	194	159	120	81	554	
		35.0%	28.7%	21.7%	14.6%	100.0%	
Skip breakfast 3 days or more per week	Yes	12	10	5	6	33	0.752
		36.4%	30.3%	15.2%	18.2%	100.0%	
	No	198	166	129	80	573	
		34.6%	29.0%	22.5%	14.0%	100.0%	
Drink alcohol	Rarely (can't drink)	33	24	21	15	93	0.832
		35.5%	25.8%	22.6%	16.1%	100.0%	
	Sometimes	36	33	20	10	99	
		36.4%	33.3%	20.2%	10.1%	100.0%	
	Everyday	141	119	93	61	414	
		34.1%	28.7%	22.5%	14.7%	100.0%	
Feel refreshed after a night's sleep	Yes	161	124	98	67	450	0.448
		35.8%	27.6%	21.8%	14.9%	100.0%	
	No	49	52	36	19	156	
		31.4%	33.3%	23.1%	12.2%	100.0%	
Start lifestyle modifications	no plan to improve	40	41	23	10	114	0.10
		35.1%	36.0%	20.2%	8.8%	100.0%	
	going to start in the future (within 6 months)	23	17	6	6	52	
		44.2%	32.7%	11.5%	11.5%	100.0%	
	going to start soon (in a month)	21	19	9	11	60	
		35.0%	31.7%	15.0%	18.3%	100.0%	
	already started (<6 months ago)	60	47	42	20	169	
		35.5%	27.8%	24.9%	11.8%	100.0%	
	already started (≥6 months ago)	66	52	54	39	211	
		31.3%	24.6%	25.6%	18.5%	100.0%	

Table 1. *Cont.*

		Cognitive Ability Level in Daily Life					
		Can Make on Their Own	**Have Some Difficulty**	**Need Support**	**Have Little Ability**	**Total**	***p*-Value**
Willing to have Health Guidance	Yes	113	87	69	34	303	0.163
		37.3%	28.7%	22.8%	11.2%	100.0%	
	No	97	89	65	52	303	
		32.0%	29.4%	21.5%	17.2%	100.0%	
	Total	210	176	134	86	606	
		34.7%	29.0%	22.1%	14.2%	100.0%	

p-value: Chi-square test.

First, a univariate logistic analysis was performed to determine the crude odds ratio, and significant crude odds ratios were obtained for the two items, "weight gain of more than 10 kg since 20 years old" and "start of lifestyle modifications" (Table 2). Subsequently, multivariate logistic regression analysis was performed to eliminate confounding factors and investigate risk factors for the development of dementia, and a significant OR was observed for the development of dementia in three items, including "insulin injection or hypoglycemic medications (Yes/No)", "weight gain of more than 10 kg since 20 years old", and "start of lifestyle modifications" (Table 2). Residents who received oral hypoglycemic drug or insulin injection were at a significantly higher risk of developing dementia (OR: 1.713, 95% CI: 1.048–2.798). Residents who gained more than 10 kg since reaching 20 years of age had a significantly lower risk of developing dementia (OR: 0.623, 95% CI: 0.415–0.935) (Table 2). Regarding the "start of lifestyle modifications" item, those who answered "already started (<6 months ago)" or "already started (≥6 months ago)" had a significantly lower risk than those who answered "no plan to improve". No significant OR was obtained for other lifestyle or dietary items, medical history, or outpatient medical expenditures in 2008 (Table 2).

Table 2. Results of logistic regression analysis.

Item		**Crude Odds Ratio**	**95% CI**		***p*-Value**	**Multivariate Adjusted Odds Ratio**	**95% CI**		***p*-Value**
			Lower Limit	**Upper Limit**			**Lower Limit**	**Upper Limit**	
Age	years	1.026	0.986	1.068	0.211	1.017	0.974	1.062	0.443
Sex	(Female/Male)	0.914	0.645	1.294	0.612	0.950	0.601	1.502	0.826
A medicine to lower blood pressure	(Yes/No)	0.832	0.597	1.159	0.276	0.832	0.573	1.207	0.332
Insulin injections or a medicine to lower blood glucose	(Yes/No)	1.439	0.921	2.249	0.110	1.713	1.048	2.798	0.032
A medicine to lower cholesterol	(Yes/No)	0.948	0.657	1.368	0.775	1.155	0.769	1.737	0.487
Stroke history	(Yes/No)	0.883	0.524	1.489	0.641	0.951	0.531	1.704	0.865
Heart disease history	(Yes/No)	0.800	0.463	1.381	0.423	0.972	0.533	1.771	0.925
Chronic renal failure history	(Yes/No)	0.000	0.000		1.000	0.000	0.000		1.000
Anemia history	(Yes/No)	0.688	0.410	1.153	0.156	0.653	0.377	1.133	0.130

Table 2. *Cont.*

Item		Crude Odds Ratio	95% CI		*p*-Value	Multivariate Adjusted Odds Ratio	95% CI		*p*-Value
			Lower Limit	Upper Limit			Lower Limit	Upper Limit	
Current regular smoker	(Yes/No)	1.087	0.653	1.812	0.748	0.995	0.566	1.749	0.987
Weight gained more than 10 kg since 20 years old	(Yes/No)	0.652	0.455	0.935	0.020	0.623	0.415	0.935	0.022
Exercising for 30 min or more, 2 days or more every week	(Yes/No)	0.948	0.679	1.324	0.754	0.893	0.604	1.320	0.570
Walking more than 1 h everyday	(Yes/No)	0.913	0.656	1.272	0.591	0.867	0.587	1.282	0.475
Walk faster than people of your age and sex	(Yes/No)	1.277	0.912	1.789	0.155	1.418	0.970	2.073	0.072
Weight gain or loss of more than 3kg over the last year		1.044	0.719	1.516	0.821	1.294	0.854	1.962	0.224
Eating pace									
Normal	Reference Group								
Faster		1.015	0.663	1.553	0.946	0.874	0.549	1.394	0.573
Slower		1.351	0.730	2.502	0.339	1.464	0.754	2.842	0.260
Evening meal within 2 h before going to bed	(Yes/No)	0.823	0.490	1.381	0.460	0.785	0.440	1.400	0.412
Have snack after the evening meal	(Yes/No)	1.011	0.560	1.825	0.971	1.215	0.640	2.305	0.552
Skip breakfast 3 days or more per week	(Yes/No)	1.011	0.560	1.825	0.971	0.862	0.384	1.932	0.718
Drink alcohol									
Rarely (can't drink)	Reference Group								
Sometimes		0.734	0.458	1.178	0.200	0.653	0.391	1.092	0.104
Everyday		1.066	0.672	1.693	0.786	1.136	0.634	2.036	0.667
Feel refreshed after a night's sleep	(Yes/No)	1.063	0.727	1.555	0.752	1.091	0.722	1.650	0.679
Start lifestyle modifications									
no plan to improve	Reference Group								
going to start in the future (within 6 months)		0.735	0.486	1.113	0.146	0.702	0.436	1.130	0.145
going to start soon (in a month)		0.634	0.348	1.158	0.138	0.578	0.299	1.117	0.103

Table 2. *Cont.*

Item		Crude Odds Ratio	95% CI		*p*-Value	Multivariate Adjusted Odds Ratio	95% CI		*p*-Value
			Lower Limit	Upper Limit			Lower Limit	Upper Limit	
already started (<6 months ago)		0.381	0.189	0.767	0.007	0.335	0.157	0.714	0.005
already started (≥6 months ago)		0.517	0.317	0.842	0.008	0.473	0.274	0.816	0.007
Willing to have Health Guidance	(Yes/No)	0.819	0.588	1.141	0.237	0.969	0.662	1.419	0.873
Outpatient Medical Expenditures (2008)		1.000	1.000	1.000	0.688	1.000	1.000	1.000	0.456
_cons						0.336			0.508

Dependent variable was classified to (III,IV)/(I,II).

4. Discussion

The number of residents certified as requiring long-term care in Japan increased from 2.18 million at the end of 2000, when the long-term care insurance system was established, to 6.68 million at the end of 2020 [35]. In order to receive these care services, residents must apply for long-term care qualifications in the area and undergo a long-term care certification survey. In this nurse care survey, doctors and nurse care reviewers assess the physical and mental condition of the applicant and identify the type of care required. The results of this accreditation survey are used to assess the level of care required by all Japanese residents. The data investigated in this review are collected nationwide and continue to accumulate in a large database. This database is expected to help identify risk factors for the incidence of dementia and to clarify primary care policies.

In Japan, specific health examinations and health guidance to prevent metabolic syndrome were initiated in 2008 [40]. The National Health Insurance Claims Database for this specific medical checkup shows that there is a difference in annual medical costs between those who have been screened for metabolic syndrome reserves and those who have not [41]. Based on the results of these health examinations, residents who require specific health guidance according to the risk can be classified as requiring one of three levels of support. Specific health guidance will guide the improved lifestyle-related risks, such as eating habits and exercise habits, and if the risk factors for the development of dementia can be identified from the collected results of this specific health checkup, these systems may be able to provide support to prevent the risk of dementia as well as metabolic syndrome. In this study, lifestyle risk factors were identified by matching a specific health checkup questionnaire with long-term care certification 10 years later.

The results of this study showed that those who answered "weight gain of more than 10 kg since 20 years old" had a lower risk of dementia. Qizilbash N et al. reported that being underweight after middle age increased the risk of dementia over the next 20 years [42]. Nam GE et al. reported that a decreased baseline BMI has been associated with an increased risk of dementia of all causes, and weight loss was also reported to be significantly associated with the risk of developing dementia [43]. On the other hand, Kivimäki M et al. reported that higher BMI was an important risk factor for dementia if BMI was detected more than twenty years before the onset of dementia. However, they reported that a low BMI was a significant risk factor for dementia if measured within ten years of diagnosis [44]. In Japan, women with high blood pressure and low weight

and men with dyslipidemia and low weight have been reported to be at increased risk of developing dementia. [14]. In our previous study, we performed a multivariate analysis by adding abdominal circumference simultaneously as an independent variable with BMI and body weight. We did not obtain a significant OR for BMI and body weight, but a significant OR was obtained for abdominal circumference [19]. Few studies have examined the association between abdominal circumference and the development of dementia, and further studies using multivariate analysis using abdominal circumference, body weight, and BMI simultaneously as independent variables are needed in the future.

Although previous studies have reported the effects of physical exercise on cognitive function [8–10], the results for people with dementia have been inconsistent [11,12]. In addition, there are few studies on whether lack of exercise in healthy people affects the development of dementia in the future. In this study, no significant OR was obtained for exercise-related lifestyle habits, such as "exercising for 30 min or more, 2 days or more every week" and "walking more than 1 h daily" reported in the survey 10 years prior.

On the other hand, residents who answered "already started" when asked about "start of lifestyle modifications" had a significantly lower risk of developing dementia. Therefore, providing guidance to increase the motivation for lifestyle-related improvements in specific health guidance can be effective.

In this study, individuals taking insulin injections or oral hypoglycemic agents were at an increased risk of developing dementia. Hirabayashi et al. have reported that diabetes is a risk factor for dementia, and hippocampal atrophy with the progression of diabetes has been reported to occur especially in patients with long-term illness [45–47]. The results of this study are consistent with the results of these previous reports.

In the future, to prevent the onset of dementia in Japan, it is necessary to clarify more accurate risks, such as lifestyle-related diseases. If the risk of developing dementia becomes clear, it is possible that specific health examinations and guidance already being implemented in Japan to prevent metabolic syndrome can also be used to prevent dementia. Therefore, in the future, larger samples and long-term studies are needed to identify specific health care items related to the risk of dementia.

5. Conclusions

The results of this study suggest that those who have been prescribed insulin injections or hypoglycemic agents have an increased risk of dementia based on the questionnaire-specific health checkups. In contrast, those who gained more than 10 kg since reaching 20 years of age and those who answered "already started to improve" in the question regarding the "start of lifestyle modifications" had a lower risk 10 years after the first survey. Further long-term studies using larger samples are needed to identify specific health care items that screen for the risk of developing dementia.

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Informed Consent Statement: The data used in this study was anonymous data with personal information removed by the municipality. In Japan, the national data of medical receipts and specific medical examinations can be used for academic research with high public interest for purposes other than the original purpose without the consent of the residents. (24 December 2010 Minister of Health, Labor and Welfare Notification No. 424).

Data Availability Statement: To protect the participants' anonymity, the data will not be shared unless requested through an administrative procedure.

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