INTERNAL MEDICINE

□ ORIGINAL ARTICLE □

Even Low-Intensity and Low-Volume Exercise Training May Improve Insulin Resistance in the Elderly

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Abstract

Objective Moderate to high intensity exercise training is known to ameliorate the coronary risk factors in relation to an improvement in body composition. However, the benefit of low-intensity and low-volume training for these risk factors remains unclear in elderly people. Therefore, we investigated the effects of low-intensity and low-volume exercise training on blood lipid values and insulin resistance in the elderly.

Methods A total of 56 healthy elderly individuals (42 females and 14 males) aged 64±6 years participated in a 12-week exercise program, comprising aerobic training and resistance training.

Results After the program, there were no significant changes in high-density lipoprotein cholesterol, triglyceride serum levels, or in peak oxygen uptake on average. However, the homeostasis of minimal assessment of insulin resistance (HOMA-IR) value was significantly reduced by 21%. The participants were categorized into tertiles based on initial Body Mass Index (BMI). The Middle-BMI group (non-obese subjects) showed reduced HOMA-IR (2.0→1.3, $P<0.01$), but this reduction was not associated with the reduction in BMI ($r=0.08$, $P=0.74$), whereas the two reductions were significantly associated in the High-BMI group ($r=0.61$, $P=0.01$).

Conclusion Even low-intensity and low-volume exercise training, which would ordinarily be insufficient for improving mean lipid values or aerobic fitness, was found to be effective in improving insulin resistance in the elderly. The improvement in insulin resistance was independent of the improvement in obesity.

Key words: elderly, exercise training, low-intensity, insulin resistance, aerobic fitness, obesity

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Introduction

Dyslipideamia [i.e. high serum levels of triglycerides (TG) and/or low serum levels of high density lipoprotein cholesterol (HDL-C)] and insulin resistance are major risk factors for coronary heart disease (CHD) in elderly people (1). It is well known that moderate to high intensity exercise training ameliorates these risk factors for CHD. Additionally, the improvements in blood lipids and insulin resistance are associated with loss of body weight and/or body fat (2-5). By contrast, the improvements in physical fitness achieved by exercise training are not necessarily associated with a reduction in these risk factors (2-4).

Regular exercise training can also help to reduce CHD risk factors in the elderly (6). Because elderly people have more physical and/or medical limitations than middle-aged people, however, the intensity of the exercise program is usually lower and the amount of exercise undertaken tends to decline with aging (7-9). Although feasible for most elderly people, such low-intensity and low-volume exercise may be insufficient to improve lipid metabolism and/or insulin resistance. Indeed, few studies have investigated whether a low level of exercise training is also effective in improving insulin resistance and/or blood lipid levels (10). Moreover, the relationship between the improvement in metabolic pa-

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rameters and physical fitness remains unknown.

Thus, here we have investigated the effects of a low-intensity and low-volume exercise program suitable for the elderly on lipid and glucose metabolism in this population. Where exercise resulted in metabolic improvements, we also investigated the association between these metabolic improvements and the exercise-related physical improvements in body composition and aerobic fitness.

Methods

Subjects

A total of 75 older adults (26 males, aged 68±6 years; and 49 females, aged 65±6 years) volunteered to participate in the exercise program through public advertisement. Individuals were excluded if they had 1) cardiovascular disease, renal failure or other serious illnesses; 2) orthopedic problems likely to interfere with exercise participation; 3) resting blood pressure >159/99 mmHg; or 4) plasma total cholesterol >300 mg/dL, and triglyceride concentration >500 mg/dL. Individuals on medication, including antihyperlipidemic or antihypertensive drugs, were included if there was no change in the dose throughout the intervention period. Subjects gave their written consent to participate in the study, which had received the approval of the Ethics Committee of University of Tsukuba.

Measurement of body composition

Body composition was evaluated by BMI and abdominal fat area. BMI was calculated as the weight/(height)^2(kg/m^2). Abdominal fat area was determined by computed tomography (CT) scan (Aquilion16, Toshiba, Tokyo, Japan) according to the procedure of Tokunaga et al (16), in which the total fat area (TFA) and visceral fat area (VFA) were measured at the level of the umbilicus.

Measurement of aerobic capacity

Aerobic fitness was assessed as peak oxygen uptake (VO_2 peak). The subjects sat quietly on a cycle ergometer (75 XLII, Combi Co, Tokyo, Japan) for 3 min and then warmed up at a rate of 0.5 Kp over 4 min. They then pedaled at the higher rate of 0.5 Kp/min. The air expired was analyzed breath-by-breath by using an automatic expired gas analyzer (AE280, MINATO, Osaka, Japan). The VO_2 peak tests fulfilled at least one of the following three criteria: 1) systolic blood pressure >250 mmHg; 2) heart rate within 10 beats/min of the maximal heart rate predicted for age; 3) volitional fatigue. Ventilatory threshold (VT) was determined by the V-slope method (12), using computer regression analysis of the plot of carbon dioxide production versus oxygen consumption.

Blood sampling

Blood was drawn in the morning after an overnight fast. Total cholesterol (TC), HDL-C, TG, fasting immunoactive insulin (IRI), fasting plasma glucose (FPG) and glycosylated hemoglobin (HbA_1c) were determined. Plasma glucose was measured by the glucose oxidase method. HbA_1c was measured by Latex agglutination. Serum TC, TG and HDL-C were determined by enzymatic methods. Low density lipoprotein cholesterol (LDL-C) was calculated by the Friedewald formula (13). However, LDL-C was not calculated if the TG level was >300 mg/dL. Serum insulin was determined by enzyme immunoassay (EIA). Insulin resistance was evaluated by HOMA-IR [FPG (mg/dL)×IRI (μLU/mL)/405], according to the method developed by Matthews et al (14).

Measurement of blood pressure (BP)

BP was not measured for practical reasons, namely, minimizing the variation across measurements calls for five or more BP measurements to be taken in at least two settings (15) and the reproducibility of within-day BP measurements is known to be poor (16).

Diet evaluation

Dietary intake was estimated on the basis of consecutive three-day (including one weekday) food diaries at the beginning and the end of the program. Each participant was instructed on how to record detailed descriptions of all foods consumed. Total dietary energy and lipid intake were calculated with the PC software 'Food Frequency Questionnaire Based on Food Groups' Ver. 2.3 (Kenpaku Co., Tokyo).

Exercise training program

A 12-week supervised training program was designed to improve the aerobic capacity and strength of large muscle groups (back, abdomen, lower and upper bodies). Two different training elements were employed in the program: low-intensity aerobic training three times a week, and resistance training with body weight alone (no external load) twice a week. Aerobic training was carried out for 30 min at 80% VT (corresponding to 50.2±8.6% of VO_2 peak) on the basis of an initial maximal graded exercise tolerance test. The resistance exercises selected were seated knee extension, hip extension in the standing position, knee flexion while holding onto a wall, calf raise, bent-knee sit up, back extension in the prone position, and bent knee push up (with knees on the floor). The subjects performed three sets of 10 repetitions.

Statistical analysis

The results are expressed as the mean ± standard deviation (SD). Analysis of variance (ANOVA) was used to compare variables between males and females or among stratified groups. Duncan's multiple range test was used to identify the difference across stratified groups if the ANOVA was significant. Pearson's correlation coefficient (r) was used to assess the relationship between changes in physical and metabolic parameters. A P value of less than or equal to 0.05 was considered to be statistically significant. SPSS 13.0

Table 1. Physical and Metabolic Profiles before and after Training

variable	before	after	Mean Relative Changes (%)	Confidence Interval (%)
age (yr)	64 ± 6			
Body mass index (kg/m^2)	23.4 ± 2.4	22.9 ± 2.3	−1.9 ± 2.9^b	[−2.7, −1.1]
Total fat area (cm^2)	202 ± 75	187 ± 72	−1.0 ± 3.3	[−10.0, 8.0]
Visceral fat area (cm^2)	72 ± 45	63 ± 40	−1.8 ± 4.9	[−15.2, 11.7]
VO_2 peak (mL/kg/min)	22.5 ± 4.2	22.8 ± 3.6	2.7 ± 12.4	[−0.7, 6.1]
Triglycerides (mmol/L)	1.20 ± 0.66	1.12 ± 0.58	0.3 ± 33.1	[−8.7, 9.3]
HDL cholesterol (mmol/L)	1.55 ± 0.37	1.59 ± 0.37	3.2 ± 13.2	[−0.4, 6.8]
LDL cholesterol (mmol/L)	3.31 ± 0.70	3.12 ± 0.65	−4.1 ± 14.8^c	[8.2, −0.0]
Fasting plasma glucose (mmol/L)	5.81 ± 0.72	5.73 ± 0.78	−0.9 ± 7.2	[−2.9, 1.0]
Fasting plasma insulin (pmol/L)	58.0 ± 36.2	44.5 ± 36.3	−20.6 ± 31.5^b	[−29.2, −12.0]
HOMA-IR	2.2 ± 1.5	1.7 ± 1.4	−18.4 ± 34.7^b	[−27.7, −9.0]
HbA_1c (%)	5.2 ± 0.5	5.1 ± 0.5	−1.0 ± 4.0	[−2.1, 0.1]

Data were mean±SD. ^{a}Relative changes are post-training to pre-training values. $^b P<0.01$, $^c P<0.05$

J for Windows software (SPSS Institute, Chicago, IL) was used for the analysis.

Results

Effect of exercise on physical and metabolic profiles

Of the 75 participants enrolled in the trial, 56 (14 males and 42 females; mean age, 64±6 years) who attended more than 85% of the 12-week training program and provided all of the pre- and post-training data were included in the analysis. Dietary intake did not change significantly during the intervention (data not shown). The physical and metabolic characteristics of the subjects at the beginning and the end of the 12-week training program are shown in Table 1. There were no differences between the genders in the baseline values or in the responses to the 12-week exercise program, except that women had significantly higher LDL-C than men (3.46±0.60 mmol/L vs. 2.85±0.81 mmol/L; $P=0.02$). There were no significant changes in TFA, VFA, VO_2 peak, HDL-C, TG, FPG, or HbA_{1c}. The reduction in BMI was small but highly significant ($P<0.001$). A borderline-significant reduction was seen in LDL-C (-4%, $P=0.05$). By contrast, the relative changes in IRI and HOMA-IR were larger (-20% and -21%, respectively) than those in the other variables and were statistically significant ($P<0.001$ for both).

Relationship between physical and metabolic profiles

To investigate whether there was an association between the improvement in insulin resistance and physical changes, we tested for a correlation between the reduction in HOMA-IR and other physical changes. We found a borderline significant correlation between the reduction in HOMA-IR and the reduction in BMI ($r=0.26$, $P=0.06$). However, neither the improvement in VO_2 peak nor that in VFA was significantly related to the reduction in HOMA-IR ($r=-0.19$, $P=0.17$, and $r=0.06$, $P=0.65$, respectively).

To investigate in more detail the relationship between the reduction in HOMA-IR and the physical changes, we divided the data into tertiles on the basis of the baseline BMI and VO_2 peak values. The data stratified into tertiles by baseline BMI are shown in Table 2. The reduction in BMI was small but statistically significant in all groups. A paired t-test confirmed that there was a significant reduction in HOMA-IR in the Middle- and High-BMI groups ($P<0.01$ and $P=0.04$, respectively). In the High-BMI group, there was a significant correlation between the reduction in HOMA-IR and the reduction in BMI ($r=0.61$, $P=0.01$) (Fig. 1), and the association between the reduction in HOMA-IR and the reduction in VFA was borderline significant ($r=0.47$, $P=0.06$). In the Middle-BMI group, however, the reduction in HOMA-IR was independent of the reduction in BMI ($r=0.08$, $P=0.74$) (Fig. 1) or VFA ($r=0.07$, $P=0.79$).

The data categorized into tertiles by baseline VO_2 peak are shown in Table 3. Exercise training led to a significant improvement in VO_2 peak in the Middle- and Low-VO_2 peak groups ($P=0.02$ and $P=0.02$, respectively), but there was no significant improvement across all three groups (see Table 1) or in the High-VO_2 peak group.

ANOVA did not reveal a difference in the reduction in HOMA-IR among the three groups ($P=0.69$). In the Middle-VO_2 peak group, we did not find a significant relationship between the reduction in HOMA-IR and the improvement in VO_2 peak, as in the overall analysis. In the Low-VO_2 peak group, however, the reduction in HOMA-IR was related to the improvement in VO_2 peak (Fig. 2).

Discussion

Previous reports have noted that exercise training may improve insulin resistance and lipid metabolism in elderly subjects (17-21). However, it is doubtful whether the exercise training programs studied are feasible for most elderly people. Thus, here we implemented a low-intensity (~50% VO_2 peak) and low-volume (90 min/wk in aerobic training) exercise training program that, to our knowledge, has not previously been studied.

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Table 2. Mean Values of the Subjects Stratified into Tertiles of BMI

BMI tertile	Low		Middle		High		Significance (at baseline)[c]
	pre	post	pre	post	pre	post	
No. of participants (women)	19 (15)		19 (13)		18 (14)		
Age (yrs)	66±6		63±6		63±6		NS
BMI (kg/m²)	20.9±1.1	20.7±1.2[a]	23.4±0.7	22.7±0.9	26.0±1.3[a]	25.5±1.6	L< M< H
TFA (cm²)	146±42	134±50	193±51	181±53	268±75	246±65	L< M< H
VFA (cm²)	37±21	34±19	70±32	63±34	106±47	88±44	L< M< H
VO_2 peak	24.2±4.5	23.1±3.5	22.1±2.4	23.9±3.4	21.2±4.9	21.2±3.5	L> H
TG (mmol/L)	0.91±1.42	0.83±0.33	1.22±0.78	1.11±0.71	1.48±0.42	1.42±0.50	L< H
HDL-C (mmol/L)	1.75±0.34	1.81±0.28	1.52±0.42	1.58±0.43	1.36±0.22	1.37±0.24	L> M, H
LDL-C (mmol/L)	3.30±0.60	3.05±0.52[a]	3.44±0.66	3.22±0.61	3.18±0.84[a]	3.09±0.82	NS
FPG (mmol/L)	5.81±0.86	5.83±1.12	5.75±0.76	5.63±0.65	5.83±1.12	5.75±0.76	NS
IRI (pmol/L)	45.0±36.6	41.7±53.8	53.7±28.1	34.5±17.1	76.3±38.6	58.8±23.1	L< H
HOMA-IR	1.8±0.6	1.6±2.1	2.0±1.1	1.3±0.7	2.9±1.5	2.1±0.9	L< H
HbA_1c (%)	5.3±0.7	5.3±0.8	5.2±0.4	5.1±0.3	5.3±0.8	5.2±0.4	NS

Data were mean±SD [a] Significant difference (P<0.01) between pre- and post-training value by the paired t test.

[b] Significant difference (P<0.05) between pre- and post-training value by the paired t test.

[c] Analysis of variance (ANOVA) and Duncan's multiple range test was performed to investigate the difference in initial values among tertiles. NS, not significant.

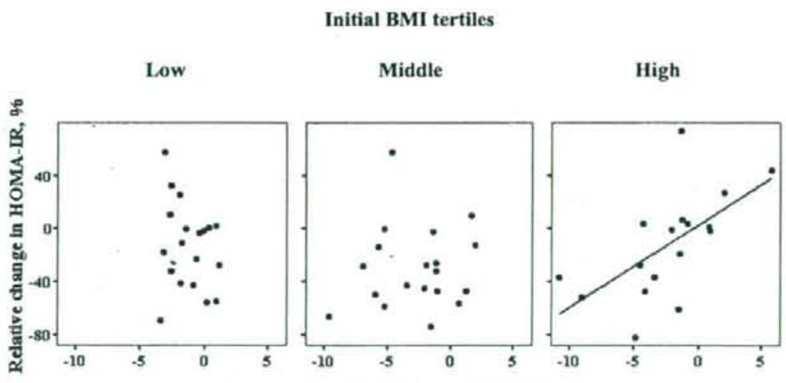

Figure 1. Relationships between relative change in HOMA-IR and relative change in BMI in three groups stratified on the basis of baseline BMI (Low, Middle, High). Low: y=-18.84+ -5.12x, r= -0.24 (P=0.33), Middle: y=-27.31+0.81x, r=0.08, (P=0.74), High: y=2.25+6.16x, r=0.61 (P=0.01).

This exercise training did not result in an improvement in serum HDL-C or TG levels in the elderly. Several studies suggest that there is a dose-response relationship between exercise training volume and blood lipid changes in the general population (22). Our result indicates, however, that low-volume exercise training is not sufficient to alter lipid values in the elderly.

The American College of Sports Medicine (ACSM) has stated that exercise training at an intensity of less than about 50% maximal oxygen uptake (VO_2 max) is generally not sufficient for developing fitness in healthy adults (23). In the present study, the VO_2 peak did not significantly increase after training on average (Table 1) or in those individuals with an initially high VO_2 peak (Table 3), consistent with the statement by the ASCM. This finding suggests that low-intensity (i.e. 50% of maximal aerobic capacity or less) exercise training is also not necessarily effective in improving aerobic capacity in healthy elderly people. By contrast, a large reduction in mean IRI and HOMA-IR was seen after the exercise training program. This finding indicates that even a low level of exercise that fails to improve lipid values and/or aerobic fitness can improve insulin resistance in elderly subjects.

Several studies have indicated that an improvement in insulin resistance is associated with weight and/or fat loss but not with an exercise-induced improvement in aerobic capac-

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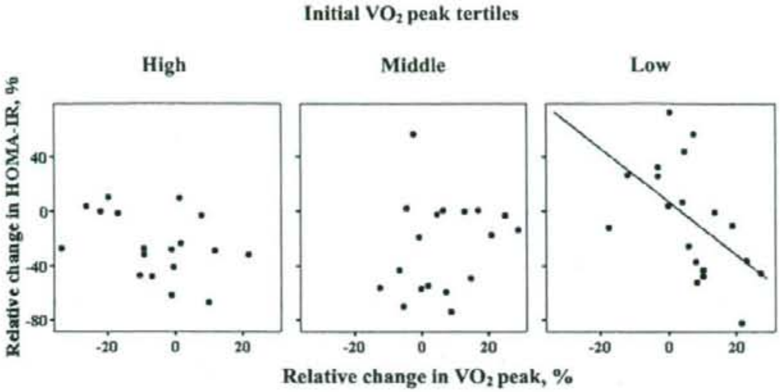

Figure 2. Relationships between relative change in HOMA-IR and relative change in VO_2 peak in three groups stratified on the basis of baseline aerobic fitness (Low, Middle, High-VO_2 peak). Low: y=7.01+1.97x, r=-0.54 (P=0.02), Middle: y=-29.30+0.63x, r=0.21 (P=0.40), High: y=-27.75+ -0.61x, r=-0.37 (P=0.13).

Table 3. Mean Values of the Subjects Stratified into Tertiles of VO_2 Peak

VO_2 peak tertile	Low pre	Low post	Middle pre	Middle post	High pre	High post	Significance (at baseline)[c]
No. of participants (female)	19 (13)		18 (14)		19 (15)		
age (yrs)	62±5		64±6		66±6		H< L
VO_2 peak (mL/kg/min)	27.0±3.2	25.1±2.5	22.2±0.8	23.7±2.6[b]	18.4±1.9	19.7±3.1[b]	H> M> L
BMI (kg/m^2)	22.8±2.1	22.3±2.0[a]	22.7±0.9	22.3±1.9[b]	24.7±2.7	24.2±2.6[b]	M, H< L
TFA (cm^2)	181±66	175±67	161±43	149±53	255±76	229±71	M< L
VFA (cm^2)	70±45	65±42	54±31	43±24	88±51	76±45	NS
TG (mmol/L)	1.18±0.82	1.06±0.69	1.06±0.58	0.91±0.41	1.36±0.54	1.36±0.54	NS
HDL-C (mmol/L)	1.58±0.41	1.63±0.43	1.60±0.39	1.68±0.36	1.48±0.32	1.47±0.29	NS
LDL-C (mmol/L)	3.26±0.71	3.09±0.65	3.26±0.83	2.97±0.68[a]	3.41±0.58	3.29±0.61	NS
FPG (mmol/L)	5.98±0.90	5.88±1.12	5.57±0.48	5.50±0.53	5.87±0.69	5.81±0.52	NS
IRI (pmol/L)	55.2±30.6	40.6±24.4[a]	53.3±33.8	42.7±54.6	65.1±43.4	49.9±23.4	NS
HOMA-IR	2.1±1.4	1.6±1.1[a]	1.9±1.3	1.5±2.0	2.5±1.7	1.9±0.9	NS
HbA_1c (%)	5.2±0.7	5.2±0.8	5.1±0.3	5.1±0.4	5.2±0.4	5.1±0.3	NS

[a] Significant difference (P<0.01) between pre- and post-training value by the paired t test.

[b] Significant difference (P<0.05) between pre- and post-training value by the paired t test.

[c] Analysis of variance (ANOVA) and Duncan's multiple range test was performed to investigate the difference in initial values among tertiles. NS, not significant.

ity (2, 3, 5). However, the subjects in those studies were obese or overweight (BMI>25). It is not known whether weight and/or fat loss is an important indicator of an improvement in insulin resistance during exercise training in non-obese participants. Therefore, we categorized the participants into three groups based on their obesity level (i.e. BMI). As shown in Fig. 1, for the High-BMI group, the reduction in BMI was significantly associated with the reduction in HOMA-IR, in agreement with the results of previous studies. However, there was no relationship between the reduction in BMI and that in HOMA-IR in the Middle-BMI (non-obese) group. These results suggest that the improvement in insulin resistance after exercise training is independent of weight loss for non-obese elderly people. According to the results of the Japan Diabetes Complication Study Group, Japanese individuals with type 2 diabetes are less obese than their European counterparts (24). Therefore, it will be important to investigate whether exercise training can also improve insulin resistance independent of weight loss in individuals with type 2 diabetes.

By contrast, most studies (2, 5) have found no association between an improvement in insulin resistance and an improvement in aerobic capacity. However, those studies did not consider the effect of the initial fitness levels of the participants on this association and, in addition, the exercise intensity in those studies was higher than that in our study. Because differences in the initial aerobic capacities of the subjects affect the physical fitness response to the exercise training (particularly when the exercise intensity is low) (25), as indicated in the present study (see Table 3), it seems to be necessary to categorize the subjects on the basis of their initial fitness level in order to investigate the association between the improvement in insulin resistance and the improvement in aerobic capacity. Therefore, we categorized the participants into tertiles based on VO_2 peak.

In the overall study population, there was no significant correlation between the improvements in HOMA-IR and in VO_2 peak ($r=-0.19$, $P=0.17$), in support of previous studies. In the stratified analysis, by contrast, the improvement in HOMA-IR was associated with the improvement in VO_2 peak for the Low-VO_2 peak group. The present findings suggest that exercise training can be effective/important/indication, especially for elderly people with a low fitness level, because it improved insulin resistance in parallel with an increase in aerobic capacity.

The present study has the following strengths. First, the exercise level of the training program employed was low, and thus it would be suitable for most elderly people. Second, there was no dietary restriction. Some studies indicate that not only intentional but unintentional weight loss in elderly adults may lead to a decrease in total body mineral density (26), or the development of disease and an increase risk of mortality (27). The mean body weight loss during the intervention period was small (1.2 kg), and thus safe from a medical viewpoint.

Some limitations of the current study should be emphasized. First, the subjects recruited might be healthier than the general elderly population, who may possibly be more fragile and have barriers to exercise training. Second, we did not determine the effect of exercise training on BP. More than half the population over 60 years of age has hypertension (defined as systolic blood pressure of at least 140 mmHg and/or diastolic pressure of at least 90 mmHg) (28), and elevated BP leads to a number of cardiovascular complications (29). Although it is well known that exercise lowers resting blood pressure (30), there is little evidence that low-intensity, low-volume exercise training also has a BP-lowering effect. Further research is therefore needed to determine the effect on resting BP of a low-level exercise training program that is feasible for most elderly people. Third, no sedentary control group was included. Thus, we might not have adequately demonstrated the benefits of the exercise training program itself.

In conclusion, even low-intensity and low-volume exercise training, which would ordinarily be insufficient to improve aerobic fitness and lipid metabolism in healthy elderly subjects, was found to be effective in reducing insulin resistance in the elderly. In non-obese elderly subjects, exercise training can improve insulin resistance independent of weight loss; in obese subjects, by contrast, the improvement in insulin resistance and weight loss were found to be mutually associated. Furthermore, in elderly people with low aerobic fitness, insulin resistance was improved in relation to an exercise-induced improvement in their fitness level.

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軽度要介護者の血中ビタミンDレベルの分布状況とビタミンD・乳酸カルシウム製剤補充による介護予防効果

－生活機能・身体機能と血中ビタミンDレベルとの関連より－

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日本骨粗鬆症学会 平成18年度 研究奨励賞

軽度要介護者の血中ビタミンDレベルの分布状況とビタミンD・乳酸カルシウム製剤補充による介護予防効果

ー生活機能・身体機能と血中ビタミンDレベルとの関連よりー

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はじめに

介護保険制度が施行され5年がたち，要介護認定者が約2倍に増加している。全体の約5割を占める要支援・要介護1の軽度要介護者は，サービスが開始された2年後には半数以上が重度化しており，サービスが利用者の状態改善につながっていないといわれている。平成13年国民生活基礎調査によると介護が必要となった主な疾患は骨折・転倒，関節疾患（リウマチ等）で27〜28%を占めている。在宅の軽度要介護者の多くは，関節疾患などがあるために下肢機能の低下が目立ち，要介護の主要原因としてあげられている転倒・骨折の危険性が高い集団であり，これらを予防することが介護度悪化を予防できると推測される。

ビタミンDの欠乏は，骨粗鬆症の危険因子であり，高齢者のふらつきや転倒と関連があり[1,2]，筋力の低下[3]や高齢者の下肢機能低下[4]をもたらすといわれており，筋力低下は高齢者の転倒の主要な危険因子である[5]。ビタミンDの補充は，骨密度を増加させる作用の他に，転倒の予防やふらつき・つまずきを改善するという報告がある[1,2]。一方，効果がみられないという報告もあり[6]，ビタミンDの評価は一定ではない。

われわれはこれまで地域在住の軽度要介護者と特定高齢者を対象にビタミンD濃度と生活機能・身体機能との関連を研究してきたので報告する。

1 目　的

本研究では，①要支援・要介護1の高齢者・特定高齢者の血清ビタミンD濃度と身体機能との関連を横断調査により明らかにする。また，②ビタミンD・乳酸カルシウム製剤の補充による身体機能への効果を縦断的に検討することを目的とした。

2 方　法

1) 対　象

平成17・18年の6〜9月に介護予防教室に参加した茨城県Y町（北緯36度）の地域在住の要支援・要介護1の65歳以上の高齢者（軽度者），特定高齢者レベルの者（基本チェックリストの「運動」の項目が3個以上該当）61名。

2) 調査方法

質問紙による面接聞き取り調査，体力測定，採血を行った。

①質問項目：属性，生活機能，ADL（Barthel index），転倒回数，つまずき・ふらつきの有無，外出回数，椅子やベッドからの起き上がり・立ち上がりなどを調査した。

②体力測定：歩行能力としてTimed Up & Go (TUG)・5m歩行，柔軟性として長座体前屈，バランス能力としてファンクショナルリーチ・開眼

Key words：軽度要介護者，ビタミンD，乳酸カルシウム製剤

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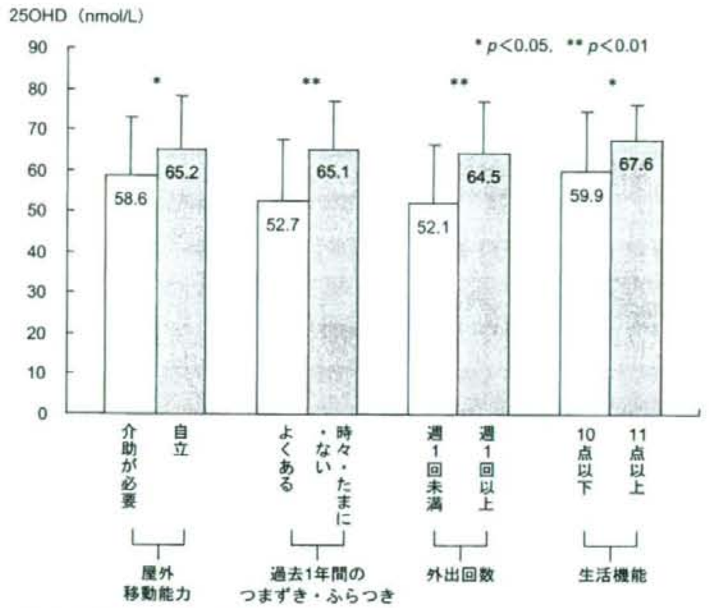

図1　血清ビタミンDと関連のある項目

片足立ち，筋力として握力・足関節背屈力を測定した。2回測定し平均値を用いた。測定が1回の者はその値を用いた。開眼片足立ち・握力・足関節背屈力は左右の平均値を用いた。

③血液データ：血清アルブミン，クレアチニン，カルシウム，intact PTH（iPTH）（ECLIA法），ビタミンD（25OHD）（RIA法）を測定した。

上記の調査は初回と3ヵ月目に実施した。

④介護予防教室：運動と栄養指導を合わせた包括的なプログラムよりなり，週1回約90分12回開催した。参加者のうち38名は介護予防教室へ参加し（運動群），残りの23名は介護予防について説明を受けただけである（コントロール群）。

⑤ビタミンD・乳酸カルシウム製剤の補充効果：運動群の希望者（n=17）にアルファカルシドール1μg/日および乳酸カルシウム4g/日を3ヵ月間投与した。服用1ヵ月目に採血を実施し副作用チェックを行った。

3）解析方法

2群間の比較には，連続変数の場合はt検定を，カテゴリー変数の場合は χ^2 検定または Fisher の直接法により比較検討した。また，多重ロジスティック回帰分析により「過去1年間のつまずき・ふらつき」に影響する要因を検討した。ビタミンD製剤服用有無の影響は繰り返しのある2元配置分散分析により解析した。また，開始前後の連続変数の比較は paired t-test を実施した。統計解析には SPSS 12.0 J for Windows を用い，p<0.05 を有意差ありとした。

本研究は，筑波大学人間総合科学研究科の倫理委員会の承認を得，参加者には文章と口頭による説明を行い同意を得てから実施した。

3　結　　果

1）対象者の背景

参加者61名（運動群とコントロール群）の開始時の特性は，平均年齢：77.0±5.6歳（65～90歳），男性：18名（29.5%），Barthel index 平均得点：89.7±10.3，過去1年間に転倒経験有：32名（52.5%），つまずき・ふらつき経験有：45名

表 1　ビタミン D・乳酸カルシウム製剤服用有無による身体機能への効果－運動群において－

	ビタミン D 非服用群 (n=16)	ビタミン D 服用群 (n=16)	交互作用
25OHD (nmol/L)	59.9±11.9	65.1±14.8	
pre TUG (sec)	17.1±8.2[a]	23.4±8.0	
post TUG (sec)	14.4±7.9*	18.6±5.1**	
pre 5m 通常歩行 (sec)	8.2±3.3	8.5±2.8	
post 5m 通常歩行 (sec)	7.2±4.7	8.3±2.4	
pre 長座体前屈 (cm)	7.6±8.1	3.0±6.4	
post 長座体前屈 (cm)	6.6±11	3.7±6.7	
pre ファンクショナルリーチ (cm)	21.6±5.5	20.6±5.0	
post ファンクショナルリーチ (cm)	24.2±5	22.1±6.5	
pre 開眼片足立ち[b] (sec)	9.1±11.7	4.0±2.6	
post 開眼片足立ち (sec)	11.3±13.1	5.8±4.6*	
pre 握力[b] (kg)	17.7±8.7	19.6±7.4	
post 握力 (kg)	19.7±7.5	21.2±6.3	
pre 足関節背屈力[b] (kg)	8.7±2.1	10.7±3.6	#
post 足関節背屈力 (kg)	9.4±2.1	13.4±3.7**	

Values are Means±SD, TUG : Timed Up & Go, * $p<0.05$ vs pre, ** $p<0.01$ vs pre,
a : $p<0.05$ vs ビタミン D 服用群
b : 開眼片足立ち・握力・足関節背屈力は左右の平均値を用いた。
: $p<0.05$

(73.8%), 血清 25OHD 濃度 (±SD) : 62.0±14.0 nmol/L (27.5～87.5), 血清 25OHD<50nmol/L の割合 : 18.0%, 血清 iPTH (±SD) : 48.7±22.5pg/mL (17.0～118.0) であった。年齢・性で調整後も, 血清25OHD はiPTH と有意な負の相関 ($r=-0.38$, $p<0.01$) を示していた。

2) 血清 25OHD と生活機能・身体機能との関連

一人で歩ける者は支えが必要な者に比し, 週 1 回以上外出する者は未満の者に比し, 生活活動能力指標総得点が 11 点以上の者は 10 点以下の者に比し, 25OHD 濃度は有意に高い値を示し, 過去につまずき・ふらつきがよくあると回答した者はその他の者に比し, 25OHD 濃度が有意に低い値を示した (**図 1**)。また,「つまずき・ふらつきがよくある」に影響する因子を年齢・性で調整した多重ロジスティック回帰分析を実施した結果, 25OHD 濃度が独立した影響因子であった (OR : 0.92, 95%信頼区間 0.87～0.97)。

3) ビタミン D・乳酸カルシウム製剤服用有無と身体機能との関連

運動群 (n=38) の希望者 (n=17) にビタミン D としてアルファカルシドール 1 μg/日と乳酸カルシウム 4g/日を 3 ヵ月間投与し (服用群), 希望しなかった者は非服用群 (n=21) とした。開始時と 3 ヵ月目の身体測定データがある者を解析対象とし (服用群 16 名, 非服用群 16 名), 身体機能との関連を検討した (**表 1**)。服用群と非服用群間で開始時の 25OHD 濃度, 25OHD<50 nmol/L の割合, TUG 以外の体力測定値に有意差はみられなかった。開始時の TUG は服用群のほうが非服用群より有意に劣っていたが, 3 ヵ月目には有意差はみられなかった。1 ヵ月目の採血で副作用があった者はいなかった。ビタミン D・乳酸カルシウム投与の効果を繰り返しのある 2 元配置分散分析を行った結果, 足関節背屈力にビタミン D・乳酸カルシウム投与有無と時間との間に

交互作用がみられたが，その他の項目ではみられなかった。そこで，各群において，開始時と3ヵ月目の身体機能を比較検討した。服用群では，TUG・開眼片足立ち・足関節背屈力が有意に改善し，非服用群においてもTUGが有意に改善していた。さらに，開始時の25OHD濃度がどのように影響しているか各群で検討を試みたところ，50nmol/L以上の者は有意に改善していたが，50nmol/L未満の者は数が少なく統計的な解析は困難であったが，身体機能の改善はみられない傾向であった。

4 考　察

ビタミンDの欠乏は，転倒・骨折，下肢機能の低下や筋力の低下と関連があると報告されている。本研究の目的①として，起き上がり・立ち上がり・歩行能力の低下が特徴とされている地域在住の軽度要介護者と特定高齢者を対象に血清ビタミンD濃度とADL，身体機能との関連について横断的に検討した。屋外での移動能力として「支えが必要・一人で移動ができない者」，「過去1年間のつまずき・ふらつきがよくある者」，「外出回数が週1回未満の者」，「生活機能得点が10点以下の者」は，その他の者に比し，25OHD濃度は有意に低い値であり，また，25OHD濃度が1nmol/L上昇すると「つまずき・ふらつき」が8%低下することから，25OHD濃度は生活機能・歩行能力・バランス能力と関連があることが示唆された。

本研究の対象者の52.5%は過去1年間に1回以上の転倒経験があり，日本の地域在住高齢者の1年間の転倒発生率である約10〜20%[7]と比較すると，本研究対象者のほうが転倒歴のある者の割合が高かった。さらに，約74%が過去1年間につまずき・ふらつきの経験があり，将来，転倒・骨折へつながる可能性が非常に高い集団であることが推測されることから，軽度要介護者や特定高齢者の25OHD濃度を測定することは介護予防にとって重要と思われた。

ビタミンD補充の効果に関しては一致した見解はない[4,6]。さらに，日本の介護保険対象者へのビタミンD補充による介護予防効果に関する研究はほとんどみあたらない。本研究では目的②のビタミンDの補充効果について，介護予防教室に参加した運動群の希望者にビタミンDとしてアルファカルシドール1μg/日，乳酸カルシウム4g/日を3ヵ月間投与し（服用群），身体機能への効果を服用しなかった群（非服用群）と比較検討した。繰り返しのある2元配置分散分析により分析した結果，3ヵ月目の足関節背屈力は開始時に比し，ビタミンD・乳酸カルシウム製剤補充により有意に改善し，ビタミンD・乳酸カルシウムの補充は，脚筋力を改善し，将来の転倒を予防できる可能性が示唆された。しかし，その他の身体機能に関しては，ビタミンD・乳酸カルシウム製剤服用有無で身体機能に交互作用はみられなかった。そこで，各群で教室前後の身体機能を比較した結果，服用群ではTUG・開眼片足立ち・足関節背屈力が有意に改善した。さらに，非服用群でもTUGが有意に改善しており，その理由の一つとして，開始時の25OHD濃度が50nmol/L未満だと3年後には体力が低下しているという報告があるように[8]，開始時のビタミンD濃度がその後の体力に影響している可能性が考えられる。また，先のわれわれの横断研究により[9]，歩行能力やふらつきとの関連からビタミンD不足の閾値を25OHD<50nmol/Lと設定した場合，各群とも開始時の25OHDが50nmol/L未満の者は教室終了時にも身体機能は改善しない傾向を示していた。開始時の25OHD濃度を少なくとも50nmol/L以上維持し，軽い運動を継続することで下肢筋力，歩行能力を維持改善できる可能性が推測されるが，本研究は対象者数が少ないことから，今後さらに対象者を増やし検討する必要がある。

結　論

地域在住の軽度要介護者・特定高齢者を対象とした場合，低い25OHD濃度は，「閉じこもり」高齢者，生活機能が低下している者，移動能力が劣っている者，バランス能力が低下している者と関連があった。また，運動の提供と同時にビタミンD・乳酸カルシウム製剤の補充は歩行能力・バ

ランス能力・下肢筋力を改善することが示唆された。

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Validation of the Telephone Interview for Cognitive Status (TICS) in Japanese

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SUMMARY

Background In recent years, the population of elderly people in Japan with dementia has increased. Detection of cognitive impairment in the early stages is important for adequate treatment, care, and prevention.

Aim To investigate whether the reliability and validity of the instrument would carry over to a different population and language before using it for population-based epidemiological studies.

Methods We studied 135 subjects, 49 patients with Alzheimer's disease (AD) and 86 healthy controls (CTL) using the Telephone Interview for Cognitive Status (TICS) and developed the Japanese version of the TICS (TICS-J). We also evaluated combination of another telephone battery, the Category Fluency Test (CF).

Results The sensitivity and specificity of the TICS-J to differentiate AD patients from CTL was 98.0% and 90.7%, respectively. Pearson's correlation coefficient for the TICS-J and Mini-Mental State Examination (MMSE) was 0.858 ($p < 0.001$). On the Receiver Operating Characteristic (ROC), the area under the curve for the TICS-J was 98.7%. The combination of the TICS-J with the CF did not change the validity of the discrimination.

Conclusion These results indicated that TICS-J was a sensitive and specific instrument for differentiating AD patients from healthy controls. Copyright © 2007 John Wiley & Sons, Ltd.

KEY WORDS—telephone interview; cognitive assessment; Alzheimer's disease; category fluency; TICS-J

INTRODUCTION

In 2005, dementia was diagnosed in about 1,690,000 people in Japan, and the number is predicted to increase to 2,500,000 by 2015. Thus, detection of cognitive impairment in the early stages is important for adequate treatment, care, and prevention.

Cognitive function is important in epidemiological studies of elderly populations. The Mini Mental State Examination (MMSE) is one of the most widely used screening instruments to assess cognitive status (Folstein *et al.*, 1975). However, it requires face-to-face administration, and cannot be used with persons with visual deficits or some physical disabilities. The ceiling effect also limits the usefulness of the MMSE. Screening large populations for cognitive function is time-consuming and costly because of the face-to-face interviews. Also, elderly people often have a variety of physical impairments or minimal motivation that affects the results of any study.

The Telephone Interview for Cognitive Status (TICS) is a brief test of cognitive function administered via telephone for use in large-scale screenings and epidemiologic surveys (Brandt *et al.*, 1988). The TICS does not require vision or reading and writing, thus it is ideal for assessing cognitive function of illiterate persons or individuals with visual impairments (Mangione *et al.*, 1993). The TICS is a reliable, simple instrument for cognitive assessment in research and clinical practice.

The TICS consists of 11 test items, orientation, attention, short-term memory, repetition, comprehension and

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conceptual knowledge, mathematical skills and praxis. It correlates highly with the MMSE, has high test–retest reliability, and its sensitivity and specificity for the detection of cognitive impairment are excellent.

The Category Fluency test (CF) measures long-term semantic memory, which is impaired in AD. The CF requires similar items in a semantic category; it is adequate for telephone administration and may complement the TICS.

The TICS has been translated into several foreign languages, including Spanish (Desmond *et al.*, 1994; Gude Ruiz *et al.*, 1994), Italian (Ferrucci *et al.*, 1998) and Finnish (Järvenpää *et al.*, 2002). Japanese language, including the culture, the social systems and education is quite different from the languages and cultures of countries of Europe. So, it is important to verify whether the telephone battery is acceptable and useful for Japanese people. In this study, we developed the Japanese version of the TICS (TICS-J) and evaluated its reliability and validity separately and with a combination of TICS-J and CF.

SUBJECTS AND METHODS

Study population

Participants selected from the Memory Clinic of the National Hospital for Geriatric Medicine, National Center for Geriatrics and Gerontology, consisted of 49 outpatients with Alzheimer's disease (AD) [19 men and 30 women, average age: 75.2 ± 6.8 years (mean ± SD)]. Diagnosis of AD was based on the criteria from the DSM-IV and NINCDS-ADRDA and was based on a general medical examination, neurological examination, laboratory tests, brain magnetic resonance imaging (MRI), brain single photon emission computed tomography (SPECT), and neuropsychological examination. All AD subjects had sufficient auditory function for telephone assessment.

The controls (CTL) were 92 healthy volunteers aged 60 or older with no acute or terminal conditions who were not taking drugs affecting cognitive function. Most control subjects were urban residents. Of these, six persons were excluded because they could not complete the TICS-J due to hearing impairments. Consequently 86 controls were analyzed for the following study [15 men and 71 women; average age: 74.3 ± 7.2 years] (Table 1).

The mean level of education was 11.0 ± 3.0 (mean ± SD) years for AD and 11.4 ± 2.2 years for CTL, and no significant differences were observed (Table 1). Informed consent was obtained from all subjects.

TICS-J

The translation and back-translation were conducted by two neurologists and an English-Japanese translator. Minor modifications were made with the permission of the author to make the questions more suitable for the Japanese society and culture. The maximum score on the TICS-J was 41, which was the same as the original TICS.

CF

Subjects were asked to name as many vegetables as possible in 1 min. All responses were recorded, and the scores were the sum of the new items, excluding preservations and intrusions.

Procedure

All participants were initially screened by the MMSE, and 2 weeks later, the TICS-J and CF were administered by the same interviewer as with the MMSE. TICS-J was repeated 4 weeks later to some participants for test–retest reliability. The interviewers,

Table 1. Characteristics of AD and CTL groups

	AD ($n = 49$)	CTL ($n = 86$)	p–value
Gender [men/women]	19/30	15/71	<0.001*
Age [years, mean ± SD, (range)]	75.2 ± 6.8 (62–89)	74.3 ± 7.2 (60–90)	0.465[a]
Education [years, mean ± SD, (range)]	11.0 ± 3.0 (6–17)	11.4 ± 2.2 (6–16)	0.405[b]
MMSE [points, mean ± SD, (range)]	20.6 ± 4.6 (11–29)	28.7 ± 1.2 (24–30)	<0.001[‡]
TICS-J [points, mean ± SD, (range)]	26.1 ± 6.1 (12–34)	36.4 ± 2.3 (31–41)	<0.001[b]
Category Fluency [mean ± SD, (range)]	7.7 ± 4.5 (0–20)	14.1 ± 3.6 (7–26)	<0.001[a]
Time [seconds, mean ± SD, (range)]	473.1 ± 121.9 (263–720)	328.8 ± 60.4 (205–591)	<0.001[b]

*Chi-square test.
[a]t-test.
[b]Mann–Whitney U-test.

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all well-trained professionals, informed the participant that the use of pens, pencils, papers, newspapers or calendars was not allowed as sources of orientation (Brandt and Folstein, 2003).

Statistical analysis

The Kolmogorov-Smirnov normal evaluation was performed for each item. For items that ensured normality, Student's *t*-test was used, and for items that did not ensure normality, the Mann–Whitney *U*-test was used. Test–retest reliability was evaluated by the Intraclass Correlation Coefficient (ICC). The correlation between MMSE and TICS-J was calculated by Pearson's correlation coefficient. The areas under the curves on the Receiver Operating Characteristic (ROC) for the MMSE and TICS-J were generated to plot the advantages/disadvantages of sensitivity and specificity.

RESULTS

The mean cognitive scores for the MMSE, TICS-J, and CF and the testing time in CTL by gender, age, and years of education are presented in Table 2. There were no differences in mean MMSE scores, TICS-J scores, CF scores, and testing time between men and women, among the different age groups, and between the low and high education groups.

The mean score for the MMSE was significantly low in AD (20.6 ± 4.6 points, maximum 30) compared with CTL (28.7 ± 1.2 points) ($p < 0.001$). The mean score for the TICS-J was also significantly low in AD (26.1 ± 6.1 points, maximum 41) compared with CTL (36.4 ± 2.3 points) ($p < 0.001$). The mean TICS-J testing time per individual was significantly longer in AD (473.1 ± 121.9 sec) compared with that in CTL (328.8 ± 60.4 sec) ($p < 0.001$) (Table 1). The scores from the CF were significantly lower in AD (7.7 ± 4.5 points) compared with CTL (14.1 ± 3.6 points) ($p < 0.001$)(Table 1).

The MMSE scores ranged from 11 to 29 points in AD, and in CTL the scores ranged from 24 to 30 points, showing a ceiling effect. The distribution of the TICS-J in AD was 13 to 34 points. Normal distribution for the TICS-J was shown in CTL (Figure 1a, b, c, d).

As to test–retest reliability of the TICS-J performed 4 weeks apart with 47 subjects (14 AD and 33 CTL), intra-class correlation (ICC) was calculated as 0.946 ($p < 0.001$).

The correlation between the TICS-J score and the MMSE score for the whole group was excellent ($r = 0.858$, $p < 0.001$), whereas it was 0.742 ($p <$ 0.001) in the AD group only (Figure 2).

When choosing the cutoff score of 26 points for the MMSE, sensitivity was 91.8% and specificity was 95.3%. The cutoff score of 33 points for the TICS-J resulted in a sensitivity of 98.0% and a specificity of 90.7%.

When ROC curves were constructed, the area under the curve for the MMSE was 97.2% (95% Confidence Intervals (CI): 94.4%–100%), and 98.7% for the TICS-J (95% CI: 97.5%–100%) (Figure 3).

To determine whether or not the telephone battery could be improved, the CF was combined with the TICS-J. When choosing the cutoff score of 43 points for the TICS-J plus the CF, sensitivity was 85.7% and specificity was 93.0%.

The ROC curve in Figure 4 displays the TICS-J plus CF sensitivity-specificity data. The area under the curve was 95.9% for the TICS-J plus CF.

DISCUSSION

In the population of elderly people in Japan, it is important to detect cognitive impairment in the early

Table 2. Characteristics of CTL group by gender, age and education (CTL group: $n = 86$)

	MMSE*	TICS-J*	CF*	Time[a]
Gender				
men ($n = 15$)	28.8 ± 0.8 (28–30)	35.1 ± 2.2 (32–40)	11.7 ± 2.8 (7–18)	325.1 ± 55.2 (205–415)
women ($n = 71$)	28.6 ± 1.3 (24–30)	36.7 ± 2.2 (31–41)	14.6 ± 3.5 (7–26)	329.6 ± 61.8 (220–591)
Age (years)				
<70 ($n = 25$)	28.8 ± 1.1 (26–30)	36.5 ± 2.2 (31–40)	14.8 ± 3.1 (7–19)	310.9 ± 53.3 (205–479)
70–79 ($n = 37$)	28.8 ± 1.2 (27–30)	36.9 ± 2.5 (32–41)	14.3 ± 3.5 (8–26)	327.0 ± 59.6 (220–591)
+80 ($n = 24$)	28.3 ± 1.5 (24–30)	35.6 ± 2.1 (32–40)	13.0 ± 3.9 (7–20)	350.3 ± 64.3 (266–488)
Education (years)				
<10 ($n = 20$)	28.8 ± 1.1 (27–30)	36.0 ± 2.5 (32–40)	13.6 ± 3.0 (10–19)	327.5 ± 47.6 (263–439)
+10 ($n = 66$)	28.6 ± 1.3 (24–30)	36.6 ± 2.2 (31–41)	14.2 ± 3.7 (7–26)	329.2 ± 64.1 (205–591)

*Points, mean ± SD, (range).
[a]Seconds, mean ± SD, (range).

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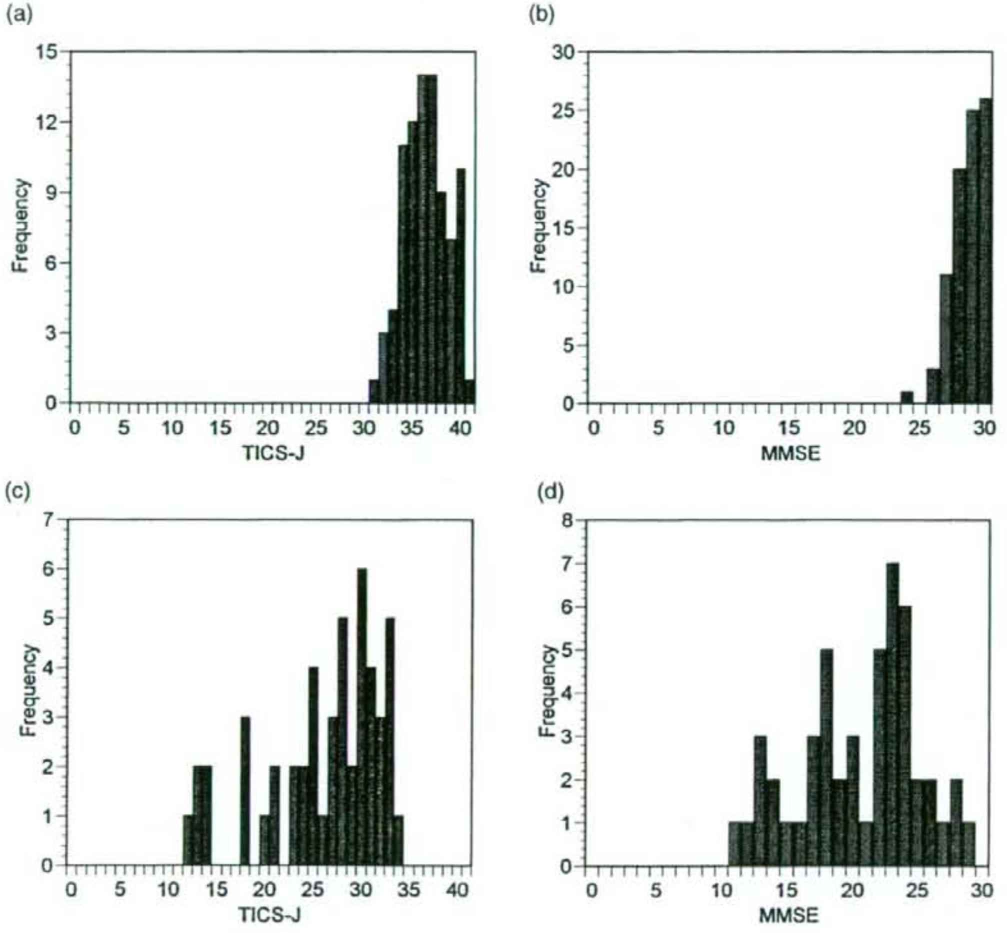

Figure 1. Distribution of MMSE and TICS-J for AD and CTL group. (a) Distribution of TICS-J for CTL (N = 86); (b) Distribution of MMSE for CTL (N = 86); (c) Distribution of TICS-J for AD (N = 49); (d) Distribution of MMSE for AD (N = 49).

stages for adequate treatment, care, and prevention. There are also public health reasons to develop effective methods of screening cognitive impairment. With appropriate screening procedures, cost-effective program of medical care can be developed.

TICS is useful for detecting cognitive impairment and has been used in studies of the cognitive status of patients after a stroke (Barber and Stott, 2004), regular use of anti-inflammatory drugs (Kang and Grodstein, 2003), vitamin consumption (Grodstein *et al.*, 2003), alcohol consumption (Stampfer *et al.*, 2005) and postmenopausal hormone therapy (Kang *et al.*, 2004).

We developed a Japanese version of the TICS (TICS-J) and evaluated validity and usefulness. In CTL, gender, age, and years of education did not influence the scores for the MMSE and TICS-J or testing time. We demonstrated a significant correlation between the MMSE and TICS-J. The relatively weaker correlation in our study was due to the larger population of mild to moderate AD cases. Sensitivity and specificity was distinguished between AD and CTL. The cutoff score for the TICS-J was higher than in previous studies (Brandt *et al.*, 1988; Mangione *et al.*, 1993; Desmond *et al.*, 1994; Ferrucci *et al.*,

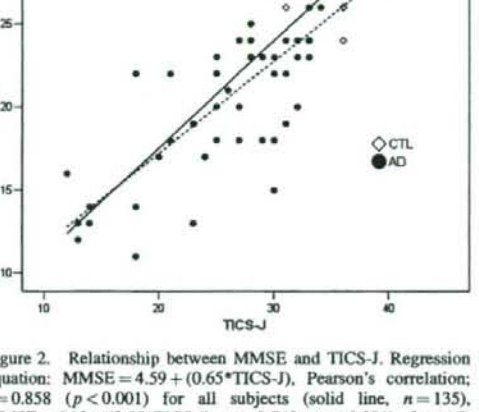

Figure 2. Relationship between MMSE and TICS-J. Regression equation: $MMSE = 4.59 + (0.65*TICS\text{-}J)$, Pearson's correlation; $r = 0.858$ ($p < 0.001$) for all subjects (solid line, $n = 135$). $MMSE = 6.12 + (0.55*TICS\text{-}J)$, $r = 0.742$ ($p < 0.001$) for AD patients (dashed line, $n = 49$).

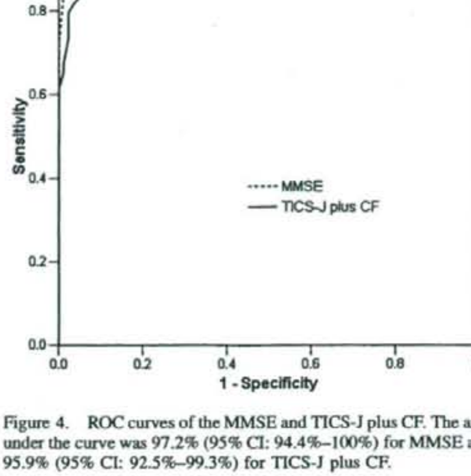

Figure 4. ROC curves of the MMSE and TICS-J plus CF. The area under the curve was 97.2% (95% CI: 94.4%–100%) for MMSE and 95.9% (95% CI: 92.5%–99.3%) for TICS-J plus CF.

1998; Järvenpää *et al.*, 2002; Barber and Stott, 2004). Subjects in CTL were urban residents and well educated with an active social life which may be lead to the high cutoff points for the TICS-J and the MMSE. Moreover, the differences between Japanese and the other languages may have played a role. The TICS-J was not subject to the ceiling effect that constrained the MMSE. The greater difficulty due to the higher memory component in the TICS-J may have made it a more sensitive test to milder degrees of cognitive impairment and not subject to the ceiling effect. These data correspond to previous studies that demonstrated that TICS was a reliable and valid screening test for AD.

Figure 3. ROC curves of the MMSE and TICS-J. The area under the curve was 97.2% (95% CI: 94.4%–100%) for MMSE and 98.7% (95% CI: 97.5%–100%) for TICS-J.

TICS-J is easy and acceptable by telephone. Only six volunteers failed to complete the battery due to hearing difficulty. de Jager *et al.* (2003) reported that the advantages to the administration of the TICS by telephone included: (1) cost effectiveness for use in large-scale studies; (2) greater acceptability; (3) individuals with visual difficulties or poor hand-eye coordination would be able to complete; (4) results can easily be recorded directly into a computer; and (5) sensitive parametric statistics can be used for analysis of results.

The CF alone is useful for cognitive screening and well suited to telephone administration. We could not show improvement in discriminative validity by combining the TICS-J and CF. Vegetables may be familiar and relatively easy to remember. The choice may have resulted in failure to improve discriminative validation of the TICS-J plus CF compared to the TICS-J alone.

Telephone screening has limitations and the assessment of cognitive function may be constrained in older adults due to hearing loss or reduced social contact. However, as in previous studies, telephone screening differentiated AD patients from healthy control subjects.

In conclusion, the TICS-J is a valid instrument for detecting cognitive dysfunction in persons with visual or physical impairments. Effective telephone screening provides a valuable tool for large-scale community and clinic-based screening and intervention programs.

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◆資　料◆

介護家族の視点からみた認知症高齢者の終末期治療
——その現状と課題——

山下真理子*1，小林敏子*2，松本一生*3，小長谷陽子*4，中村淳子*5

抄録

認知症高齢者を介護し，看とった家族の視点から認知症の終末期治療について検討した．調査対象家族は41例(男性1：女性40)，調査はアンケート形式で行った．看とられた認知症高齢者は男性17例(平均年齢79.8歳)，女性24例(同89.4歳)であった．その結果，認知症高齢者は原疾患自体の進行に伴う経口摂取困難や肺炎などの合併症，他疾患の合併・増悪により，多くは一般病院で専門医以外の医師に終末期治療を受けながら，ほぼ6か月以内に最期を迎えていた．その際，家族は本人の状態から最期が近いことを認識し，点滴などを希望して無理な延命を求めず，自然な最期を迎えさせてやりたいと望み，看とり後もおおむね満足していることが分かった．ただ，本人の意思は十分に反映されていないこともうかがえた．今後，認知症における適切な終末期治療のために，専門医の関与とともに本人の意思表示や家族の認識，一般病院における対応の改善などの課題が残されている．

Key Words：嚥下障害，介護家族，終末期治療，認知症，病院

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I．研究目的

認知症高齢者の終末期治療について，欧米では20年以上前から検討され，治療内容の決定に関してもインフォームド・コンセントに基づく本人の意思表示や自己決定に主眼をおいて論じられている[1)]．しかし，わが国では，ようやく高齢者の終末期治療について本格的に論議され始めたばかりであり[2)]，とくに認知症高齢者の終末期やその治療的対応についてはまだ関心が低く，本人や家族の視点から現実の医療内容を検討した研究はほとんどない[3)]．認知症高齢者の場合，終末期での意思表示が困難となるため，ほとんどの場合，家族が代理人として治療方針の決定に参与する．したがって，そのなかで家族が本人の意思をどのように反映させるのか，また家族自身にとっても満足な最期を迎える条件とはなにかが医療やケアを提供する側にとっても重要な点になる．

今回，われわれは認知症高齢者を介護し，看とった家族の視点から，認知症高齢者が終末期を迎えて，そこで受けた医療内容(とくに，嚥下障害発症後の治療的対応)とその場所，そこで家族が希望したこと，看とり後の気持ちなどについて調査した．

II．研究方法

1．調査対象者

認知症高齢者の介護を行い，看とった家族(以下，看とり家族)のなかの主介護者を調査対象にした．看とり家族は，大阪市介護家族の会と大阪府認知症の人と家族の会に所属していた家族，一般病院の訪問看護ステーション(1か所)からの訪問看護を受けていた家族，認知症専門の診療所(1か

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