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ORIGINAL ARTICLE

Effects of a laughter and exercise program on physiological and psychological health among community-dwelling elderly in Japan: Randomized controlled trial

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Aim: To examine the effects of a once-weekly laughter and exercise program on physical and psychological health among elderly people living in the community. As a regular exercise program can be difficult to maintain, we provided a more enjoyable program to enhance adherence to exercise.

Methods: A total of 27 individuals aged 60 years or older, without disabilities, were randomly assigned to either an immediate treatment group ($n = 14$) or a delayed treatment group ($n = 13$). The intervention was a 120-min session consisting of laughter and exercise, carried out once a week for 10 consecutive weeks. Measurements taken at baseline, 3 and 6 months included bodyweight, height, body fat, lean mass, bone mineral density, hemoglobin A1c (HbA_{1c}), glucose, high-density lipoprotein and low-density lipoprotein cholesterol, and triglycerides, as well as self-rated health and psychological factors.

Results: All participants completed the 3-month program. Bone mineral density increased significantly in the immediate treatment group compared with the delayed treatment group during the first 3 months ($P < 0.001$). In addition, HbA_{1c} decreased significantly ($P = 0.001$), and self-rated health increased significantly ($P = 0.012$).

Conclusions: The combination of a laughter and exercise program might have physiological and psychological health benefits for the elderly. Laughter might be an effective strategy to motivate the elderly to participate in physical activity. **Geriatr Gerontol Int 2012; ••: ••–••.**

Keywords: bone mineral density, exercise, hemoglobin A1c, laughter, self-rated health.

Introduction

Many studies have shown that physical exercise has positive effects in older adults, including a reduced risk of cardiovascular disease[1,2] and type 2 diabetes mellitus,[3] prevention of falls,[4] improvements in cognitive performance,[5] reduced anxiety and depression,[6] and

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improved sleep.[7] It has also been reported that physical activity reduces all-cause mortality risk.[8–10] Stessman *et al.* showed that even among the very old, initiating physical activity was beneficial for survival.[11] However, many older adults remain sedentary, and a lack of interest has been reported to be the main deterrent to physical activity.[12,13] A large number of exercise interventions for the elderly have been carried out, but participants generally have difficulty adhering to regular exercise; previous studies have shown that approximately half of sedentary older adults dropped out of exercise programs within the first 6 months.[14] Exercise adherence is also reported to be low in clinical settings, and therefore exercise plus behavioral intervention is recommended.[15,16]

In the present study, we provided an enjoyable program consisting of two main sessions: laughter and exercise. There were several reasons laughter was chosen. First, a laughter session should add enjoyment to a general exercise program, which is useful for enhancing exercise adherence. It has been reported that pleasant sensations associated with exercise are one of the factors that positively influence adherence to an exercise program among older adults.[14] Second, several studies have suggested that laughter itself has several psychological and physiological health benefits. Mirthful laugher can moderate stress, improve mood and influence the immune system.[17–19] It also reduces the increase in postprandial blood glucose in patients with diabetes,[20] and helps improve vascular function.[21,22] Most studies, however, have concentrated on the acute effects of laughter, and there has been little research into the long-term effects of laughter intervention.[23]

The purpose of the present study was to examine the effects of a once-weekly laughter and exercise program on physical and psychological health among elderly people living in the community.

Methods

Study design and participants

The present study used a partial crossover design, as shown in Figure 1. In the previous study, which reported the effect of laughter on the increase in postprandial blood glucose, the difference in the mean increase between a lecture and comedy show was 0.8 ± 0.5 mmol/L in healthy participants.[20] We calculated that 13 patients per group were necessary to detect a significant difference in hemoglobin A1c (HbA_{1c}) between a control group and a treatment group, with a two-sided 5% significance level and a power of 80%. A total of 27 community-dwelling men and women aged 60 years or older, who had no medical contraindications to exercise, were recruited from May to June 2005 from various sources, including advertisements in the local media and on the homepage of the Osaka Medical Center for Health Science and Promotion. Participants were randomly assigned to either an immediate treatment group ($n = 14$) or a delayed treatment group ($n = 13$) using computerized random numbers. The immediate treatment groups started a session in July and the delayed treatment group started in October 2005. A total of 12 out of the 13 people in the delayed treatment group were included in the analysis (one person dropped out because of personal reasons before the program started). The flow of participants through the study is provided in Figure 2. The local institutional review boards at the Osaka Medical Center for Health Science and Promotion approved the study, and all study participants gave written informed consent to participate.

Intervention

Participants attended a 120-min session once a week for 10 consecutive weeks. The session consisted of a combination of a 10-min lecture about health topics relevant

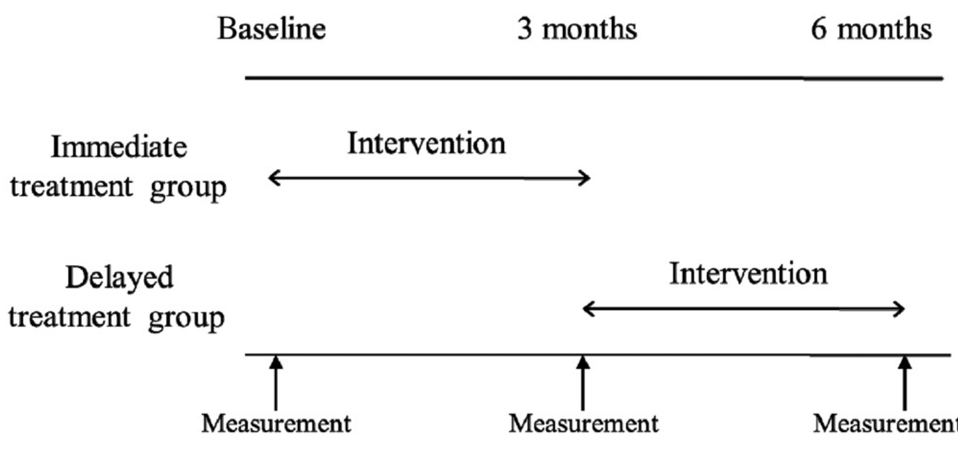

Figure 1 Study design.

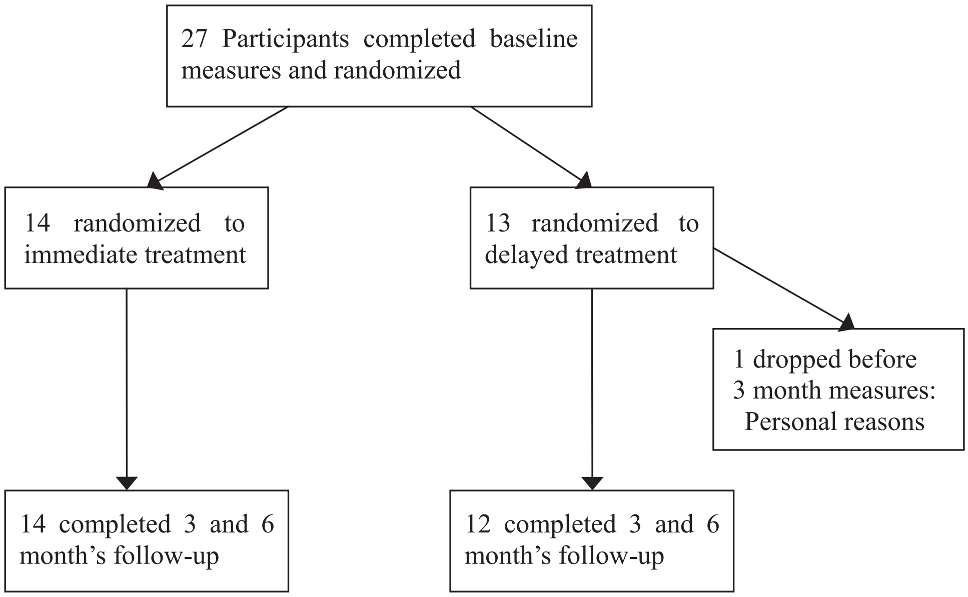

Figure 2 Flow of participants.

to older adults, such as nutrition, medication and recommended preventive healthcare; 50-min of watching comedy programs (video or live); and 60-min of light exercise, mainly in the sitting position. Phone calls were made after each missed session to encourage regular participation, and participants received detailed reports of the measurements taken. Participants were not especially instructed to improve their regular lifestyle.

Measurements

Sociodemographic and clinical data, body composition, and psychological state were assessed three times: at baseline, and at 3 and 6 months postbaseline. Venous blood samples were analyzed for HbA_{1c}, fasting blood glucose, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C) and triglycerides. Serum glucose was measured with an automatic analyzer (AU2700; Olympus, Tokyo, Japan) using the hexokinase method. Serum cholesterol and triglycerides were measured by the enzymatic method using an automatic analyzer (Hitchi 7250; Hitachi Medical, Hitachi, Japan). Anthropometric measurements included bodyweight and height. Total body fat, lean mass and bone mineral density were measured using dual-energy X-ray absorptiometry.

Depressive symptoms were assessed using the 30-item Geriatric Depression Scale (GDS-30).[24] Self-rated health was assessed with the following question, "How would you rate your current health status?" according to a scale from 1 to 4 (1 = very poor, 2 = poor, 3 = good, 4 = very good).

Statistical analyses

The differences in baseline characteristics among the groups were tested using Student's *t*-tests for continuous outcomes, and using χ^2-tests for categorical outcomes. Between-group comparisons were made between the immediate treatment group and the delayed treatment group for changes in physiological and psychological measurements over months 0–3 using Student's *t*-tests.

Among the delayed treatment group, within-person comparisons were made for changes from months 4 to 6 (during treatment) versus months 0 to 3 (no treatment), also using Student's *t*-tests. In these comparisons, the delayed treatment participants were used as their own controls. To examine the changes after the intervention, within-person comparisons were also made for changes in the immediate treatment group from months 0 to 3 (during treatment) versus months 4 to 6 (no treatment). Again, Student's *t*-tests were used.

All data were analyzed using the SPSS statistical software package for Windows (version 14.0; SPSS, Inc., Chicago, IL, USA). All tests were two-sided, and $\alpha = 0.05$ was considered statistically significant.

Results

Baseline characteristics of the 26 participants who completed the study are shown in Table 1. The mean age in the immediate treatment group was 68.2 years compared with 69.8 years in the delayed treatment group. The majority of the participants were women. There

Table 1 Baseline characteristics

Variable	Immediate treatment (n = 14)	Delayed treatment (n = 12)	P-value
Age (years)	68.2 ± 6.49	69.8 ± 5.93	0.538
Female (%)	10 (71.4)	10 (83.3)	0.802
Hight (cm)	153.5 ± 7.74	151.8 ± 6.28	0.552
Weight (kg)	57.8 ± 12.2	51.5 ± 8.60	0.146
BMI (kg/m^2)	24.3 ± 3.19	22.5 ± 4.38	0.219
Obesity (BMI ≥ 25) (%)	4 (28.6)	2 (16.7)	0.802
Bone mineral density (mg/cm^2)	944.1 ± 97.4	950.4 ± 99.1	0.871
HbA_{1c} (%)	5.26 ± 0.57	5.00 ± 0.32	0.179
Glucose(mg/dL)	131.9 ± 32.3	120.0 ± 36.3	0.384
HDL-C	57.7 ± 20.8	54.9 ± 15.0	0.702
LDL-C	117.6 ± 28.0	124.8 ± 25.1	0.502
Triglyceride	169.7 ± 92.5	192.3 ± 123.6	0.599
Hypertension	3 (21.4)	2 (16.7)	0.758
Diabetes	2 (14.3)	0 (0)	0.483
GDS score (0–30)	8.7 ± 6.8	8.3 ± 6.3	0.858
Self-rated health	2.9 ± 0.9	2.8 ± 0.7	0.773
Exercise, ≥90 min/week (%)	12 (85.7)	10 (83.3)	1.000
Current alcohol drinking (%)	6 (42.9)	3 (25.0)	0.589
Smoking status (%)			0.653
Never	10 (71.4)	10 (83.3)	
Former	3 (21.4)	1 (8.3)	
Current	1 (7.1)	1 (8.3)	
Sleep duration (hours)	7.11 ± 1.22	6.55 ± 0.88	0.201

Mean ± standard deviation values and n (percentage) are shown. BMI, body mass index; HbA_{1c}, hemoglobin A1c; HDL-C, high-density lipoprotein cholesterol; GDS, Geriatric Depression Scale; LDL-C, low-density lipoprotein cholesterol.

were no significant differences in baseline characteristics between the two groups.

Participants in both groups showed adherence rates of 100%. The average rate of attendance at the sessions was 97.9% (with a range of 80–100) for the immediate treatment group, and 91.7% (range 70–100) for the delayed treatment group.

Table 2 shows body measurement values (mean ± SD), as well as changes over the first 3 months (the period of the randomized controlled trial) and over months 4 to 6 (the period of no treatment for the immediate treatment group and treatment for the delayed treatment group). Bone mineral density increased significantly in the immediate treatment group compared with the delayed treatment group during the first 3 months, but returned to baseline levels after 3 months of no treatment. Lean body mass also decreased significantly and body fat increased significantly in the immediate treatment group after 3 months of no treatment, compared with the change seen during the 3 months of treatment. There were also significant differences in the changes in body fat mass and lean body mass during the no treatment period between the immediate treatment group and the delayed treatment group (data not shown).

Table 3 shows the changes in HbA_{1c}, fasting blood glucose, HDL-C, LDL-C, triglycerides, GDS score and self-rated health. HbA_{1c} decreased significantly in the immediate treatment group compared with the delayed treatment group during the first 3 months. However, HbA_{1c} increased again in the period without treatment between month 3 and month 6. Self-rated health increased significantly in the immediate treatment group compared with the delayed treatment group during the first 3 months, and remained stable during the 3 months without treatment. There was a significant correlation between the change in self-rated health and the GDS score in the immediate treatment group (–0.61, $P = 0.02$; these data are not shown in the table).

The percentage of people with exercise habits (85.7%) did not change at 3 months (85.7%) and decreased at 6 months (71.4%) in the immediate treatment group. The change was not statistically significant. There were no changes in the delayed treatment group (data not shown). The percentage of people who

Table 2 Changes in body size and bone mineral density during the intervention

	Baseline Mean ± SD	3 months Mean ± SD	6 months Mean ± SD	Δ0–3 months Mean ± SD	$P^{†}$	Δ3–6 months Mean ± SD	P
Bodyweight (kg)							
Immediate treatment	57.8 ± 12.2	57.2 ± 12.4	56.8 ± 12.0	−0.63 ± 1.52	0.483	−0.42 ± 0.85	0.690‡
Delayed treatment	51.5 ± 8.60	51.3 ± 9.19	51.2 ± 9.21	−0.21 ± 1.47		−0.06 ± 0.94	0.755§
BMI (kg/m^2)							
Immediate treatment	24.3 ± 3.19	24.1 ± 3.30	24.0 ± 3.16	−0.22 ± 0.73	0.644	−0.16 ± 0.35	0.785‡
Delayed treatment	22.5 ± 4.38	22.4 ± 4.63	22.4 ± 4.70	−0.10 ± 0.57		0.01 ± 0.46	0.586§
Body fat mass (kg)							
Immediate treatment	17.8 ± 3.82	16.4 ± 3.54	16.8 ± 3.60	−1.37 ± 1.08	0.296	0.38 ± 1.02	0.001‡
Delayed treatment	16.2 ± 5.89	15.3 ± 5.88	15.5 ± 6.23	−0.93 ± 0.99		0.23 ± 1.12	0.038§
Lean body mass (kg)							
Immediate treatment	38.1 ± 9.41	38.9 ± 9.72	38.3 ± 9.37	0.86 ± 1.07	0.890	−0.64 ± 0.96	0.009‡
Delayed treatment	33.3 ± 5.21	34.1 ± 5.63	33.8 ± 5.42	0.80 ± 1.01		−0.37 ± 0.68	0.017§
Bone mineral density (mg/cm^2)							
Immediate treatment	944.1 ± 97.4	961.2 ± 103.3	943.4 ± 106.1	17.1 ± 18.2	<0.001	−17.8 ± 15.4	<0.001‡
Delayed treatment	950.4 ± 99.1	934.3 ± 95.5	939.7 ± 94.6	−16.1 ± 13.7		5.3 ± 13.2	0.008§

†*P*-value for comparing the changes in the immediate treatment group to the changes in the delayed treatment group over the first 3 months. ‡*P*-value for comparing the immediate treatment group changes from 4–6 months to the one from 0–3 months (within person control). §*P*-value for comparing the delayed treatment group changes from 4–6 months to the one from 0–3 months (within person control). BMI, body mass index.

reported eating until full also did not significantly change in both groups (data not shown).

Discussion

The purpose of the present study was to investigate the effects of laughter and exercise intervention on physical and psychological health among community-dwelling elderly Japanese. Results of the study showed that the program had positive effects on HbA_{1c}, bone mineral density and self-rated health, and the adherence rate was 100%. These findings suggest that a laughter and exercise program can be an effective and useful intervention for community-dwelling elderly people in Japan, in order to maintain health status.

This finding is consistent with previous studies that have found that exercise reduces HbA_{1c} levels.[25,26] A meta-analysis of 47 randomized controlled clinical trials found that structured exercise training (aerobic, resistance, or both) was associated with HbA_{1c} reduction in patients with type 2 diabetes, and exercise of more than 150 min per week was associated with greater reductions in HbA_{1c}.[27] The sessions in our intervention program were shorter (50-min laughter sessions and 60-min exercise sessions), but still showed a favorable effect on HbA_{1c}. Hayashi *et al*. showed that 40 min of laughter suppressed the increase in 2-h postprandial blood glucose in patients with diabetes.[20] The combination of exercise and positive emotion – such as laughter – might have a greater effect on glucose metabolism than exercise alone.

The increase in bone mineral density is also consistent with previous studies that have reported the positive effects of exercise on bone mineral density in elderly women.[28–30] Most of these studies involved carrying out exercise 2–4 times per week for more than 8 months, which is a longer duration of exercise than was undertaken in our intervention. However, in the present study, the average number of steps per day taken by individuals in the treatment group during the intervention – measured with a pedometer – was 8897 (data not shown in the results). This is higher than the average number of steps per day for Japanese women aged in their 60s (which is 6381), and more than double the average for women aged over 70 years (which is 3797).[31] This might be one reason for the improvement in body mineral density seen in our short-term intervention. As bone mineral density is reported to be a predictor of hip fractures,[32] the increase shown in this study might be beneficial for future falls prevention.

Previous studies have found no change in self-rated health after exercise interventions.[33–35] However, the present study showed an improvement in self-rated health in the 3-month intervention, which could possibly be attributed to the effects of the laughter sessions. Many participants reported that they enjoyed the

Table 3 Changes in hemoglobin A1c, glucose, cholesterol, triglyceride and psychological valuables during the intervention

	Baseline Mean ± SD	3 months Mean ± SD	6 months Mean ± SD	Δ0–3 months Mean ± SD	*P*-value†	Δ3–6 months Mean ± SD	*P*
HbA_{1c} (%)							
Immediate treatment	5.26 ± 0.57	5.14 ± 0.60	5.43 ± 0.53	–0.12 ± 0.15	0.001	0.29 ± 0.19	<0.0001‡
Delayed treatment	5.00 ± 0.32	5.07 ± 0.37	5.11 ± 0.45	0.07 ± 0.10		0.04 ± 0.31	0.800§
Glucose (mg/dL)							
Immediate treatment	131.9 ± 32.3	121.1 ± 61.1	107.4 ± 24.0	–10.8 ± 45.0	0.832	–13.7 ± 60.1	0.914‡
Delayed treatment	120.0 ± 36.3	112.9 ± 22.1	96.8 ± 8.2	–7.1 ± 42.5		–16.1 ± 18.2	0.584§
HDL-C							
Immediate treatment	57.7 ± 20.8	58.0 ± 21.0	62.9 ± 18.8	0.29 ± 8.88	0.724	4.92 ± 9.29	0.299‡
Delayed treatment	54.9 ± 15.0	56.3 ± 14.4	59.5 ± 15.3	1.33 ± 5.29		3.25 ± 5.97	0.529§
LDL-C							
Immediate treatment	117.6 ± 28.0	111.9 ± 34.6	117.6 ± 39.2	–5.71 ± 18.2	0.653	5.79 ± 24.2	0.272‡
Delayed treatment	124.8 ± 25.1	121.8 ± 25.7	118.8 ± 22.8	–2.92 ± 11.9		–3.08 ± 16.7	0.983§
Triglyceride							
Immediate treatment	169.7 ± 92.5	135.9 ± 65.5	120.2 ± 71.0	–33.9 ± 57.7	0.601	–15.6 ± 79.7	0.531‡
Delayed treatment	192.3 ± 123.6	174.6 ± 102	150.2 ± 70.1	–17.8 ± 95.4		–24.4 ± 69.7	0.877§
GDS (score)							
Immediate treatment	8.7 ± 6.8	7.1 ± 5.4	6.3 ± 4.5	–1.5 ± 4.9	0.211	–0.9 ± 2.4	0.706‡
Delayed treatment	8.3 ± 6.3	8.8 ± 7.4	9.0 ± 7.4	0.5 ± 2.9		0.3 ± 4.1	0.858§
Self-rated health							
Immediate treatment	2.9 ± 0.9	3.4 ± 0.6	3.4 ± 0.7	0.5 ± 0.8	0.012	–0.1 ± 0.5	0.071‡
Delayed treatment	2.8 ± 0.7	2.6 ± 0.7	3.0 ± 0.6	–0.3 ± 0.6		0.4 ± 0.7	0.025§

†*P*-value for comparing the changes in the immediate treatment group to the changes in the delayed treatment group over the first 3 months. ‡*P*-value for comparing the immediate treatment group changes from 3–6 months to the one from 0–3 months (within person control). §*P*-value for comparing the delayed treatment group changes from 3–6 months to the one from 0–3 months (within person control). HbA_{1c}, hemoglobin A1c; HDL-C, high-density lipoprotein cholesterol; GDS, Geriatric Depression Scale; LDL-C, low-density lipoprotein cholesterol.

program and the contact with other participants very much. Considering that self-rated health is an important longitudinal predictor of future health outcomes, including mortality, morbidity, functional ability and healthcare utilization,[36–38] the improvement in self-rated health in the present study is likely to be important for the elderly.

Karinkanta *et al*. reported that the effects of exercise on muscle strength and self-rated physical functioning disappeared 1 year after cessation of the exercise intervention.[39] In the present study, the physiological effects, such as the decrease in HbA_{1c} and increase in body mineral density, disappeared 3 months after the intervention ended. Body fat mass also increased and lean body mass decreased during the 3 months of no treatment in the immediate treatment group, suggesting the effect of cessation of the intervention. This finding suggests that it might be difficult to maintain the physiological improvement without the intervention. It is necessary to make laughter and exercise a habit in the participants' daily life. The duration of our intervention might have been relatively short to help them establish a habit of laughter and exercise. It would be better if we could provide advice on how to bring more laughter into daily life.

However, the improvement in self-rated health persisted for at least 3 months after the termination of the intervention. Although a longer duration of follow up would be necessary to confirm the trend, this finding suggests that the positive psychological effects of the intervention might be more likely to be maintained.

The high adherence rate for this program suggested that it was feasible for the elderly, and that they were satisfied with its contents. The attendance rate (more than 90%) was also high. These rates compare favorably with other studies: in a previous study in Japan, Suzuki *et al*.[40] reported that more than 20% of the participants dropped out of an exercise intervention designed to prevent falls in community-dwelling elderly women, with an average rate of attendance of just 75.3%. Laughter is an important communication tool, and might be helpful in allowing the participants to interact with each other more easily, and to build up a sense of fellowship.

The GDS score decreased in the immediate treatment group and increased in the delayed treatment group during the first 3 months, but the difference between the two groups was not statistically significant. There are two possible explanations for this result. First, the participants in the present study were community-dwelling people, whereas most studies of the effects of exercise on depression have specifically targeted depressed people, with GDS scores of 11 or higher generally taken to indicate the presence of depressive symptoms.[41] In the present study, the mean GDS scores tended to be low at baseline (8.71 in the immediate treatment group, and 8.25 in the delayed treatment group), meaning that there was less scope for improvement in GDS scores. Second, the period of the intervention might have been too short, and/or the frequency might have been insufficient. It has been shown in a previous study that a 6-month exercise intervention (three times per week) has a positive effect on depressive symptoms.[15,42]

The present study had limitations. The sample size was relatively small. Further studies with larger samples might provide better results in examining the effects of an enjoyable exercise program for the elderly. Additionally, given that most participants in the present study were women, the results cannot be generalized to older men. However, it has previously been reported that women in Japan are likely to cease regular physical activity.[43] This suggests the importance of the present results. Our study might have also captured a more active sample of the elderly population than is representative. Almost all study participants reported exercising regularly (Table 1). This might have influenced the high adherence rate, given that those who are already in the habit of regular physical activity tend to remain active.[44] Lifestyle changes that we did not assess in the present study might have also leaded to health improvement in the participants.

Finally, it was unclear whether some of the beneficial effects seen in this program were the result of exercise or laughter. A previous study showed that laughter therapy had positive effects on depression and insomnia in the elderly;[23] however, further investigations are required to identify the effects of laughter itself. Atlantis *et al*. suggested that the effects of their multimodal intervention were mainly attributable to the supervised exercise component.[15] In the present study, the effects of the intervention on bone mineral density are likely to be as a result of exercise, but the decrease in HbA_{1c} and the improvement in self-rated health might be partly attributable to the laughter component. This is supported by the previous studies showing that laughter reduces the increase in postprandial blood glucose in patients with diabetes[20] and improves psychological health.[18,19] The high adherence rate is also considered to be a result of the effects of laughter.

In conclusion, the findings presented here show that a laughter and exercise program provided physiological and psychological health benefits for the elderly. A more enjoyable program can help motivate the elderly to participate in exercise programs, and laughter is an effective strategy towards achieving this.

Acknowledgments

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Disclosure statement

All authors hereby declare that there are no conflicts of interest.

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