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Effect of a Two-year Health Program on Brain Function, Physical Fitness and Blood Chemistry

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Abstract

Background: Protocols for carrying out health programs for aged adults have not been clearly presented. Thus, the aim of this study is to examine the effects from the first year to the second year of the Matsumoto health promotion program and to make use of the results in future health promotion for elderly people.

Method: The city of Matsumoto offered local residents a two-year health program which includethe use of a pedometer, anthropometry, blood pressure, go/no-go brain function, a physical fitness test and a blood chemistry test. Eighty-six elderly people age 65.9 ± 5.9 years participated in the program. All the participants were given pedometers and a target of 7,000 to 8,000 steps per day was set based on the weight-bearing index. During the first year, the participants did their walking exercise and attended a series of monthly seminars. Then the second year, the participants continued their walking exercise, attended series of monthly seminars and began a 2 hour weight training once a week.

Result: The result from the pedometer in the first year showed that the average daily walking step was 6552.9 ± 474.2. The second year, the average daily walking steps was 7170.4 ± 547.9. The results from first year to second year showed significant improvement; the number of incorrect response in the go/no-go tasks (before: 5.3 times ± 0.4, after: 2.9 times ± 0.2, $p<0.001$), sit-ups(before: 12.4 times ± 0.6 times, after: 17.4 times ± 0.8, $p<0.001$), sit and reach flexibility(before: 39.4 cm ± 1.2, after: 42.0 cm ± 1.3, $p<0.05$), eyes open single leg stance(before: 86.2 sec ± 5.4, after: 98.7 sec ± 4.6, $p<0.001$), 10-meter obstacle walk(before: 5.1 sec ± 0.1, after: 4.0 sec ± 1.1, $p<0.001$), 6-minute walking(before: 637.4 m ± 5.3, after: 716.6 m ± 9.8, $p<0.001$), the uric acid(before: 5.4 mg/dL ± 0.2, after: 5.1 mg/dL ± 1.2, $p<0.001$) and HDL (before: 68.5 mg/dL ± 2.4, after: 73.2 mg/dL ± 2.6, $p<0.001$) in the blood test.

Conclusion: These results from the two-year program suggests that the increase in walking and the 2 hour weight training may reflect the influence of wearing a pedometer, and improved anthropometry, blood pressure, brain function, physical fitness and blood chemistry. However, the girth of the abdomen, handgrip strength and blood chemistry did not show significant improvement. Thus we must think about enlightenment program that wouldinclude muscular strength training and nutrition.

Keywords: Health education; Brain function; Physical fitness; Blood chemistry

Abbreviation: WHO: World Health Organization; CDSMP: Chronic Disease Self-Management Program; HEP: Health Enhancement Program; HDL: High-Density Lipoprotein; LDL: Low-Density Lipoprotein; ANOVA: Analysis of Variance; WBI: Weight Bearing Index

Introduction

Health promotion has become a global effort since the Ottawa WHO Charter of 1986 [1]. Based on this charter, the "Kenko Nippon 21" program, formulated in Japan in 2000, aimed to reduce mortality rates among late-middle-aged individuals, to prolong healthy lives, to improve quality of life, and to promote regional health. "Kenko Nippon 21" states that a decrease in physical activity is not only a risk factor for obesity and lifestyle diseases, but also for chronic diseases or infirmities among the elderly [2].

Periodic exercise and strength training is particularly well known and recommended as beneficial to the health of elderly adult's [3]. Its effects on lowering risk and/or reducing signs and symptoms of many chronic diseases along with its importance for sustaining the physical functions and activities of normal, everybody living are well known [4]. For example, randomized test trials with senior adults have shown positive effects of strength training on bone health, type 2 diabetes, muscle strength, physical performance, arthritic symptoms, depression, sleep, and other age related recurring conditions [5]. Scientific evidence confirms that physical activity and exercise can add years of active independent living, lower rate of disability, and improve quality of life of seniors [6]. Several randomized test trials using disability prevention programs such as the Chronic Disease Self-Management Program(CDSMP) and the Health Enhancement Program (HEP) now known as Enhance Wellness in the United States for elders with

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chronic diseases reportedly increase functional outcomes, raise exercise tolerance, lower hospitalization rates, improve the quality of life [7]. Therefore, selecting and or developing appropriate exercise programs designed to lessen deteriorating health conditions would help reduce illness and improve health.

A revised version of the health-promotion law was put into place in 2002. It included a strong demand for health-promotion policies by each prefecture and conscious effort toward implementing local policies by every city citation. Further, a new national policy for the prevention and treatment of metabolic syndrome was introduced by The Japanese Ministry of Health Labour and Welfare since 2013 residents who do not meet preventive criteria for the syndrome have been charged a penalty by the National Federation of Health Insurance Societies citation. The economic pressure created by this policy seems to have resulted in increased health education at national, prefectural, and civic level [2].

To implement this policy, various forms of health education for the improvement of metabolic syndrome have been presented in each city in Japan. However, it has been reported that program contents differ from city to city. Among these programs the city of Matsumoto offered local residents an active two-year health program developed by the Japanese authors. This program measured energy expenditure with a pedometer, monitored the effects of exercise with anthropometry, blood pressure, brain function tests, physical fitness tests and blood tests, and provided monthly educational seminars and 2 hour weight training once a week. This research focused on the city of Matsumoto because Nagano prefecture, where Matsumoto has had one of Japanese highest longevity rates over the last few decades. Since Japan had the world's highest longevity rate in 2005, Matsumoto is expected to continue to be an area with one of the world's highest longevity rates [8].

As supported by the literature, health programs are beneficial for elderly. However, among reviewed studies, protocols for carrying out health programs for aged adults have not been clearly presented. Program non-completion or refusals impair health outcomes [9]. In order to create better health programs, it is important to evaluate the exact effects of a program. Therefore, it is necessary to know whether a two-year program is more effective than a one-year program. Thus, the aim of this study is to examine the effects from the first year to second year of the Matsumoto health promotion program and to make use of the results in future health promotion.

Method

General methods

This is a prospective survey of one year and nine month health program established for elderly people between May 2009 to February 2011 in the city of Matsumoto, and these periods will subsequently be referred to as the first year and the second year. This program for the elderly people is the most recent introduce in the city of Matsumoto, Japan. It measured energy expenditure with pedometers, anthropometry, blood pressure, brain function test of go/no-go, physical fitness test and blood chemistry test. Eighty six (86) elderly people aged 65.9 ± 5.9, 34 elderly men aged 66.9 ± 5.9 years and 52 elderly women aged 64.9 ± 6.0 years participated in the program, during the first year of the program, the participants were engaged in a series of seminars once or twice a month in the form of practical skills or a lecture. The program activities are: April; opening ceremony, May; various measurements and tests and a lecture about the exercising for good health, June; practical skills for stretching and recreation, July; a lecture about blood pressure and camping, August; a lecture on the personal computers and practical aerobic skills, September; natural observation of the mountains, October; practical skills of tennis or golf, November; practical skills on coordination-training, December; practical skills on Tai chi chuan, January; practical skills of fitness exercise, February; lecture on the brain and exercise, and various measurements and tests, March; closing ceremony. During the second year, participants performed 2 hour weight training once a week and took series of seminars once or twice a month in the form of practical skills or a lecture. The activities are April; opening ceremony, May; practical skills on circuit training, June; practical skills on the muscle strength training, July; hiking on the mountain, August; lecture on nutrition, September; practical skills of new sports, October; the practical skill of right walking, November; the practical skill of walking together, December; lecture on prevention of heart attack and stroke, January; the practical skill of recreation, February; the practical skill of skill walking, March; closing ceremony.

The energy expenditure was tested with pedometers, and anthropometry, blood pressure, the brain function, physical fitness and blood chemistry tests were conducted before and after each year of the program to assess its interim effectiveness.

Pedometer

The daily number of steps taken and the energy expenditure were measured from May 2009 to Feb 2011. An approximate target of 7,000 to 8,000 steps per day was set based on the Weight Bearing Index (WBI) [10]. The pedometer used was a recent model (Acos Inc., FS500) that allowed the transfer of saved data from the pedometer to a personal computer. Participants do attend a monthly meeting and reported their progress to the program leader.

Go/no-go tasks

Go/no-go tasks, are frequently used to investigate response inhibition, which is an essential executive function implemented by the prefrontal cortex [11-13], and they require a variety of cognitive components besides response inhibition. The go/no-go task of the present study consisted of three experimental stages: formation, differentiation, and reverse differentiation. For the formation stage, participants were required to squeeze a rubber ball when they saw a red light. During the differentiation stage, participants squeezed the rubber ball when they saw the red light, but not when they saw a yellow light. For the reverse differentiation stage, participants were asked to squeeze the rubber ball when they saw the yellow light but not for the red light. For the differentiation and reverse differentiation stages, the red and yellow lights appeared 10 times each in a random order, thus participants completed 20 trials for each stage. In this paper, "forget" refers to an omission when participants failed to squeeze the rubber ball when it should have been squeezed. The term "mistake" refers to an incorrect response when participants squeezed the rubber ball when it should not have been squeezed.

Physical fitness test

We applied between test and for physical fitness test for 65 to 79 year olds, which were introduced by the Ministry of Education, Culture, Sports, Science and Technology of Japan. This test assesses grip strength, sit-ups, eyes-open single-leg stance, sit-and-reach flexibility, 6-minute walk, and 10-meter obstacle course. The test was designed to assess six physical parameters; the handgrip strength test was used to assessed muscle strength, sit ups for muscle endurance, the sit and reach flexibility for muscle flexibility, eyes open single leg stance for balance, the 10-meter obstacle walk for walking ability and the 6-minute walk for endurance. Each participant underwent the physical test both before and after each year of the health program [14].

Blood chemistry test

Blood sample was taken after fasting in order to measure blood sugar levels of each participant between levels and under the supervision of a doctor, the before nurses collected blood and tested for total cholesterol, HDL (high-density lipoprotein), LDL (low-density lipoprotein), neutral fat, uric acid and blood sugar.

Blood pressure assessment

Maximum blood pressure and minimum blood pressure were measured by auscultation (mercury sphygmomanometer, Kenzumedico 0601B001, Japan) after the participant's had been sitting for 15 minutes in a room with an ambient temperature of 25°C and relative humidity of approximately 50%.

Date analysis and management

Paired t-test was used to compare results for before and after participation in each year of the health program. A two-way repeated measured ANOVA was used to assess differences between the first and the second years and value of before and after each test. The number of steps walked for the first and second years was compared using Student t-test. Test for significance was set at $p<0.05$. Statistical analyses were performed using SPSS Statistical Packages (SPSS 4.0.1 Inc., Chicago, USA).

Ethics protocol

The physical fitness tests for 65 to 79 olds were approved by the Japanese Ministry of Education, Culture, Sports, Science and Technology. No subjects had a history of neurological, major medical, or physical disorders, at the time of the study. Prior to participating in the experiment, all subjects gave their written informed consent. This study was approved by the Ethics Committee of the School of Medicine, Shinshu University, Japan.

Results

Participants pedometer assessment

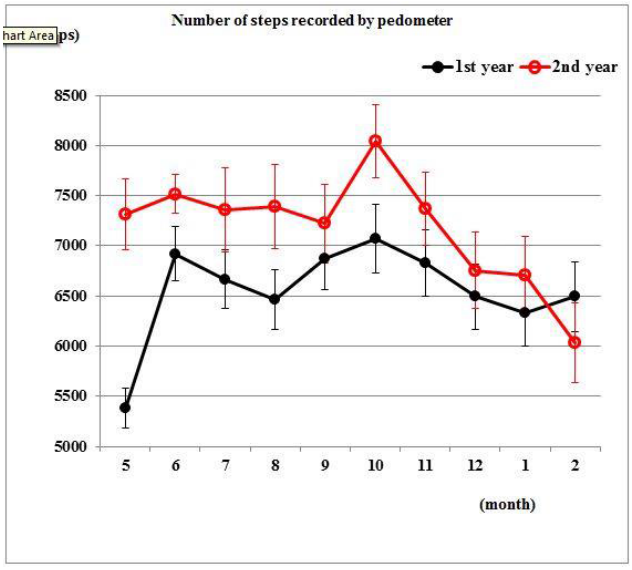

Figure 1: Monthly average steps of participants. Black point is 1st year and red point is 2nd year.

Figure 1 shows the average steps walked for each month. A comparison of the average number of steps from the first year to second year, the second year became significantly more steps than the first year (first: mean ± SE, 6552.9 ± 474.2, after: 7170.4 ± 547.9, $p<0.001$) (Tables 1 and 2).

Anthropometry and blood pressure

The comparison of the Anthropometry and blood pressure results from before and after the first year of the program showed significant decrease in weight (before: 58.1 kg ± 1.2, after: 57.4 kg ± 1.2, $p<0.05$), BMI (before: 22.7 ± 4.4, after: 22.4 ± 5.3, $p<0.05$), maximal blood pressure (before: 133.0 mmHg ± 2.1, after: 126.4 mmHg ± 2.2, $p<0.001$), minimal blood pressure (before: 77.2 mmHg ± 1.4, after: 74.0 mmHg ± 1.2, $p<0.05$), and a significant increase in the girth of the abdomen (before: 84.5 cm ± 0.8, after: 86.8 cm ± 0.9, $p<0.001$). A comparison of the anthropometry and blood pressure results from before and after the second year of the program showed significant decrease in maximal blood pressure (before: 136.2 mmHg ± 2.0, after: 128.0 mmHg ± 1.3, $p<0.001$), and minimal blood pressure (before: 80.4 mmHg ± 1.1, after: 73.5 mmHg ± 0.9, $p<0.001$). A comparison of before the first year and after the second year results showed significant decrease in weight (before: 58.1 kg ± 1.2, after: 57.2 kg ± 1.1, $p<0.001$), BMI (before: 22.7 ± 4.4, after: 22.3 ± 4.5, $p<0.001$), maximal blood pressure (before: 133.0 mmHg ± 2.1, after: 128.0 mmHg ± 1.3, $p<0.05$), and minimal blood pressure (before: 77.2 mmHg ± 1.4, after: 73.5 mmHg ± 0.9, $p<0.05$).

Go/no-go tasks

A comparison of go/no-go task from before the first year of the program began to after, the first year ended revealed that average reaction time was significantly longer at the end of the first year (before: 343.7 ms ± 6.6, after: 402.5 ms ± 8.7, $p<0.001$). In addition, total error rate decreased significantly (before: 5.3 times ± 0.4, after: 2.5 times ± 0.4, $p<0.001$). A comparison of brain function test results from before and after the second year of the program showed no significant differences in reaction time or error rate. A comparison of first year before and second year after results showed significant improvement in error rate

Month	1st year	2nd year
April	Opening Ceremony	Opening Ceremony
May	Measurements and tests and a lecture about the exercising for good health	Practical skills of circuit training
June	practical skills for stretching and recreation	Practical skills on muscle strength training
July	A lecture about blood pressure and camping	Hiking on the mountain
August	A lecture on personal computers and practical aerobic skills	Lecture on the nutrition
September	Natural observation of the mountains	Practical skills of new sports
October	practical skills of tennis or golf	The practical skill of right walking
November	Practical skills on coordination training	The practical skill of walking together
December	Practical skills of Tai chi chuan	Lecture on prevention of heart attacks and strokes
January	Practical skills of fitness exercise	The practical skill of recreation
February	Lecture on the brain and exercise, and various measurements and tests	The practical skill of skill walk
March	Closing ceremony	Closing ceremony

Table 1: Contents of program of the first year and the second year.

	1st year		Paired	2nd year		Paired	1st year	2nd year	Paired
	Before	After	p-value	Before	After	p-value	Before	After	p-value
Anthropometry and blood pressure									
Weight (kg)	58.1±1.2	57.4 ± 1.2	*	57.5 ± 1.2	57.2 ± 1.1	NS	58.1 ± 1.2	57.2 ± 1.1	***
Girth of abdoment (cm)	84.5 ± 0.8	86.8 ± 0.9	***	83.8 ± 0.3	85.0 ± 0.3	NS	84.5 ± 0.8	85.0 ± 0.3	NS
BMI	22.7 ± 4.4	22.4 ± 5.3	*	22.4 ± 4.3	22.3 ± 4.5	NS	22.7 ± 4.4	22.3 ± 4.5	***
Maximal bloodpressure (mmHg)	133 ± 2.1	126.4 ± 2.2	***	136.2 ± 2.0	128.0 ± 1.3	***	133 ± 2.1	128.0 ± 1.3	*
Minimal blood pressure (mmHg)	77.2 ± 1.4	74.0 ± 1.2	*	80.4 ± 1.1	73.5 ± 0.9	***	77.2 ± 1.4	73.5 ± 0.9	*
Physical fitness tests									
Handgrip strength (kg)	30.6 ± 1.0	31.0 ± 1.0	NS	31.0 ± 1.0	31.0 ± 1.0	NS	30.6 ± 1.0	31.0 ± 1.0	NS
Sit-up (times)	12.4 ± 0.6	14.7 ± 0.8	***	14.2 ± 0.8	17.4 ± 0.8	***	12.4 ± 0.6	17.4 ± 0.8	***
Sit and research flexibility (cm)	39.4 ± 1.2	39.8 ± 1.3	NS	41.5 ± 1.2	42 ± 1.3	NS	39.4 ± 0.6	42 ± 1.3	*
Eyes open single leg stance (sec)	86.2 ± 5.4	88.9 ± 5.9	NS	95.5 ± 5.1	98.7 ± 4.6	NS	86.2 ± 5.4	98.7 ± 4.6	***
10-meter obstance (sec)	5.1 ± 0.1	4.3 ± 0.1	***	4.7 ± 0.1	4.0 ± 0.1	***	5.1 ± 0.1	4.0 ± 0.1	***
6-minute walk (m)	637.4 ± 5.3	689.8 ± 7.7	***	674.4 ± 6.9	716.1 ± 9.8	***	637.4 ± 5.3	716.1 ± 9.8	***
Blood									
Total cholesterol (mg/dL)	215.9 ± 5.3	216 ± 4.4	NS	216.2 ± 4.3	215.5 ± 4.5	NS	215.9 ± 5.3	215.5 ± 4.5	NS
HDL (mg/dL)	68.5 ± 2.4	72.4 ± 2.7	***	69.6 ± 2.5	73.2 ± 2.6	***	68.5 ± 2.4	73.2 ± 2.6	***
LDL (mg/dL)	132.3 ± 5.0	126.4 ± 3.8	NS	130 ± 44.0	127.4 ± 4.1	NS	132.3 ± 5.0	127.4 ± 4.1	NS
neutral fat (mg/dL)	103.1 ± 6.4	113.9 ± 9.4	NS	117.2 ± 10.1	99.9 ± 7.7	*	103.1 ± 6.4	99.9 ± 7.7	NS
Uric acid (mg/dL)	5.4 ± 0.1	5.1 ± 0.15	***	4.9 ± 1.1	5.1 ± 1.2	NS	5.4 ± 0.1	5.1 ± 1.2	***
Blood sugar (mg/dL)	101.6 ± 1.3	100.1 ± 1.7	NS	100.2 ± 1.5	103.1 ± 2.0	*	101.6 ± 1.3	103 ± 2.0	NS
G0/No-Go task (ms)									
Response time total (ms)	343.7 ± 6.6	402.5 ± 8.8	***	338.08 ± 6.3	331.8 ± 6.2	NS	343.7 ± 6.6	331.8 ± 6.2	NS
The number of error total(times)	5.3 ± 0.4	2.5 ± 0.4	***	3.0 ± 0.4	2.9 ± 0.2	NS	5.3 ± 0.4	2.9 ± 0.2	***
(Mean ± SE, NS: Not Significant, *.p,0.06, **.p,0.01, ***.p,0.001									

Table 2: Results of before and after the health program in Matsumoto.

(before: 5.3 times ± 0.4, after: 2.9 times ± 0.2, p<0.001).

Physical fitness test

A comparison of the physical fitness test results from before and after the first year the program showed significant improvement in sit-ups (before: 12.4 times ± 0.6, after: 14.7 times ± 0.8, p<0.001), the 10-meter obstacle course (before: 5.1 sec ± 0.1, after: 4.3 sec ± 0.1, p<0.001) and the 6-minute walk(before: 637.4 m ± 5.3, after: 689.8 m ± 7.7, p<0.001). A comparison of physical fitness test results from before and after the second year showed sit-ups(before: 14.2 times ± 0.8, after: 17.4 times ± 0.8, p<0.001), the 10-meter obstacle course(before: 4.7 sec ± 0.1, after: 4.0 sec ± 0.1, p<0.001), and the 6-minute walk (before: 674.4 m ± 6.9, after: 716.6 m ± 9.8, p<0.001). A comparison of first year before and second year after results showed significant improvement in sit-ups(before: 12.4 times ± 0.6, after: 17.4 times ± 0.8, p<0.001), sit and reach flexibility(before: 39.4 cm ± 1.2, after: 42.0 cm ± 1.3, p<0.05), eyes open single leg stance(before: 86.2 sec ± 5.4, after: 98.7 sec ± 4.6, p<0.001), the 10-meter obstacle course (before: 5.1 sec ± 0.1, after: 4.0 sec ± 1.1, p<0.001), and the 6-minute walk (before: 637.4 m ± 5.3, after: 716.6 m ± 9.8, p<0.001).

Blood chemistry test

A comparison of blood chemistry test results from before and after first year of the program showed significant improvement in HDL levels (before: 68.5 mg/dL ± 2.4, after: 72.4 mg/dL ± 2.7, p<0.001) and uric acid levels (before: 5.4 mg/dL ± 0.17, after: 5.1 mg/dL ± 0.15, p<0.001).

A comparison of blood chemistry test results from before and after the second year of the program showed significant improvement in HDL levels (before: 69.6 mg/dL ± 2.5, after: 73.2 mg/dL ± 2.6, p<0.001) and neutral fat(before: 117.2 mg/dL ± 10.1, after: 99.9 mg/dL ± 7.7, p<0.05). However blood sugar level was significant high (before: 102.2 mg/dL ± 1.5, after 103.1 mg/dL ± 2.0, p<0.05). A comparison of first year before and second year after blood test results showed significant improvement in HDL levels (before: 68.5 mg/dL ± 2.4, after: 73.2 mg/

dL ± 2.6, p<0.001) and uric acid (before: 5.4 mg/dL ± 0.17, after: 5.1 mg/dL ± 1.2, p<0.001).

A two-way repeated measured ANOVA was used to assess differences between the two year and value of before and after. However, in all items there were no significant differences.

Discussion

Pedometer

A comparison of the average number of steps from the first year to the second year shows that the second year was significantly more than first year. This result suggests that the second year there was more motivation than the first year. Some studies have shown that participants walk both further and for more time when they use a pedometer than when they do not [15,16]. In this study, the use of pedometers may have led to increased distance and time walked by participants. This may be pertinent in regards to health education, as finding ways to help participants increase both the quality and quantity of their exerciseis important [4], and educational intervention is an essential part of improving the quality of future programs (Figure 2).

During the Matsumoto health program, the average number of steps taken gradually increased between May and October, but decreased between November and February. Winter in Matsumoto is cold and snowy, thus the decrease in the average number of steps taken may be attributable to difficulties walking during the winter months.

Anthropometry and blood pressure

Although weight and BMI significantly decreased by participating in health education for two years, tendency to increase was seen in the girth of the abdomen. Generally, it is reported that for a decrease 1 kg in weight, the girth of the abdomen decrease in diameter of approximately 1 cm [2]. Because the measurement of the girth of the abdomen may be a problem, we must think about a method to improve it in the future. Improvement of the blood pressure may have been an effect of the walking and 2 hour weight training once a week.

Go/no-go tasks

Go/no-go tasks are frequently used to investigate response inhibition, which is an essential executive function implemented by the prefrontal cortex [13,17] and they recruit a variety of cognitive components besides response inhibition. In this study, the participants in the first year of continuous exercise had an average of 6,552 steps a day, and while go/no-go task reaction times increased significantly the number of error responses decreased significantly. The second-year's continuation of the walking exercise and 2 hour weight training once a week had an average of 7,170 steps per day and resulted in reduced reaction times and significant decreased the number of error responses. Overall, average reaction times for the go/no-go task had become faster and error rates had significantly decreased by the end of the second year in comparison to the first year. These results suggest that the Matsumoto health program led to improved brain function, including working memory, at the end of the program.

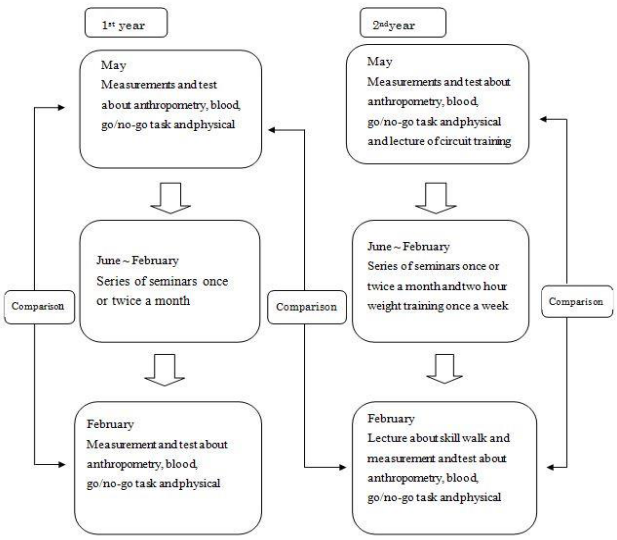

Figure 2: Flow chart of this health education.

Physical fitness test

How physical fitness is measured differs between countries. Japanese employs two types of fitness tests geared toward the elderly. The first which is recommended by the Ministry of Health, Labour and Welfare includes six physical tests designed to assess the functionality of the motor system: hand grip strength, muscle strength in the lower extremities, functional reach test, eyes-open single leg stance, timed up & go test, 5 m-normal-and-maximal walk [2]. The second, which is recommended by the Ministry of Education, Culture, Sports, Science and Technology is geared towards healthy seniors, and includes six physical tests: hand grip strength, sit ups, sit-and-reach flexibility, single leg stance, 10-meter obstacle walk and 6-minute walk [14]. The second fitness test was implemented for the Matsumoto health program.

In Matsumoto, five of the 6 components of the physical fitness test significantly improved after the program. This suggests that the quantity of exercise in this program had a positive influence on the physical fitness of the participants. The superior number of steps in the Matsumoto health program may reflect better performance in the physical fitness tests. It has been reported that increased exercise momentum leads to improved physical fitness test results [18,19]. Our results reveal a similar tendency. However, a relationship of the physical test results from before and after the first year, the second year, and first year before and second year after the program demonstrated no significant improvement in handgrip strength. Although the value of the handgrip strength was not decreased, from now on, we must consider what to do for muscular strength.

Blood chemistry test

HDL and uric acid levels improved significantly after the first year of the program and HDL, neutral fat levels improved significantly after the second year. Finally HDL and uric acid levels improved significantly between the end of the first year and the end of the second year. These results imply that increased number of steps and 2 hour weight training once a week may also be effective as reflected in the blood chemistry. In a different study, 46 women with a mean age of 56 participated in an exercise group using a treadmill exercise program. They exercised for 30 min at a heart rate intensity reaching 60%-80% of the heart rate maximal, 3 times/wk. for 12 weeks and experienced improved HDL levels [20]. Similarly, in this study an increase in the average number of steps from 6,552 steps to 7,170 steps further improved HDL and uric acid levels. However, the total cholesterol, natural fat and blood sugar results from before the first year to after the second year program illustrated not significant improvement. From now on, we must think about an enlightenment program that will include nutrition.

In this study, associations were made between the results from May

and January. The blood chemistry test and other tests are known to be influenced by seasonal variations. In the future it will be necessary to set tests at the same time when seasonal variations do not occur.

In the second year there were significant improvement in weight, BMI in anthropometry, sit and reach flexibility and eyes open single leg stance in the physical fitness test, uric acid in blood, and the number of errors in the go/no-go tasks. The improvements above may have been due to: the increase in the number of steps in walking (about 600 steps) and the introduction of two- hour a week weight training. These results suggested the importance of appropriate quantity and continuation of exercise.

Conclusion

Conclusively the energy expenditure with pedometers, anthropometry, blood pressure, the brain function, physical fitness and blood chemistry tests were conducted before and after each year of the program to assess its interim effectiveness. A comparison of the average number of steps from the first year to the second year shows that the second year had significantly more steps. Although the anthropometry and blood pressure significantly improvedfor two years, there was a tendency for an increase in the girth of the abdomen. The brain function average reaction times for the go/no-go task had become faster and error rates had significantly decreased by the end of the second year in comparison to the first year. For the physical fitness tests, five of the 6 components significantly improved after the program. Although value of the handgrip strength was not decreased, we must think about an enlightenment program of the muscular strength from now on. Blood chemistry test HDL and uric acid levels improved significantly between the end of the first year and the end of the second year. However, the total cholesterol, natural fat and blood sugar results from the first year to the second year program showed not significant improvement. We must think about an enlightenment program to include nutrition from now on.

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