Heliyon

The effectiveness of a Japanese style health program: comparison between Minowa, Japan and Rayong, Thailand

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Abstract

Aim: This study aimed to appropriately establish a Japanese style healthcare program under the ISO9001:2008 (ISO: International Organization for Standardization) in Minowa, Japan and Rayong, Thailand to improve problem areas and inspect its effectiveness. Furthermore, we want to make this health

promotion through ISO widely available in Asian countries and to make an international contribution.

Method: We implemented a 6-month health program in the c Rayong city, Thailand, and a 12 month health program in the Minowa town, Japan. This study assessed findings from pedometry, anthropometry and blood pressure measurements, physical fitness, blood chemistry, and brain function tests.

Results: The comparisons were made using interaction effects between the participants in Rayong and Minowa. They showed significant differences in the 10-m obstacle walk, the 6-minute walk, HDL, the reverse and reverse differentiation time, the total number of forgets, the total number of mistakes, and the total number of brain function errors.

Conclusions: To improve the brain function in participants from Rayong through this health education program, measures such as increasing the number of steps, adding muscular strength/stretching exercises, and home training every day is suggested.

Keyword: Health profession

1. Introduction

In line with the increase in aging population worldwide, the prevalence of >65-years-old adults are expected to increase from 22.7% in 2010 to 35.6% in 2020 in Japan and from 8.9% in 2010 to 25.1% in 2020 in Thailand. It is expected that Thailand will be at the same level of aging as Japan in future [1]. However, about the social system of preventive care for senior citizens is not in good order yet. World Health Organization (WHO) declared to achieve the goal "Health for All" by the year 2000 and beyond in a health promotion conference in Ottawa in 1986 [2]. In response to the trend of WHO, Japan Ministry of Health, Labor and Welfare (MHLW) formulated the "Kenko Nippon 21" program in 2000 and aimed to make Japan a vibrant society in the 21st century, where all citizens can improve their quality of life [3]. The Japanese MHLW introduced a national policy to improve the prevention and treatment for metabolic syndrome [4]. An active health program, developed by the Japanese authors, has been implemented by measuring energy expenditure and conducting brain function, physical fitness, and blood tests as well as providing educational seminars regarding exercise and nutrition, and recreational activities, such as hiking and cooking [5, 6, 7]. On the other hand, Thailand's health policy changed its focus from "primary health care" in the 1978 to "health promotion" since 1986. The Chuan Government's decentralization policy was instrumentally used by community health-oriented bureaucrats in pursuing legislation or the National Health Act, which was considered as a concrete expression of the health promotion movement [8]. Unique health education is being conducted

in many areas in Thailand. However, it is unlike our Japan ISO health education, which includes anthropometry, physical fitness, brain function, and blood tests and the evaluation are used for the next target setting for the participants. Over the past decades Nagano prefecture, including Minowa town, has been one of the areas with the highest life expectancy rates in Japan. Research by WHO [9] showed Japan to be the highest longevity country in the world in 2005, and also in 2015, Also, the Minowa town area is expected to be a world-class area where longevity is foreseen. This study aimed to appropriately establish a Japanese style healthcare program under the ISO9001:2008 (ISO: International Organization for Standardization) in Minowa, Japan and Rayong, Thailand to improve problem areas and inspect its effectiveness. Furthermore, we want to make this health promotion through ISO widely available in Asian countries and to make an international contribution.

2. Methods

2.1. General method

We implemented a 6-month health program (ISO9001:2008) from August 2013 to January 2014 in Rayong city, and a 10-month health program from May 2013 to February 2014 in Minowa town. In Thailand, reform in the Ministry of Health was carried out in 1974. Prevention along with medical treatment was unified. A community center connecting with the general hospital was established [8]. In this research, as a continuing activity of the community center in Rayong city, elderly volunteers who agreed to this research plan were included as participants. Meanwhile, in Minowa town also, the elderly volunteers agreeing with this research plan were included as participants. This ISO health education plan must be rooted in the region and be an effective program in the community. Because the health program in Japan and Thailand prioritized regional events and later incorporated the events of this health program, the health education program in the Minowa town in Japan was for 12 months and in Rayong city in Thailand lasted 6 months. This study assessed findings from pedometry, anthropometry and blood pressure measurements, physical fitness, blood chemistry, and brain function tests. The Rayong city subjects were 114 aged 60.5 ± 11.1 years, including 31 men aged 66.3 ± 7.1 years and 83 women aged 58.3 ± 11.5 years. The Minowa subjects were 43 aged 63.2 ± 4.4 years, including 17 men aged 61.8 ± 4.1 years and 26 women aged 65.5 ± 4.0 years. In Rayong city and Minowa town during these programs, the subjects received a series of seminars regarding recreational activities for 90 or 120 min once or twice a month. In addition, Rayong subjects performed aerobic exercises three times a week, and Minowa subjects performed stretching and muscular training of 120 min once a week, and home training every day (Table 1). An approximate target of 7,000−8,000 steps per day was set based on the Weight Bearing Index (WBI) [10]. Because the results of the WBI for participants in Rayong and Minowa

Table 1. Program contents of the health education in the Rayong city and Minowa town.

Month	Rayong program	Minowa program
Apr.		Opening ceremony
May		Measurements before the health education and training once a week
June		Lecture on the importance of health and training once a week
July		Practical recreation and training once a week
Aug.	Measurements before the health education	Hiking and training once a week
Sept.	Aerobic exercises three times a week	Lecture of nutrition and training once a week
Oct.	Aerobic exercises three times a week	Practical walking and training once a week
Nov.	Lecture on health and aerobic exercises three times a week	Lecture on blood pressure and training once a week
Dec.	Visit of the temple and aerobic exercises three times a week	Lecture on dental health and training once a week
Jan.	Measurements after completion of the program	Tai Chi Chuan and training once a week
Feb.		Measurements after completion of the program

Rayong: monthly classroom activity plus weekly 90-min strength and weight training.
Minowa: monthly classroom activity or/and weekly 120-min aerobic exercises.

was 90% corresponding to 6,000 steps, 60% corresponding to 7,000 steps, 20% corresponding to 8,000 steps, and that the brain function, physical fitness, body weight and blood chemistry test values are significantly improved by exercise of 7,000 or more steps [5, 6, 7], the latest guidelines based on the Helsinki Declaration was adopted by the Institutional Ethics Committee of Mahidol University (Mahidol Univ. IRB: 01-58-10) and Shinshu University (UMIN000009309). Written informed consents were obtained from all the participants.

2.2. Pedometry

The daily numbers of walking steps and the amount of energy expenditure was measured using a pedometer (Acos Co. Ltd., Japan; AM500NE). The step value in one day (daily steps) is the total of exercise steps of more than 4 Mets and normal steps of less than 4 Mets. Exercise steps are defined as steps taken during expenditure >4 METs (METs metabolic equivalent: energy expenditure during acting ÷ amount of metabolite during sitting quietly). The pedometer enabled the data to be transferred and saved to the computer. These walking steps were measured from August 2013 to January 2014 in Rayong city, and from March 2013 to February 2014 in Minowa town. The Minowa subjects reported their results to a project leader during a monthly meeting.

2.3. Anthropometry and blood pressure measurements

Weight and body mass index (BMI) were included in the anthropometry measurements. Weight measurement used body composition monitors with scales (Omron Healthcare Co., Ltd. JAPAN; HBF-359). Weight measurement was implemented at the time of fasting >10 h from the last meal. Maximum and minimum blood pressures were measured via auscultation (mercury sphygmomanometer, Kenzumedico 0601B001, Japan) after the subjects had been sitting for 15 min in a room with an ambient temperature of 25 °C and relative humidity of approximately 50%.

2.4. Physical fitness tests

The physical fitness tests administered in the current study were approved by the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) [11]. The physical fitness test (target age: 65–79 years) included six physical assessments: 1) grip strength for muscle strength; 2) sit-ups for muscle endurance; 3) sit-and-reach flexibility for muscle flexibility; 4) eyes-open single-leg stance for balance ability; 5) 10 meter obstacle walk for walking ability; and 6) a 6-min walk for endurance. The subjects' physical ability was assessed before and after the health program.

2.5. Blood chemistry tests

Blood chemistry assessment included five components: 1) fasting blood glucose; 2) hemoglobin A1c (HbA1c); 3) high-density lipoprotein (HDL); 4) low-density lipoprotein (LDL) and 5) triglycerides. Blood chemistry measurements were taken after the fasting time >10 h from the last meal. The subjects' blood chemistry was assessed before and after the health program.

2.6. Brain function tests

The go/no-go tasks [12, 13, 14], were used to estimate the inhibitory decision process, which consisted of three experimental stages: 1) formation; 2) differentiation, and 3) reverse differentiation. First, in the formation stage, subjects were instructed to squeeze a rubber ball in response to a red light that was randomly displayed. The formation stage consisted of five trials. Second, during the differentiation stage, subjects squeezed a rubber ball in response to a red light, but not a yellow light, when a red or yellow light was randomly displayed. Third, during the reverse differentiation stage, subjects squeezed a rubber ball in response to a yellow light, but not a red light, when a red or yellow light was randomly displayed. In each of the differentiation and reverse differentiation stages, subjects completed 20 trials. Red and yellow lights were equally randomly displayed 10 times each. In this article, the term "forget" indicates an incorrect response when study subjects did not squeeze a rubber ball when it should have been squeezed. Another, the term "mistake" means an

incorrect response when subjects squeezed the rubber ball when it was not supposed to be squeezed. We administered the go/no-go tasks to assess the participants' brain function before and after the health program.

2.7. Statistical analyses

The non-paired-t test was used to compare the results of Minowa and Rayong in the steps numbers that counted by the pedometer. The paired-t test was used to compare the results before and after participation in the health program. Comparison of pre- and post- health programs in subjects of Rayong and Minowa were analyzed via a two-way ANOVA replication. The level of significance was set at $p < 0.05$. Statistical analyses were performed using SPSS 11.0.1 (SPSS Inc., Chicago, USA).

3. Results

3.1. Pedometry

Fig. 1 shows the average walking numbers of daily and exercise steps for each month in participants in Rayong and Minowa. The daily steps are the total of the exercise steps of more than 4 Mets and the normal steps of less than 4 Mets. In subjects of Rayong, the daily and exercise steps in month were 4216.2 ± 440.8 (mean ± SE) and 1502.0 ± 568.3, respectively, in August; 5031.2 ± 366.8 and 1501.0 ± 122.7 in September; 4841.5 ± 314.9 and 1452.9 ± 98.7 in October; 4670.1 ± 303.2 and 1317.5 ± 86.2 in November; 4751.8 ± 374.3 and 1294.3 ± 112.3 in December; and 4662.3 ± 396.5 and 1301.3 ± 112.1 in January. The average numbers of daily steps decreased in November and January. However, there were not many changes in the average numbers of exercise steps from 1200–1500 steps in all months. For the 6-month analysis, the average numbers of daily and exercise steps were 4695.5 ± 361.1 and 1394.8 ± 183.4, respectively (Fig. 1). In participants
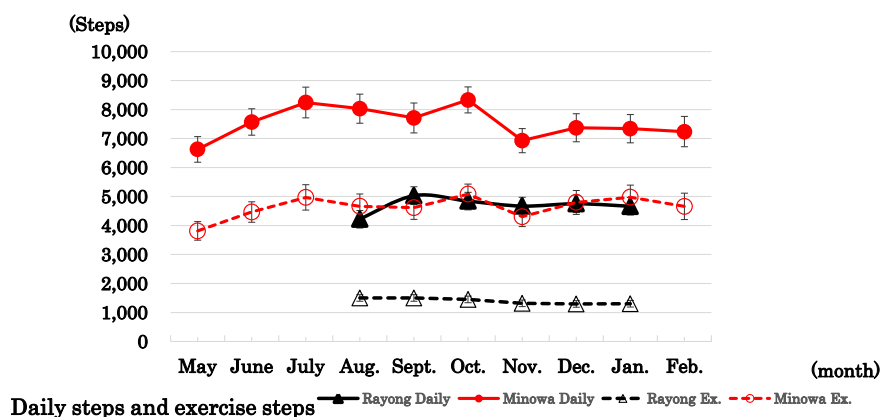

Fig. 1. Pedometry comparison of Rayong and Minowa.

in Minowa, the daily exercise steps in month were 6626.1 ± 440.2 and 3816.3 ± 320.3 in May; 7569.8 ± 456.7 and 4468.1 ± 351.9 in June; 8242.6 ± 527.5 and 4969.0 ± 436.6 in July; 8032.6 ± 501.4 and 4663.0 ± 426.9 in August; 7710.8 ± 515.4 and 4614.9 ± 398.5 in September; 8330.7 ± 447.1 and 5082.8 ± 349.0 in October; 6929.0 ± 417.2 and 4303.5 ± 336.8 in November; 7371.3 ± 485.6 and 4798.1 ± 412.8 in December; 7340.8 ± 486.9 and 4976.0 ± 421.0 in January; and 7237.3 ± 523.7 and 4660.5 ± 453.2 in February (Fig. 1). The average numbers of daily steps increased from May to October, however, it decreased from November to February. Not many changes in the average numbers of exercise steps from 4 000−5 000 steps were noted during all through the months. There was a period of 10 months between start to finish of the health education, the average numbers of daily and exercise steps were 7593.1 ± 481.6 and 4635.2 ± 391.5, respectively. Overall, daily steps (Rayong; 4695.5 ± 361.1 vs. Minowa; 7593.1 ± 481.6, p < 0.001) were significantly higher than exercise steps in subjects of Rayong (Rayog; 1394.8 ± 183.4 vs. Minowa; 4635.2 ± 391.5, p < 0.001). Participants in Rayong had a rainy season from June to August, and participants in Minowa had snow in October to March. The rain and snow affected the participants walking during that time.

3.2. Anthropometry and blood pressure measurements

In subjects of Rayong, a comparison of the anthropometry measurements results before and after the program showed that weight (before: 61.7 kg ± 1.1; after: 62.3 kg ± 1.1, p < 0.006) and BMI (before: 24.9 ± 0.4; after: 25.2 kg ± 0.4, p < 0.001) significantly increased after the program; however, in subjects of Minowa, weight (before: 59.8 kg ± 1.7; after: 56.7 kg ± 1.6, p < 0.001) and BMI (before: 23.2 ± 2.7; after: 22.0 kg ± 2.4, p < 0.001) significantly decreased after the program. In subjects of Rayong, a comparison of the blood pressure results from before and after the program showed no significant differences in both maximum and minimum blood pressure; however, in subjects of Minowa, maximum blood pressure (before: 137.5 mmHg ± 2.6; after: 129.5 mmHg ± 1.7, p < 0.002) and minimum blood pressure (before: 84.1 mmHg ± 1.2; after: 81.4 mmHg ± 1.5, p < 0.03) showed significant decreases (Table 2).

3.3. Physical fitness tests

In subjects of Rayong, a comparison of the physical fitness tests results from before and after the program showed no significant difference in the numbers of sit-ups, 10-meter obstacle walk, and 6-min walk. The grip strength (before: 26.3 kg ± 0.8; after: 27.8 kg ± 0.7, p < 0.002) and sit-and-reach flexibility (before: 34.4 cm ± 0.9; after: 38.0 ± 1.3, p < 0.004) significantly increased after the program. In contrast, eyes-open single-leg stance (before: 45.0 s ± 4.1; after: 35.2 s ± 3.8, p < 0.002) was

Table 2. Comparison of before and after health program in Rayong and Minowa.

	R/pre	R/post	p-value	M/pre	M/post	p-value	2 way ANOVA		
							B·A	R·M	Interaction
Anthropometry measurements									
Weight (kg)	61.7 ± 1.1	62.3 ± 1.1	0.006	59.8 ± 1.7	56.7 ± 1.6	0.001	0.397	0.082	0.849
BMI	24.9 ± 0.4	25.2 ± 0.4	0.001	23.2 ± 2.7	22.0 ± 2.4	0.001	0.809	0.000	0.130
Blood pressures measurements									
Systolic blood pressure	134.0 ± 1.7	135.7 ± 1.6	0.271	137.5 ± 2.6	129.5 ± 1.7	0.002	0.620	0.505	0.021
Diastolic blood pressure	79.2 ± 1.3	79.0 ± 1.0	0.889	84.1 ± 1.2	81.4 ± 1.5	0.030	0.366	0.029	0.230
Physical fitness tests									
Grip strength (kg)	26.3 ± 0.8	27.8 ± 0.7	0.002	32.1 ± 1.5	33.0 ± 1.4	0.082	0.185	0.000	0.893
Sit-ups (times)	5.1 ± 0.7	5.4 ± 0.9	0.654	11.8 ± 0.8	14.2 ± 1.0	0.001	0.047	0.000	0.060
Sit-and-reach flexibility (cm)	34.4 ± 0.9	38.0 ± 1.3	0.004	39.8 ± 1.5	45.7 ± 1.2	0.001	0.000	0.000	0.231
Eyes-open single leg stance (sec.)	45.0 ± 4.1	35.2 ± 3.8	0.002	98.1 ± 5.8	111.6 ± 3.9	0.001	0.245	0.580	0.047
10-m Obstacle walk (sec.)	8.5 ± 0.2	8.4 ± 0.2	0.079	7.4 ± 0.2	5.9 ± 0.1	0.001	0.015	0.000	0.002
6 minutes walk (m)	514.3 ± 9.6	508.3 ± 8.7	0.778	604.6 ± 7.2	722.3 ± 9.8	0.001	0.080	0.000	0.001
Blood chemistry tests									
Fasting blood glucose (mg/dl)	102.5 ± 2.8	96.9 ± 4.4	0.001	102.4 ± 1.7	100.5 ± 2.8	0.113	0.257	0.912	0.649
HbA1c (%)	5.6 ± 1.2	6.0 ± 1.0	0.001	5.3 ± 0.4	5.2 ± 0.3	0.030	0.002	0.000	0.165
HDL (mg/dl)	61.2 ± 13.0	52.9 ± 10.5	0.001	61.6 ± 2.6	62.0 ± 2.7	0.715	0.000	0.000	0.010
LDL (mg/dl)	113.2 ± 3.1	124.0 ± 3.1	0.002	122.7 ± 23.1	114.4 ± 24.1	0.033	0.097	0.267	0.021

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Table 2. (*Continued*)

	R/pre	R/post	p-value	M/pre	M/post	p-value	2 way ANOVA		
							B·A	R·M	Interaction
Triglyceride (mg/dl)	150.0 ± 11.7	140.3 ± 7.4	0.662	107.8 ± 7.4	88.2 ± 6.6	0.075	0.311	0.000	0.883
Brain function tests (go/no-go tasks)									
Response									
Formation (msec.)	356.4 ± 13.5	380.0 ± 14.4	0.119	237.3 ± 4.5	263.7 ± 6.6	0.001	0.635	0.000	0.064
Differentiation (msec.)	446.9 ± 9.0	481.7 ± 10.0	0.001	381.9 ± 10.1	432.3 ± 11.9	0.001	0.060	0.000	0.019
Revers Differentiation (msec.)	427.6 ± 12.1	446.2 ± 11.2	0.001	404.8 ± 10.2	429.0 ± 11.4	0.001	0.011	0.000	0.003
Average (msec.)	425.1 ± 8.3	446.2 ± 9.6	0.060	364.3 ± 8.0	399.7 ± 9.5	0.001	0.379	0.000	0.042
Times									
Total numbers of Forgets (Times)	1.2 ± 0.2	0.3 ± 0.1	0.001	0.1 ± 0.0	0.1 ± 0.1	0.710	0.000	0.000	0.003
Total numbers of Mistakes (Times)	5.8 ± 0.5	2.6 ± 0.3	0.001	3.0 ± 0.4	3.0 ± 0.4	0.712	0.000	0.007	0.001
Total numbers of Errors (Times)	7.1 ± 0.6	2.9 ± 0.3	0.001	3.1 ± 0.4	3.1 ± 0.4	0.754	0.000	0.000	0.000

B·A: main effect of before and after, R·M main effect of Rayong and Minowa, Intraction: intraction effect between B·A and R·M.

significantly decreased after the program. In subjects of Minowa, a comparison of the physical fitness tests results from before and after the program showed no significant difference in hand grip strength. The sit-ups (before: 11.8 times $\pm$ 0.8; after: 14.2 times $\pm$ 1.0, p < 0.001), sit-and-reach flexibility (before: 39.8 cm $\pm$ 1.5; after: 45.7 $\pm$ 1.2, p < 0.001), eyes-open single-leg stance (before: 98.1 s $\pm$ 5.8; after: 111.6 s $\pm$ 3.9, p < 0.001), 10-meter obstacle walk (before: 7.4 s $\pm$ 0.2; after: 5.9 s $\pm$ 0.1, p < 0.001), and 6-min walk (before: 604.6 m $\pm$ 7.2; after: 722.3 m $\pm$ 9.8, p < 0.001) was significantly improved after the program (Table 2).

3.4. Blood chemistry tests

In subjects of Rayong, a comparison of blood chemistry measurements results before and after the program showed no significant differences in triglycerides levels. HbA1c (before: 5.6% $\pm$ 1.2; after: 6.0% $\pm$ 1.0, p < 0.001) and LDL (before: 113.2 mg/dl $\pm$ 3.1; after: 124.0 mg/dl $\pm$ 3.1, p < 0.002) were significantly increased, and, HDL (before: 61.2 mg/dl $\pm$ 13.0; after: 52.9 mg/dl $\pm$ 10.5, p < 0.001) was significantly decreased after the program. In contrast, fasting blood glucose (before: 102.5 mg/dl $\pm$ 2.8; after: 96.9 mg/dl $\pm$ 4.4, p < 0.001) was significantly improved after the program. In subjects of Minowa, a comparison of blood chemistry measurements from before and after the program showed no significant differences in fasting blood glucose, triglycerides, and HDL cholesterol levels. HbA1c (before: 5.3% $\pm$ 0.4; after: 5.2% $\pm$ 0.3, p < 0.030) and LDL (before: 122.7 mg/dl $\pm$ 23.1; after: 114.4 mg/dl $\pm$ 24.1, p < 0.033) significantly improved after the program (Table 2).

3.5. Brain function tests

In subjects of Rayong a comparison of the brain function as go/no-go tasks from before and after the program showed no significant differences in both formation and average reaction times. Differentiation reaction times (before: 446.9 ms $\pm$ 9.0; after: 481.7 ms $\pm$ 10.0, p < 0.001) and reverse differentiation reaction times (before: 427.6 ms $\pm$ 12.1; after: 446.2 ms $\pm$ 11.2, p < 0.001) significantly increased after the program. In contrast, total numbers of forgets (before: 1.2 times $\pm$ 0.2; after: 0.3 times $\pm$ 0.1, p < 0.001), mistakes (before: 5.8 times $\pm$ 0.5; after: 2.6 times $\pm$ 0.3, p < 0.001), and errors (before: 7.1 times $\pm$ 0.6; after: 2.9 times $\pm$ 0.3 p < 0.001) were significantly decreased after the program. In subjects of Minowa, a comparison of the brain function as go/no-go tasks from before and after the program showed significant differences in short times in formation reaction time (before: 237.3 ms $\pm$ 4.5; after: 263.7 ms $\pm$ 6.6, p < 0.001), differentiation reaction time (before: 381.9 ms $\pm$ 10.1; after: 432.3 ms $\pm$ 11.9, p < 0.001), reverse differentiation reaction time (before: 404.8 ms $\pm$ 10.2; after: 429.0 ms $\pm$ 11.4, p < 0.001), and average reaction time (before: 364.3 ms $\pm$ 8.0; after: 399.7 ms $\pm$ 9.5, p < 0.001). However, the total numbers of forgets, mistakes, and errors were not significantly different after the program (Table 2).

3.6. Two-way ANOVA replication

The comparisons were made before and after between the participants in Rayong and Minowa and the interaction effects were also compared before/after for the particpants in Rayong/Minowa. Interaction effects in participants in Rayong and Minowa showed significant differences in systolic blood pressure, the eyes-open single leg stance, the 10 m obstacle walk, the 6-minute walk, HDL levels, the reverse and reverse differentiation time, the total number of forgets, the total number of mistakes, and the total number of brain function errors. Among them, a significant difference was observed between participants in Rayong and Minowa in the 10-m obstacle walk, the 6-minute walk, the HDL levels, the reverse and reverse differentiation time, the total number of forgets, the total number of mistakes, and the total number of brain function errors (Table 2).

4. Discussion

4.1. Pedometry

It is known that walking improves our defense against diseases and contributes to health improvement [15, 16, 17, 18, 19]. Walking improves health and the Ministry of Health, Labor and Welfare of Japan supports the current physical activity guidelines [3]. The number of steps monthly of the participants when the health program started was: 4,216 (Rayong city), 6,626 (Minowa town). The average steps during the health education period was: Rayong city 4,696, Minowa town 7,593. Both Rayong city and Minowa town had an average increase over the month when health education began. So this result seems to be an effect of the health education. The initial steps in Rayong city and Minowa town was already more than 2,000 steps because agriculture is popular in both regions. Health education in Minowa town continued for more than 10 years and printing monthly data may have contributed to and influenced the number of steps taken. Minowa subjects' daily records had shared each other in the monthly meetings for motivating the subjects to increase their steps. For the increasing of the numbers of steps in subjects of Rayong, it is necessary to implement the similar sharing in the meetings. An investigation in 2011 by the Japanese MHLW showed that the average steps were 7,841 for men, and 6,883 for women (age 20−64). "Kenkou Nippon 21" aims for 9,000 steps for men and 8,500 steps for women by 2020 [3].

4.2. Anthropometry and blood pressure measurements

In subjects of Rayong, a comparison of the anthropometry results from before and after the program showed that weight significantly increased after the program. However, in subjects of Minowa, weight significantly decreased after the program. Additionally, in subjects of Rayong, maximum and minimum blood pressures from

before and after the program showed no significant differences. In contrast, in subjects of Minowa, maximum and minimum blood pressures showed significantly decreased. Because of the health education provided in Japan, participants' weight, BMI, and blood pressure tended to decrease [6, 7]. Rayong subjects' significant increases in weight and BMI, suggest that the energy ingested from eating was higher than the energy consumed by exercise, during the program. It is estimated that the average number of steps in Minowa's participants is about 3,000 steps more than Rayong's participants, and that the momentum difference is that participants in Minowa are doing stretching, muscular training once a week for 120 minutes and home training every day. However, in the future we must also consider the possibility of other factors such as seasonal, religious and a different period of health education.

4.3. Physical fitness tests

In subjects of Rayong, a comparison of the physical fitness tests results from before and after the program showed significant improvements in grip strength and sit-ups; however, eyes-open single-leg stance was significantly decreased after the program. In contrast, in subjects of Minowa, other physical fitness tests, except the grip strength, were significantly improved after the program. The difference between the results from subjects of Rayong and Minowa may be because the subjects of Minowa performed the stretch and muscular training of 120 min once a week, and home training every day. The average age of Rayong participants was 61 years old and the average age of Minowa participants was 63 years old. Still, the eyes-open single-leg stance, the 10 m-obstacle walk and the 6 minute walk were significantly better in Minowa participants. The eyesopen single-leg stance has a significant relationship with the go/no-go task [20]. In addition, walking speed and distance of participants with dementia was significantly slower and shorter than healthy participants [21, 22]. Therefore, Rayong participants compared with Minowa participants may indicate the decline of brain function. The Japanese MEXT has conducted physical fitness tests on people from age 6−79 years since 1999. Physical fitness tests on people from 65−79 years old included the grip strength, sit-ups, sit-and-reach flexibility, eyes-open single-leg stance, 10-m obstacle walk, and 6min walk [11]. We have chosen these physical fitness tests for healthy elderly people. In addition, the Japanese MHLW conducts physical fitness tests for the care of people >65 years, which included the grip strength, eyes-open single-leg stance, timed up and go test, and 5-m normal and maximum walk times [3]. The increased number of steps in subjects of Rayong health program may reflect better performance in the physical fitness tests. Increased exercise momentums lead to improve physical fitness tests results [23, 24]. Therefore, physical test results in subjects of Rayong may improve if the subjects performed the stretch and muscular training for 120 min once a week and home training every day.

4.4. Blood chemistry tests

In subjects of Rayong, a comparison of blood chemistry measurements results from before and after the program showed HbA1c and LDL significantly increased, and HDL significantly decreased after the program. In contrast, fasting blood glucose significantly improved after the program. In subjects of Minowa, it was shown that HbA1c and LDL levels significantly improved after the program. It is well established that regular exercise improves blood glucose and lipid metabolism [25, 26]. In subjects of Rayong, fasting blood glucose was significantly improved. However, the HbA1c level was significantly increased. Usually fasting blood glucose and HbAlc should change/decrease or increase, in the same manner, but the above results are within normal level; fasting blood glucose $\geqq$ 130 mg/dl, HbA1c $\geqq$ 6.5. The fasting blood glucose level indicates the sugar value (mg/dl) in the blood, and HbA1c indicates the proportion (%) of hemoglobin bound to the sugar. Both values of the participants in Rayong are fluctuations within normal values. Rayong participants may be improving their blood sugar values because the fasting blood glucose shows blood condition and the HbA1c shows blood glucose levels for the past 1−2 months [27].

4.5. Brain function tests

Go/no-go tasks are frequently used to investigate response inhibition, which is an essential executive function implemented by the prefrontal cortex and these tasks recruit a variety of cognitive components besides response inhibition [12, 13, 14, 28, 29]. In subjects of Rayong, a comparison of the brain function as a go/no-go task from before and after the program showed significantly shortened times in differentiation, reverse differentiation, and average reaction. In contrast, the total numbers of forgets, mistakes, and errors were significantly decreased after the program. In subjects of Minowa, showed significantly short formation times, differentiation, reverse differentiation reaction times, and average reaction time. However, the total numbers of forgets, mistakes, and errors were not significantly different after the program. Previous go/no-go tasks studies suggested that a health program could improve brain function, including working memory [12, 13, 14, 28, 29]. In those studies, subjects performed regular exercises in the first stage where go/no-go task reaction times increased significantly and the numbers of error responses decreased significantly. In the second stage, go/no-go task reaction times decreased significantly, and the numbers of error responses decreased significantly. In precedent studies [5, 6, 7] with subjects of Rayong and Minowa, go/no-go results for the first stage improved, and are suggested to have been caused by the enforcement of health education program.

4.6. Two-way ANOVA replication

The comparisons made on interaction effects and between participants in Rayong/Minowa showed significant differences in the 10-m obstacle walk, the 6-minute walk, the HDL levels, the reverse and reverse differentiation time, the total number of forgets, the total number of mistakes, and the total number of brain function errors (Table 2). Rayong participants had a 4 month shorter health education period compared to Minowa. The average age was 63 years old for Minowa participants and 61 years old for Royong participants. However, Minowa subjects have significantly faster walking speed, more walking distance, more HDL numbers, faster response times and less error count for go/no-go tasks. The eyes-open single-leg stance has a significant relationship with the go/no-go task [20]. In addition, walking speed of dementia participants was significantly slower than healthy participants [21, 22]. Rayong participants did not have better brain functions than Minowa participants. For the prevention of dementia, through this health education, improvement measures such as increasing the number of steps, adding muscular strength/stretching exercises, and incorporating more vegetables into the diet of Rayong participants is considered necessary.

5. Conclusions

The objective of this study was to determine the effectiveness of a Japanese ISO-certified health-education system in Thailand. Our results show the effectiveness of this program in an international context, and through cooperation between Thailand countries, a Thailand organization could be launched to effectively implement a systematic approach to health education. One of our goals is to develop an ISO-certified health-education system that will be organized, improved, shared, and utilized across these countries, and that will contribute to the international community.

Declarations

Author contribution statement

Satomi Fujimori, Suchinda Jarupat Maruo, Koji Terasawa: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Noppawan Piaseu, Surintorn Kalampakorn, Siriporn Sasimonthonkul, Keisuke Nakade, Toshiaki Watanabe, Yuki Murata: Performed the experiments.

Fumihito Sasamori: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Saiki Terasawa: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Masao Okuhara, Hisaaki Tabuchi: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

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The authors declare no conflict of interest.

Additional information

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