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Achievement of Brain Training Course for the Elderly

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Abstract

Introduction: The first objective of this research was to verification to the effectiveness for combining brain training with rhythmic exercises for three-month brain training. In order to further prevent motoric cognitive risk syndrome (MCR), we gave instructions to continue exercise. In order to evaluate motoric ability, we carried out the two-step test. Confirmation of the benefits of this intervention in motoric ability and the extent of the correlation between body composition and cognitive function was the second objective of this research.

Methods: A screening test for mild cognitive impairment: Montreal Cognitive Assessment (MoCA test), measurement of body composition by an inner scan monitor, and motoric ability were performed by measuring two-step test. For statistical evaluation of scores before and after each cognitive test intervention, t tests were used. To test for relationships between the score of cognitive test and measured value of body composition and two-step test, Pearson 's correlation coefficient was used.

Results: Significant improvements in cognitive function were detected after intervention, with the strongest correlating variable with the cognitive function and body composition comparisons being blood vessel age. Furthermore, there was a correlation between two-step test and cognitive function, with those subjects with high motoric ability having high cognitive function.

Conclusion: Interventions that combine rhythmic exercises and brain training are effective in preventing dementia. Correlations were detected between cognitive function and vascular age, and motoric's ability. Therefore, in order to maintain the cognitive function, it is necessary to improve the dietary life as a means of improving vascular age and perform activities to provide maintenance and improvement of motoric's ability.

Keywords: Brain training; Rhythmic exercises; Body composition; Motoric

Introduction

Elderly people over the age of 65 years have a higher incidence of developing dementia [1], with the rate doubling every 5 additional years of ageing [2]. Therefore, the establishment of preventative measure is urgently needed. Unfortunately, amyloid vaccines developed in 2000 were not able to suppress the decline in cognitive function despite reductions in amyloid-β levels in the brain of treated patients [3]. Since preventive measures before onset are most likely to be effective, a worldwide Alzheimer's Disease Neuroimaging Initiative (ADNI) has been established to create a standardized test index that can detect AD before onset of disease and also to track its progress [4]. The Japanese division, J-ADNI, was established in 2007, but regional centers are still being sought.

These trends in disease management motivated us to begin testing interventions that combine rhythmic exercises and brain training for elderly people in Kashihara-City. The reason for using rhythmic exercises is that since the rhythmic exercises activates serotonin, we were expecting psychological effects [5]. Serotonin affects not only emotional stability but also memory and learning ability, but when a person gets older, activity value decreases [6]. Therefore, activation of serotonin leads to effective brain training for the elderly. We hypothesized that combining brain training with rhythmic exercises, which is considered to be highly effective, would further enhance this effect.

In brain training, n-back task (memory retention task answering N^{th} previous tasks) is proven to be effective, and has been verified to activate the frontal lobe and parietal cortex region [7]. In addition, it is reported that the brain becomes more activated with dual-tasks (concurrent performance of two tasks) as compared with a single task (performance of a single task, such as exercise or learning alone), which increased activation of the prefrontal cortex [8,9]. With these research findings in mind, the present study was designed with interventions with combinations of rhythmic exercises, the n-back task, and dual-task.

Additional factors strongly associated with AD either alone or in combination are common diseases or lifestyle choices such as, hypertension, obesity, smoking, dyslipidemia, diabetes and diet. The risk for AD increases in individuals with several predispositions: about 2 times for hypertension, 2.1 times for obesity (BMI 30 or more), 1.8 times for smoking, 2.9 times for dyslipidemia (total cholesterol level 250 mg/dl or more), and 4.6 times for diabetes (HbA1c 7% or more) [10]. Also, since the brains of AD patients display increased oxidation modification products [11], therefore, an improvement of dietary habits could be an important method of prevention. In this study, we focused on the fact that there is a relationship between AD and body composition, which is the result of a poor long-term dietary lifestyle. In order to further validate the relationship between the body composition and cognitive function, we carried out measurements with the inner scan monitor and compared these to cognitive function.

We also wanted to study the actual influence of motor function on the brain, along with these body compositions. The relationship between cognitive risk and walking speed has gained attention in

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recent years. Motoric cognitive risk syndrome (MCR) is a state where walking speed decreases to 3.5 km per hour and there is a minor level of cognitive function decrease. It has been reported that such people are twice as likely to develop dementia compared to the normal state. In terms of the correlation between walking ability and cognitive function, correlations between walking speed and cognitive function [12,13] correlations between stride and cognitive function [14], correlations between a decrease in walking speed and stride, and atrophy of white matter and the hippocampi [15] have been reported in prior research.

The purpose of this research is to verify the effect on cognitive function by intervention of rhythmic exercises combined with brain training, to clarify the relationship between cognitive function and body composition, and to clarify the relationship between cognitive function and motoric.

Methods

Target cohort

108 elderly people who applied for rhythmic exercises brain training advertised by public relations.

Study period

February-August 2016. Three months' non-intervention period (control period), the intervention period of the next three months.

Evaluation and analysis

Measurement of cognitive function: Japanese version of the Montreal Cognitive Assessment (MoCA-test): This is a cognitive screening instrument developed to detect mild cognitive impairment (MCI). It assesses different cognitive domains: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation.

The time taken to administer the MoCA-test is approximately 10 minutes. The total possible score is 30 points; a score of 26 or above is considered normal.

Body composition monitors: Inner scan monitor: The monitors use bioelectric impedance analysis (BIA) to monitor multiple components of overall health. Measurements include weight, body mass index (BMI), body fat, basal metabolic rate (BMR), metabolic age, bone mass, muscle mass, physique rating, and visceral fat rating.

Vascular age measurement system: Measurement is performed by placing the finger on the sensor. Blood vessel age was measured by assessing the amount of blood flow between the first joint from the tip of the finger.

Measurement of size of stride: In the two-step test, the subject is asked to stand with both feet together, take two steps as large as possible, and then subtract the height from the distance walked (Figure 1). This is said to reflect the level of self-support in daily life and the risk of falling down.

The average values for a Japanese at age is given in Table 1 (The source: Japan Locomo Challenge Promotion Conference). If the subject does not meet the average value of their age, if the situation does not change, there is high possibility of disabilities to be seen in activities like walking.

Analytical methods: To compare MoCA scores before and after the intervention, paired t-test were conducted. Correlations of MoCA scores with body composition and two step value were computed using Pearson product-moment correlation coefficients.

Ethical considerations: The outline of the research, voluntary nature of participation, anonymity, and agreement regarding the publication of the document were explained to prospective participants both in writing and verbally, and their consent was subsequently obtained. The study protocol was approved by the ethical review board of Nara Medical University.

Results

Of the 108 registrants, 79 people (73.1%) completed the study and were analyzed. Full sustained the participants with 12 men, 67 women, and mean age of 75 ± 8.2.

Regarding cognitive function, the average value of the scores of each item of MoCA test and the result of the corresponding t-test are shown in the Figure 2. The average score of the total score of the MoCA test before intervention was 22.7 points (<26 points), which did not reach the cut off value. The result of re-measurement after the control period was 23.7 points, and did not change much. After the intervention, it was 26.1 points and exceeded the cutoff value, greatly improving cognitive ability (p<0.01).

Each of the following measures of cognitive function; Trail Making, Visuo constructional skills, Verbal Fluency, Short-Term Memory Recall, were significantly improved (P<0.05). Next, the results of body composition and vascular age are shown in Table 2.

As shown in the Table 2, Body Composition decreased with age, but visceral fat was increased in the age 70's group compared to the age 60's group. Vascular age was also slightly higher in individuals in the age 70's group than in the age 80's group.

Hereinafter, the correlation coefficient between the total score of MoCA test, and other body composition: Basal metabolism:0.25*, Bone mass:0.28*, Muscle mass:0.27* *Significant at 5% level, **Significant at 1% level

As shown in Figure 3, the strongest correlation was found between cognitive function and vascular age (p<0.01). In addition, cognitive function correlated with basal metabolism, bone mass, and muscle mass (p<0.05).

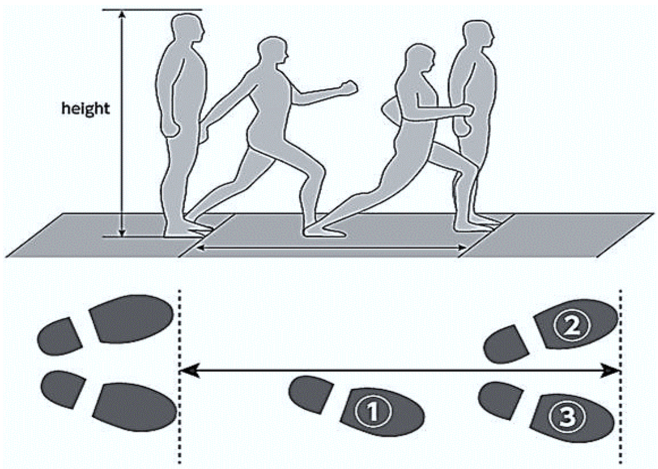
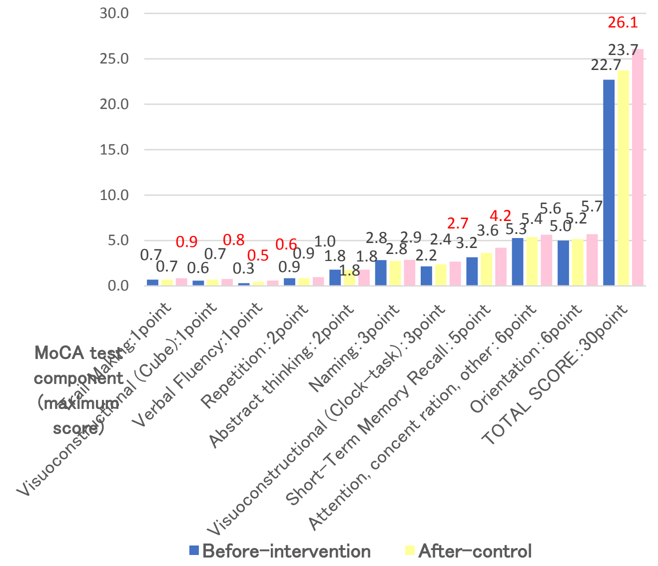


Figure 1: Two-step test. The source: Japan Locomo Challenge Promotion Conference.



Corresponding paired t-test, n=79; *Significant at 5% level; **Significant at 1% level.

Figure 2: Comparison before and after the intervention and control of the mean value of MoCA test.

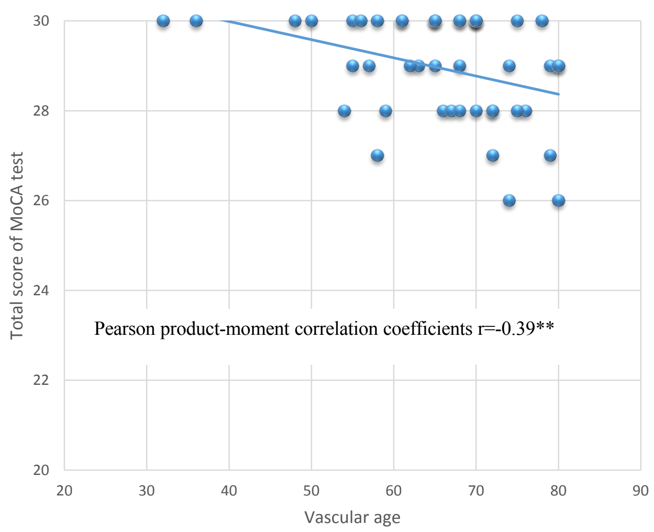


Figure 3: Correlation between total score of MoCA-test and vascular age.

Next, regarding motoric's ability, although two-step value had a negative correlation with age (Pearson product-moment correlation coefficients: r=-0.32, p=0.01), significant stride expansion was seen in comparison of before and after the intervention (Corresponding paired t-test: p=0.03). The correlation between total score of MoCA and two-step value is shown in the Figure 4. Positive correlation was seen between the two-step value and the total score of MoCA (r=0.38, p=0.03).

Discussion

The result of this intervention was [16-18], same as many past research results, and a combination of exercise and brain training

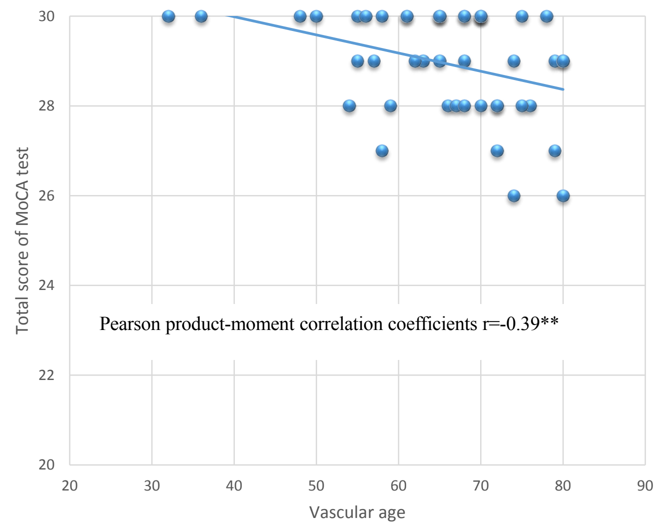


Figure 4: Correlation between total score of MoCA-test and two-step value. Positive correlation was seen between the two-step value and the total score of MoCA (r=0.38, p=0.03).

Age	Men	Women
20-29	1.64~1.73	1.56~1.68
30- 39	1.61~1.68	1.51~1.58
40- 49	1.54~1.62	1.49~1.57
50-59	1.56~1.61	1.48~1.55
60-69	1.53~1.58	1.45~1.52
70-79	1.42~1.52	1.36~1.48

Table 1: The mean of the Japanese two-step value.

gained the expected training results and improved cognitive ability. Further benefit was a significant improvement in motoric's ability due to continued exercise. For the living functions of elderly people, the importance of motoric's ability is great, and it is a deciding factor as to whether or not they can continue their independent life. Furthermore, since the correlation between cognitive ability and motoric's ability has been clarified this time, daily lower limb movement is recommended for brain training as well. In this previous study, in terms of the correlation between motoric's ability and cognitive function, correlations between walking speed and cognitive function [19,20] correlations between stride and cognitive function [21], correlations between a decrease in walking speed and stride, and atrophy of white matter and the hippocampi [22] have been reported. In addition, muscle mass and bone mass complementing motoric's ability are also correlated with cognitive ability, and the inseparable relationship between body creation and brain training became clear. Also, among the body composition, the vascular age was the most strongly correlated with the cognitive ability.

Based on the correlation between dementia and lifestyle diseases, improvement of dietary habits is indispensable in prevention. The relationship between vascular risk and cognitive function is gradually being revealed [23,24]. However, there are only a few studies that have examined correlation between body composition and cognitive function. In this regard, we believe that the increased self-awareness of body composition and cognitive function by the affected individuals it will lead to more effective self-management. In this study, it was thought that notifying the test results of the correlation between the vascular age and the cognitive function to the study participants and improved the motivation for self-management and helped maintain high participation rates.

Ages	Body mass index	Body fat	Muscle mass	Bone mass	Visceral fat rating	Basal metabolism	Metabolic age	Vascular age
60s	23.96	32.37	36.34	2.19	7.27	1119.9	58.85	63.07
70s	23.46	30.73	35.66	2.09	8.08	1079.3	65.17	68.96
80s	21.13	27.70	30.67	1.67	6.33	913.6	69.33	67.50

Table 2: The mean values of body composition and vascular age.

Interestingly, the average values of the vascular age as well as the visceral fat levels were higher in the 70s than the age of 80s. These are data likely reflect long-term lifestyle habits and clearly indicate the need for improved dietary habits. This is especially concerning, since people with dyslipidemia and diabetes are increasing year by year [25], therefore, effective preventive measures are urgently needed.

This verification of the study will help us on the interventional studies from here on. Our current challenge is the limited number of methodologies available for improving cognitive functions at the moment. In addition, their effects have not been validated. Future studies are needed to determine the precise factors that affect cognitive function, in order to refine intervention methods and potentially prevent AD onset.

Conclusion

By combining rhythmic exercises and brain training, cognitive ability of elderly people improved. In addition, this continuation improved motoric's ability. There is a correlation between motoric ability and cognitive ability, and body tissues such as Muscle mass and Bone mass were also correlated with cognitive ability. Among them, the strongest correlation was found in vascular age, and improvement in diet and lifestyle has a great influence in brain training.

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