Effects of therapeutic recreation on the brain quotient in the elderly dementia patients

Moon-Suk Lee, PhD1, Byung-Jun Cho, PhD2, Gyung-Hun Min, MD3, Seon-Rye Kim, PhD4*

1) Department of Physical Education, Chungnam National University, Republic of Korea
2) Department of Emergency Medical Technology, Kangwon National University, Republic of Korea
3) Department of Emergency Medical Technology, Woosong University, Republic of Korea
4) Department of Pharmacy, College of Pharmacy, Chungnam National University: 99 Daehakro, Yuseonggu, Daejeon 305-764, Republic of Korea

Abstract. [Purpose] This study investigated how participation in a recreation program influences electroencephalogram changes in the demented elderly. [Subjects] Fourteen patients were included in the experimental group and 18 in the control group. [Methods] They had no regular exercise habits, and walked independently, and scored 11–23 points on the Mini-Mental State Examination, and thus had no apraxia and could communicate. To empirically verify changes in electroencephalograms of the demented elderly for depression, sleep disorder, and life quality through their participation in the therapeutic recreation program, male and female citizens >65 years old at a geriatric hospital were included. The experimental group attended therapeutic recreation programs regularly for 3 months and control group did not. [Results] Electroencephalogram values were higher in the experimental than in the control group, demonstrating that the therapeutic recreation program enhances electroencephalogram values. However, post-program electroencephalograms between the two groups showed minor differences for all variables, except for the anti-stress index and brain quotient. [Conclusion] The therapeutic recreation program caused changes in brain activation, and this method revealed the relation between the activity program and emotion via the anti-stress index.

Key words: Recreation program, EEG, Dementia

INTRODUCTION

The prevalence of Alzheimer’s disease or senile dementia, in citizens over 65 years old has been implicated to increase from 8.8% in 2010 to 9.7% in 2020, 11.2% in 2040, and 13.2% in 20501. Currently, the understanding of dementia is increasing, and therapies and interventions are being developed. The concept of milieu therapy for dementia through therapeutic activities and activity therapy is increasingly gaining interest. Activity therapy, which can reduce the degeneration rate of cognitive function, which is a characteristic symptom of dementia, is being attempted, and its effectiveness has been reported. Regular exercise for a patient with dementia is an essential factor and an effective strategy to delay the onset of dementia3.

For the demented elderly, exercise was reported to not only be effective in reducing the fall risk by improving brain activation, increasing brain blood flow and neurotransmitter secretion, and enhancing muscle flexibility and the sense of balance, but also in enabling smooth gastrointestinal motility, increasing joint motion range by increasing physical strength, and providing an anti-depressant effect3.

In addition, exercise can reduce the early-onset rate of stroke and adult diseases such as hypertension, diabetes, hyperlipidemia, and obesity, which cause dementia, thus preventing dementia progression or delaying disease initiation. Further, exercise is known to prevent mental and physical malfunction, improving confidence and a sense of accomplishment in patients4,5. In particular, regular exercise results in improvements in cognitive function, as indicated by the reduced loss of frontal and temporal node tissue when the brain volume was measured using the magnetic resonance imaging6. However, there is still a lack of direct research on how activities for health promotion change electroencephalogram (EEG) findings in the demented elderly.

If a recreation program is provided for treatment and rehabilitation, it may enhance the life quality by changing EEG findings of the demented elderly.

Therefore, the purpose of this study was to investigate how participation in a recreation program influences changes in EEG findings in the demented elderly.

SUBJECTS AND METHODS

Subjects included male and female patients over 65 years old at a dementia nursing center and a municipal geriatric...
hospital. For the final analysis, 14 patients were included in the experimental group and 18 in the control group. Before the study, the purpose and process were well explained to the subjects, and then, the study was conducted. These subjects had no regular exercise habits and walked independently, and scored 11–23 points on the Mini-Mental State Examination, were diagnosed as the first and mid-term dementia, and thus had no apraxia and could communicate.

To empirically verify the changes in EEGs of the demented elderly for depression, sleep disorder, and life quality during their participation in the therapeutic recreation program, the subjects were classified into the experimental group that attended therapeutic recreation programs regularly for 3 months, and the control group that did not attend any therapeutic recreation programs. Their EEG changes were measured before and after participation in the program. Owing to the characteristics of on-site research, the experimental and control groups could not be divided evenly, and exact matching of background variables between groups was impractical; therefore, the non-equivalent control group design, which is a quasi-experimental design method, was applied.

The EEG test: The 2-channel wired EEG monitor (LXE 3202; CANS 3000, LAXTHA Inc.) and Telescan, a data acquisition and analysis software, were used to measure EEG (SP) and ERP (EP), respectively. To measure changes in EEGs and to analyze the brain functions, balance index, attention index, emotion index, anti-stress index, and brain quotient (BQ) were determined.

In this study, amusement, social activity, and habit-cultural activity were selected, as the main focus of health-sports activities, to match the health of the demented elderly, and indoor environment activities were selected by referring to the classification criteria, such as leisure education, cooking activity, outdoor activity, hobby, etc. (Table 1). These were reconstructed by Jeong [7] in reference to the models regarding amusement, social activity, hobby-cultural activity, watching-viewing activity, health-sports activity, and tour activity, as classified by Choi [8] and the leisure education programs, as suggested by the leisure-related document [9]. The therapeutic recreation program is implemented for 40 minutes, 2 times per week for 3 months, and is composed of 3 stages: introduction, development, and closing/evaluation. All experiments were reviewed and approved by the Committee of the Chungnam National University. Pre-intervention and post-intervention data were examined using the paired t-test within each group of subjects and the independent t-test between the groups. A level of significance of 5% was chosen for all statistical analyses.

**RESULTS**

In order to compare changes in EEG between the experimental and controls groups, the pre- and post-program EEG values were measured, the average and the standard deviation were calculated for each group, and the differences in EEG values between the two groups were analyzed.

Table 2 shows the average and the standard deviation values between the pre- and post-program EEG values for each group, as well as differences in the values between groups.

| Step          | Type               | Day | Program          |
|---------------|--------------------|-----|------------------|
| Introduction  | Social activity    | 1   | Massage          |
|               |                    | 2   | Game             |
|               |                    | 3   | Sing a song      |
|               |                    | 4-9 | Yoga game        |
| Health-sports |                    | 10  | Music and dance  |
| activities    |                    | 11  |                 |
|               |                    | 12-14 | Sing a song and rec-dance |
| Development   |                    | 15  |                 |
| Habit-cultural|                    | 16  | Mini sports      |
| activities    |                    | 17  | Korean music     |
|               |                    | 18  |                 |
|               |                    | 19  | Paper art        |
|               |                    | 20  | Magic            |
|               |                    | 21  | Read a book      |
| Closing       | Evaluation         | 22  | Recreation       |
|               |                    | 23  |                 |
|               |                    | 24  |                 |

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|---------------|--------------------|-----|------------------|
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|               |                    | 12-14 | Sing a song and rec-dance |
| Development   |                    | 15  |                 |
| Habit-cultural|                    | 16  | Mini sports      |
| activities    |                    | 17  | Korean music     |
|               |                    | 18  |                 |
|               |                    | 19  | Paper art        |
|               |                    | 20  | Magic            |
|               |                    | 21  | Read a book      |
| Closing       | Evaluation         | 22  | Recreation       |
|               |                    | 23  |                 |
|               |                    | 24  |                 |

Table 2 displays the average pre- and post-program EEG values for each group. The differences in pre-program EEG values in the experimental group were minor, but those in post-program EEG values between groups were greater. In brief, EEG values were higher in the experimental group than in the control group, demonstrating that participation in a therapeutic recreation program enhances EEG values. However, minor differences in post-program EEG values were noted for all variables between the two groups, except for the anti-stress index and BQ.

**DISCUSSION**

First, the balance index of patients with dementia showed significant patterns in the left-right asymmetry compared to that in the normal control group, as determined using the spatio-temporal pattern analysis [10], and the corpus callosum, which transmits information between the left and the right
hemispheres, became atrophied\textsuperscript{(13)}, and the hemispheric disconnection syndrome could be explained.

A normal brain is the one showing balance between the left and right sides, which means that there must be mutual interchange through the corpus callosum, thus providing stability in emotional inclination. Therefore, in this study, the left-right hemispheric balance index displayed more changes after the experiment compared to that before the experiment, implying partial brain activation. Second, Bryant and Veroff\textsuperscript{(12)} analyzed mental health in the social and historical context and found that the mental health structure can be positive or negative, and that “positive mental health is the psychological wellbeing and is composed of positive emotion and emotional relation”, and “negative mental health is psychological stress and is made up of anxiety, depression, and emotional loss of control”.

Chung\textsuperscript{(13)} compared the estimated values of self-reported emotion, motif, and positive personality traits in each frontal lobe by activation groups, and found that the relative left activation group showed a significantly higher level of positive affect, approach motivation, happiness, hope, and ego-resiliency than the relative right activation group. Moreover, for the personal affect type, the relative activation of the frontal cortex has relations with positive affect with respect to the left side\textsuperscript{(14)}.

This study confirmed that the therapeutic recreation program enabled changes in brain activation and revealed the relation between the activity program and emotion via the anti-stress index.

Third, the study on EEG changes with respect to attention and concentration following the yoga program by exercise intensity showed that absolute and relative alpha waves emitted during concentration or creative thinking decreased, consequently increasing attention and concentration.

In this study, the appropriate intensity of exercise implemented through therapeutic recreation enabled creative thinking in the elderly, thus increasing their attention concentration.

Fourth, catecholamine, one of the stress hormones, is not essential for life support, but is released rapidly when during stress conditions. Exercise provides an anti-depressive effect and increases stress resistance\textsuperscript{(13)}.

Many studies have used surveys to measure cognitive function through motion stimulus in elderly patients with Alzheimer’s disease, but these previous studies on the approach of brain function are from the viewpoint of physiology. Nevertheless, the study on the effect of resistance training on the brain function index in the elderly with Alzheimer's disease\textsuperscript{(16, 17)} demonstrated that the brain index increased after exercise both in the resistance training and gymnastics groups, thus supporting this study result.

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