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Research Paper

Effect of Neurofeedback Interactions and Mental Imagery on the Elderly's Balance

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Balance, Elderly, Neurofeedback, Motion imaging

ABSTRACT

Objectives Balance maintenance is one of the indices of determining independence in older people. Identifying other factors that have considerable impact on the independence of older peoples is an interesting research topic. The present study aims at determining the effect of Neurofeedback and Mental Motor Imagery practices on balance in the elderly.

Methods & Materials The population of this study consisted of elderly people of Mashhad, a city in northeast Iran. A total of 24 elderly people with age ranging from 60-82 years old volunteered to participate in the study and were randomly assigned to three groups (with eight participants in each group). The participants of experimental groups were involved in the special training (neurofeedback training and mental imagery practice) for eight weeks (with three sessions each week)while the control group were not involved in any practice. Stork Balance Stand Test and Timed Up and Go (TUG) tests were used to assess the static and dynamic balance of participants respectively, before and after the training sessions. The Shapiro–Wilk test of normality was used to check normality of data. Additionally, Analysis of Covariance (ANCOVA) was used to determine the effect of training with pre-test scores used as covariate. Statistical analysis was performed using SPSS Statistics 21 at a=0.05.

Results The results of Analysis of Covariance revealed that there was a significant effect of neurofeedback and mental imagery on the static and dynamic balance of elderly people (P<0.05). Furthermore, neurofeedback had superior effect in both of the balance conditions (P<0.05).

Conclusion The study recommends neurofeedback and mental motor imagery practices to prevent balance loosing and improving balance ability in elderly people.

Extended Abstract

1. Objectives

According to the World Health Organization (WHO), population over 60 years old are considered as elderly and it is expected to rise by 10% in the year 2000 to 21.8% in 2050, and then an increase of 32.2% in 2100 [1]. Entrance to the aging period coincides with the onset of changes in musculoskeletal systems, atria, sensory-bodily and vision, which is also referred to as a physiological system in the balance state. Consequently, elderly people are exposed to serious injuries caused by a violation of the balance. These changes are in the form that threatens the quality of life of this group of people to the extent that they are deprived of everyday activities [2]. There-

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fore, the purpose of this study was to investigate the effect of neurofeedback interventions and mental imagery on the static and dynamic balance of the elderly.

2. Methods & Materials

The present study was conducted on elderly men and women [over 60 years of age) settled in Mashhad, Iran. To select the research samples, information on the history of diseases affecting the movement (such as neurological and visual problems) was collected from the volunteers using a personal information questionnaire, and information on the probability of mental deterioration was collected using the short form of Mini–Mental State Examination (MMSE) [3]. Also, the visual abilities and motion illustration were evaluated using the Hall and Martin Mental Illustration Questionnaire (MIQ-R). Among the elderly people who volunteered for the study, 24 people were selected and then they were randomly assigned to 3 groups of 8 (Neurofeedback training group, vision and motion illustration training group, and control group).

Before applying an independent variable, the static and dynamic balance of the subjects was measured through stork balance tests and Timed Up and Go (TUG) tests respectively. This was followed by each subject attending training sessions for their group. Moral considerations were confirmed by Ferdowsi University of Mashhad. Intervention of the neurofeedback group was carried out based on 10-20 system (EEG) on the O1 and O2 points, taking into account the training protocol of increasing balance of the bipolar type. Practical sessions were held in accordance with the selected protocol within 30 minutes and eight weeks (a total of 24 sessions) based on the 4 to 7 Hz wavelength crackdown and the amplitude of the wavelength was 15 to 18 Hz [5].

The specified wavelength was unaltered and difficulty of the exercises was set automatically based on biograph software and on the rule of 80-20 rule (according to this rule, 20% of cases are suppressed from 4 to 7 Hz, and 80% of the waves are reinforced from 15 to 18 Hz). Exercise protocol of Illustration group was carried out within eight weeks (24 sessions) including three sections: 1. Relaxation (first 10 minutes); and 2. Mental training (15 minutes), and 3-Cool down (5 minutes). Subject's mental exercise was based on the practice protocol defined by Fensler et al. [6]. In this exercise, subjects imagined themselves doing balance games as they did in the distant past. The control group also engaged in daily activities.

3. Results

The results of Shapiro Wilk's test indicated normal distribution of the remaining errors in covariance analysis test (P<0.05), which was among the main assumptions of the test. In order to investigate the effect of training interventions, covariance analysis was used. Prior to that, homogeneity of variances was confirmed by Levine test (P=0.645, F=0.448). The results of this test showed a significant difference in static balance of elderly people with open eyes between the studied groups (P=0.338, F=5.10). As a result, Bonferroni's follow-up test was used to determine the difference between the groups. Accordingly, the neurofeedback group had better performance than both groups of illustration (P=0.042) and control (P=0.026), while the illustration group had no significant difference with the control group (P=0.00). Also, the results of statistical analysis in closed eyes state showed a significant difference between the groups in the post-test (P=0.778, F=5.33).

The results of Bonferroni post hoc test showed a significant difference only between neurofeedback and illustration groups (P=0.045) and neurofeedback and control (P=0.020) groups. For evaluating dynamic balance, covariance analysis was carried out. Levin's test results indicated that the homogeneity of variance of the errors (P=0.427, P=0.85). The results of covariance analysis showed a significant difference between the groups in the dynamic balance test scores (P=0.483, F=9.34). In order to determine the exact location of the differences, Bonferroni post hoc test was used. This test revealed a significant difference between neurofeedback and control groups (P=0.002) and illustration and control (P=0.002) groups, while no significant difference was observed between the neurofeedback

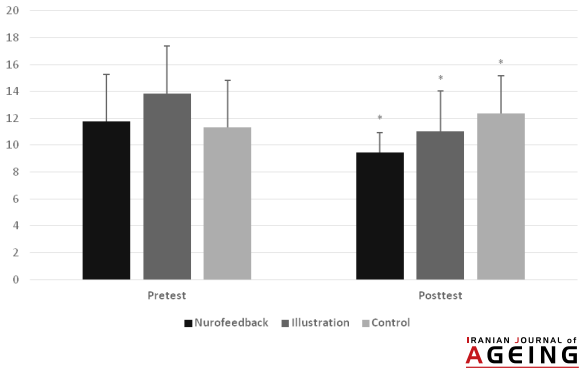

Figure 1. Average time of TUG test (dynamic balance) of groups in the pre and post test

training and illustration groups. These differences are presented in Figure 1.

4. Conclusion

Both mental and physical exercises have similar and common nervous mechanisms at the various stages of motion control. However, mental exercises prove to be more effective as no final movement outcome is generated during mental training [7, 8]. In addition, since the balance protocol works on O1-O2 regions that are located around the visual processing areas (17-17 Brudman), the theory that improved performance near the 17-18 Brudman areas improves visual guide for the cerebellum was established. On the other hand, these areas are involved in the analysis of motion, status, orientation, depth, and understanding in the elderly. The cerebellum uses signs of vision in these areas and integrates them with their motorized outputs. Considering the results of this study, we can state that modern tools such as neurofeedback and older interventions such as illustration help improve the quality of life especially during the aging period.

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Conflict of Interest

The authors declared no conflicts of interest.