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Original Article

The effect of balance exercises and computerized cognitive training on psychomotor performance in elderly

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Abstract. [Purpose] The purpose of this study was to investigate the effect of balance and computerized cognitive training on psychomotor performance in elderly females. [Subjects and Methods] Twentynine elderly females with the mean age of 63–71 years old were applied voluntarily and randomly allocated to four groups: balance training (3 d/wk for 12 wk), balance training with computerized cognitive training (3 d/wk for 12 wk), computerized cognitive training group and control group. Psychomotor performance of all subjects was measured by Vienna Test System which was a computerized psychological assessment tool. Determination test (DT) and Visual Pursuit Test (VPT) were used as indexes of psychomotor performance. [Results] The results suggested that DT and VPT were significantly improved in all experimental groups with greater improvement in the balance supplemented with computerized cognitive training group. [Conclusion] Balance training and computerized cognitive are highly recommended in elderly with the aim of increasing cognitive performance.

Key words: Balance, Cognitive, Psychomotor

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INTRODUCTION

Nowadays, degenerative changes of physical, psychological and physiological in geriatric populations are major public health problem, especially women who experience sarcopenia especially after menopause[1, 2)]. Based on research literature, there are some cognitive impairments such as delayed reaction time and poor concentration which underlies most falls in the elderly[3)]. Hence, an improvement in psychomotor performance is a good strategy with which to successfully reduce the incidence of falls in this population[3)]. The advantageous of physical exercise in improving the functional capacity of the elderly population have been the focus of considerable recent research[4)]. A growing number of studies strongly have investigated the effects of different exercise techniques on various aspects of motor and cognitive performance in elderly population. Despite the growing evidence on the benefits of exercise for the health, the available literature lacks clinical evidence that supports recommendations for exercise guidelines to improve cognitive and motor abilities[5)]. The interesting and distinguishing point of differences between previous studies and the presented study is the sort of exercise therapy with computerized cognitive training. It was hypothesized that balance with computerized cognitive training would significantly increase muscular strength, and consequently improves the psychomotor performance including MDT (Simple and choice reaction time) and VPT. The purpose of the research was to investigate the effects of balance supplemented with computerized cognitive training on psychomotor performance in elderly.

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SUBJECTS AND METHODS

The subjects of the present study were 29 elderly women, 63–71 years of age, from Qazvin, Iran. Inclusion criteria included independent gait, no experience of a fall in the 1 year period prior to the study, no specific disease that might influence task performance. All experiments were approved by a committee of Imam Khomeini International University. All the subjects gave written informed consent before starting the study protocol, in accordance with the Declaration of Helsinki. They were divided into four groups: balance training (3 d/wk for 12 wk), balance training with computerized cognitive training (3 d/wk for 12 wk), computerized cognitive training group and control group. Psychomotor performance of all subjects was measured by Vienna Test System (VTS) which was a computerized psychological assessment tool that was able to analyse many different sport psychology related constructs. VTS was developed by Schuhfried GmbH (Moedling, Austria) as a valid and reliable tool for psychological assessment and contains a myriad of tests which are relevant to sport psychology. Determination test (DT) and Visual Pursuit Test (VPT) were used as indexes of psychomotor performance. The Determination Test consisted of a complex multiple stimuli reaction test which provides measurement of reaction speed in the presence of rapidly changing and continuous optical stimuli. The subject was presented with a variety of color stimuli to which subject has to respond by pressing colored buttons on a specially provided keyboard called the universal panel. The Visual Pursuit Test of the Vienna Test System was used to measure selective and sustained attention in aged women. In this test, there was an array of nine entwined dark lines leading to nine different endpoints. The starting point of one out of the nine lines was marked and the participant was asked to follow this line with their eyes to find the corresponding endpoint as quickly as possible by pressing one of nine number buttons on a response panel. The performance of the participant was scored automatically, considering the number of correct answers and mean RT for correct answers. The training protocol consisted of a set of balancing exercises based on American College of Sports Medicine guidelines[6]. The simple home-based balance training program included warm up phase (10 minutes); main program [strengthening exercise for hip abductors and extensors; marching; stepping over a bench; closed kinetic chain quadriceps exercise; standing up from a chair with arms folded; and walking heel-to-toe in a straight line]. They were asked to perform 20 repetitions of each exercise, which took about 30 minutes/session. Cool down phase was lasted for 10 minutes. Computerized cognitive training included Cognitrone protocol (COG) in which four pictures (numbers, letters, figures, etc.) were presented in a row, with another picture presented below. Subjects had to decide whether the lower picture matched any of the four pictures above. A new set of pictures was presented either after a response or automatically after 1.8 s. Up to 200 sets of pictures were used in this protocol. A series of regular telephone calls were made by the sport physiologist to assess and ensure quality control. The study was approved by the Ethics Committee of Imam Khomeini International University (No. 17628). Data was analyzed using a one-way analysis of variance (ANOVA) to determine if there were differences between groups in pre and post-test data. A Tukey post hoc analysis was used to identify significant differences when a significant F-ratio was obtained. Significance is reported at $p<0.05$, and all values are reported as means ± standard deviation (SD).

RESULTS

Results of the ANOVA test indicated that there was a significant difference between pre- and post-measurements of groups in Visual pursuit (Accuracy rate and Reaction time) (Table 1). This result was identical for Determination test ($p=0.001$).

Post hoc Tukey suggested that all experimental group had a significant improvement in both Visual pursuit and Determination tests ($p\leq0.05$) with a greater improvement in SBT+ CCT (Table 2).

DISCUSSION

Due to the growing concern about decreased rate of psychomotor performance in aged populations, greater understanding of interventions that contribute to cognitive improvement is of interest among researchers. Thus, the focus of this research was to investigate the effect of balance exercises supplemented with computerized cognitive training on psychomotor performance in elderly females especially the combined exercise group. We found that all experimental groups attained improvements in psychomotor performance (Accuracy rate and Reaction time in both Visual pursuit and Determination tasks) in the population. Consistent with findings from other studies[7, 8], the findings support the notion that it is beneficial to combine balance and computerized cognitive training into clinical practice over an exclusively either physical or cognitive intervention since both cognitive and physical training would result in a greater achievement compared to either one. In agreement with some studies which demonstrated that elderly individuals who are physically active could retain their reaction capacity[4], it was suggested that both interventions especially combined protocol facilitated performance in the reaction time task in visual pursuit and determination tasks. The inconsistent results which found no significant effects of exercise[9] can be attributed to differences in the forms of resistance exercises (type, intensity and volume), and the psychomotor measures that were assessed. As a result, balance training and computerized cognitive training are highly recommended in elderly with the aim of increasing cognitive performance. One limitation of this study was the small number of subjects, limiting the extent to which the results can be applied to elderly women in general. Additional studies involving more subjects, a more controlled

Table 1. Comparison of Visual pursuit in experimental and control groups

Group	Test			
	Visual pursuit			
	Accuracy rate (%)		Reaction time (sec)	
	pre	post	pre	post
SBT (n=7)	88.32 (4.25)	92.14 (3.43)*	1.37 (0.03)	1.12 (0.04)*
CCT (n=8)	87.77 (3.76)	91.60 (2.97)*	1.38 (0.06)	1.11 (0.05)*
SBT+ CCT (n=8)	88.13 (4.36)	95.36 (2.98)*	1.39 (0.03)	1.01 (0.04)*
Control (n=7)	88.04 (4.21)	88.06 (4.74)	1.38 (0.04)	1.39 (0.05)

*p≤0.05.

Table 2. Comparison of Determination test in experimental and control groups

Group	Test			
	Determination test			
	Accuracy rate (%)		Reaction time (sec)	
	pre	post	pre	post
SBT (n=7)	71.65 (1.61)	83.51 (1.69)*	0.99 (0.07)	0.87 (0.13)*
CCT (n=8)	72.18 (1.43)	87.13 (2.75)*	0.97 (0.09)	0.90 (0.12)*
SBT+ CCT (n=8)	73.65 (2.26)	90.58 (1.36)*	0.97 (0.10)	0.82 (0.11)*
Control (n=7)	72.10 (1.60)	72.32 (1.30)	0.96 (0.09)	0.95 (0.09)

*p≤0.05.

environment, and/or a different variety of psychomotor tests are required in order to make conclusive assumptions about a larger population. This research may constitute a reference for further studies in the topic of psychomotor improvement in aged persons with the aim to improve selective attention and reaction speed. Future studies are advised to compare different types of physical and cognitive exercises where different specific perceptual and cognitive demands are to be considered in the research design.

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