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Exercise effectiveness on reaction and response times in older people

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Original Article

Abstract

BACKGROUND: Physical activities have effects on the improvement of motor performance. Age-related changes revealed that different factors were effective on the reaction and response time. The purpose of this study was to investigate the effectiveness of exercise and physical activities on the reaction and response times in older people.

METHODS: The study method was casual-comparative and the study population consisted of older people of Sanandaj City, Iran. 30 inactive persons were randomly selected and 30 active and available persons were also selected in this city, and their reaction and response times were measured. The reaction and response times were measured by the reaction timer made by Takei Company (model YB1000) and through the Nelson's Speed of Movement Test, respectively. Kolmogorov-Smirnov test (K-S test) and independent t-test were used for data analysis of the descriptive statistics ($P < 0.05$).

RESULTS: K-S test revealed that results had a normal distribution. According to the findings, exercise and physical activity had a positive effect on reaction and response times, so that the results of the independent t-test showed that the active group had significantly lower reaction time ($P < 0.001$) and response time ($P < 0.001$) than the inactive group.

CONCLUSION: Exercise and physical activities lead to the decrement in reaction and response times through the positive physiological and psychomotor changes.

KEYWORDS: Physical Activity; Motor Performance; Reaction Time; Response Time

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Introduction

The recent investigation about age-related changes in reaction and response time has revealed that it is shortened from infancy to old age; then, it will continue slowly until the 50's and after that, it will quickly increase. Many related studies have been focused on factors affecting the response time. These effective factors include age, type, kind of actuator (intensity and quality),[1,2] psychological features, and a person's personality type,[3] which have an impact on one's reaction time.

The studies indicate that not only exercise is effective in reaction time, but the level and intensity also affects reaction time.[4] Baker et al. in a related study concluded that the simple reaction time significantly shortened in the experimental group after 8 weeks of physical

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training compared to the untrained group.[5] Formenti et al. in another study showed that two experimental groups that had conducted exercises and physical activities with various intensities had also different reaction times, so that the group which had higher exercise intensity had lower selective and simple reaction time.[6]

Exercise is very important in old age and it is necessary for the elderly to try to stay active in order to avoid the consequences of inactivity. Exercise in the elderly causes maintaining mobility, endurance, reducing the incidence of disease, and also it promotes vitality and youthfulness, as well as a healthy life. Given the importance of this issue, the purpose of the present study was to estimate effect of exercise on reaction and response time in the elderly people.

Methods

Sampling: The statistical society of the study consisted of all old people higher than 55 years old (55 to 65 years old) in Sanandaj, Iran. The samples were selected from people who had not been examined by this method before. The inactive people were randomly selected among the persons who did not have any continuous physical activity. The active samples were also chosen in the case of accessibility among the older people who had participated in the fitness and sports classes of the Physical Education Department in Sanandaj and had continuous physical activity three times a week. The sample size was selected regarding the determining sample size formula and also previous similar studies and 30 people were selected for each active and inactive group. Therefore, the statistical sample size consisted of 60 people that were in two active and inactive groups each with 30 samples (Code: IR.MUK.REC.1397.298).[7,8]

Time measurement: For reaction time measurement, the reaction timer was used. For response time, Nelson's Speed of Movement Test was also used.[9]

To measure the response time, the red light actuator and the red button were used. The red light actuator was placed at the 80 cm height of the sample. The sample was also placed on a chair and in a comfortable situation. Participants responded to the actuator by the right-hand thumb. The samples' hands were placed on the armrest in line and at the same height as the actuator appearance point. Each sample did ten tries for getting familiar with the test and device that was not analyzed. Then, they conducted 40 tries, and data were recorded. To prevent the tiredness effect, according to the previous studies, 40 tries of each sample were conducted in two blocks including 20 tries with 5 minutes of rest.[10,11]

For preventing the predicted time by the subject's actuator, the actuator was provided randomly in a range of 2 to 4 seconds [16, 20, and 22]. During the study procedure, samples were entered into the test location in groups consisting of 4 persons, and any voices that could lead to disruption in samples' concentration were prevented.

Study procedure: Nelson's test is used in domestic and external (or abroad) studies. It has a validity coefficient of 0.81 and a reliability coefficient of 0.85. The study procedure was as follows: we drew a line by 14 yards (6.12 meters), so that its middle and ends be identified. The sample was placed in standing mode on the center of line and within 2 to 3 meters in front of him.

Examiner held the stopwatch with one hand and with the other hand or with the same hand suddenly showed one of two right or left directions and at the same time operated the stopwatch. The sample ran speedily on the line and until its end to the direction which the examiner had shown and the time of this distance was recorded in second and hundredth of a second. This event is repeated ten times and so the sample should run

randomly in the directions 5 times. In the other words, the sample should run 5 times to the right direction and 5 times to the left. 20-second rest should be considered between each performance. The mean of ten repetitions is considered as the test record for each sample. As most of the samples were low-educated or illiterate, the information about the sample's age, health, disease background, etc. for each person was completed in the special questionnaire by the researcher. At first, the reaction time test and then Nelson's field test were performed.[12]

Data analysis: In this study, for data categorization and adjustment, the descriptive statistics, and for determining the normality of data, the Kolmogorov-Smirnov test (K-S test) were used. To compare the active and inactive groups about the reaction and response times, an independent t-test with a confidence level of 0.95 was used. For data analysis, the SPSS software (version 21, IBM Corporation, Armonk, NY, USA) was also used.

Results

Response time of two active and inactive groups: Mean and standard deviation (SD) values of reaction and response times of samples of two active and inactive groups showed that response time in the inactive group (3.08 ± 0.38) was higher than that of the active group (2.65 ± 0.29), and reaction time of inactive group (0.28 ± 0.18) was also higher than that of the active group (0.25 ± 0.14).

K-S test with a confidence level of 0.95 (α = 0.05) showed normality of data (Table 1).

Table 1. Kolmogorov-Smirnov test (K-S test) for surveying the normality of data of simple reaction time

K-S test	Reaction time	Response time
Number	60	60
Considered parameters (Sec) (mean ± SD)	0.272 ± 0.023	2.860 ± 0.403
Z value	0.768	0.583
P	0.596	0.886

K-S: Kolmogorov-Smirnov; SD: Standard deviation

The results of the independent t-test in the confidence level of 0.95 (α = 0.05) for comparing the reaction and response times in active and inactive older people indicated that the active older people had significantly faster reaction and response times than the inactive group (P < 0.01) (Table 2).

Table 2. The independent t-test for comparing the reaction and response times in active and inactive older people

Groups		Mean	df	F	P
Reaction time	Active	0.254	58	0.58	< 0.01
	Inactive	0.289			
Response time	Active	2.650	58	2.66	< 0.01
	Inactive	3.080			

df: Degree of freedom

Discussion

In the current study, the reaction and response times of active older people were significantly lower than inactive older people which shows the positive effect of exercise and physical activities on these two important factors. The results of these studies have shown that increasing the reaction time and information processing speed and improvement physical activity in the elderly is also factual.

Aouadi et al. showed that among 51 male adolescents (14 to 16 years old), a significant difference (P < 0.001) was observed in reaction time between sedentary group and trained group in the different time periods. In addition, the mean of reaction time in trained group was similar to that observed in healthy group. Physical activity advances motor function. Regular exercise improves reaction time and thus cognitive function. Physical activity seems to be an essential tool for improving the performance of cognitive activities too.[13] In research done by Grimmer et al., it was reported that aging and chronic conditions resulted in wide-ranging losses in physical and sensory capabilities. As the physical and functional parameters are closely related, we believe that lost functional capabilities can be indirectly improved by

training of the physical capabilities to enhance human mobility.[14] In our study, reaction and response times between active and inactive older people had a significant relationship as well. In Laux and Corazza's study, 26 physically inactive male and female subjects underwent a program consisting of thirty-six sessions with physical exercises. An improvement in reaction time, movement time, and response time in the experimental group was observed.[15] Physical activity causes more and faster blood circulation to organs in the body and ambient temperature, faster contraction of muscles and with more power, and a quicker response of executive organs of movement and improvement of their performance.[16]

The findings of this study have also revealed that the reaction time of active older people was always lower than inactive ones and this reaction time decrease was due to the positive effect of exercise and physical activities that these samples had experienced. Hasanpoor Dehkordi et al.[7] expressed that elderly people had a decreased quality of life because of several factors such as low physical activity and impairment in mobility. 60 elderly persons were randomly divided into two groups: experimental (n = 30) with mean age of 68.63 ± 6.96 and control (n = 30) with mean age of 68.03 ± 10.65, and exercise program was performed on them. Mean level of quality of life in cases was increased but in the control group, quality of life was unchanged. Therefore, a regular and prolong exercise program can increase the level of quality of life in older adults.[7]

The studies have shown that physical activities in older people increase the blood circulation of the central nervous system and useful lifetime of brain cells as well as useful and quick information processing that is one of the most important factors in reaction time decrement. Moreover, physical training can provide the best support against the aging of brain cells because of its capability in motivating metabolism, breathing increment, and age-related muscle loss, and also improving motor performance and function.[17,18]

As it was said, in these studies about older people, the accessing and hand movement tests were used and it was not attempted to study the quick moves and comparable daily and common actual situations; thus, in the present study, this subject was investigated through a motor-field test that was like the definite moves and conditions and also the effect of physical activities on response time in older people was studied and surveyed. There are many factors in terms of physiology that lead to a decline in motor performance. Along with the age increment, the number of functional nerve fibers and muscular fibers which cause the nerve-dissemination (motor unit) will drop.[19]

In addition, along with age increment, the number of quick contractions of muscular fibers will decrease that these factors lead to slowness of motor performance and especially moves that require quick motor responses. Exercise and physical activities lead to the decrease in reaction and response times by the positive physiological and psychomotor changes that cause the reduction of reaction and response times and progress motor performance;[20] therefore, it is suggested that older people keep their motor performance and prevent from motor decline and problems that appear in older ages by conducting exercise activities and having an active life. With the exercise, they experience a lower decline in these kinds of movements. It is suggested that the results of the present research be further examined by considering the research variables. Moreover, the elderly should be taught how to do age-specific movements.

Some of the limitations of this study are: financial constraints and limited review time due to the project completion date. In this study, a specific community in a city was

examined, this type of research should be done in larger areas with more samples; so that the results can be generalized to other communities. More research is needed in larger communities with more samples.

Conclusion

Exercise and physical activities cause a decrement in reaction and response times in older people. According to this subject, reaction and response times are operative and important variables in motor performance and common daily life operations in old people; thus, they have high importance.

Conflict of Interests

Authors have no conflict of interests.

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