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Efficacy of multisensory exercise programme on cognition and functionality in postmenopausal women

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ABSTRACT

Introduction. In the last century, longer female life expectancy has implied that women now live a third of their lives beyond the end of their ovarian function, increasing the need for new therapeutic strategies to facilitate successful aging (defined as low probability of disease), high cognitive and physical abilities, and active engagement in life. Aim. This study was conducted to determine the efficacy of multisensory exercise programme on cognition and functionality in postmenopausal women. Methods. Thirty postmenopausal women in the range of 55-65 years old and a body mass index (BMI) < 35kg/m² were selected randomly from physiotherapy outpatient clinic at Al-Menshawy General Hospital. They were randomly distributed into two equal groups: control group (A) that received relaxation training programme for 30 minutes/session, three sessions per week for a period of 4 weeks and study group (B) which received multisensory exercise programme for another 45 minutes per session plus the same programme as for control group for a period 4 weeks. Assessment of all women in both groups was carried out before and after treatment programme (four weeks) through cognitive assessment (montreal cognitive assessment) and functional performance of daily living activities (nine–item physical performance test). Results. The multisensory exercise programme showed statistically significant improvements (P<0.01) on cognition, and functional performance as compared with the control group, which showed no statistically significant differences at the post intervention time point. Conclusions. The multisensory exercise programme improved the cognition and functionality of post menopausal women. The introduction of a motor and multisensory-based approach in care routines may improve residents' health and engagement to the environment.

Original Article

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INTRODUCTION

In the last century, longer female life expectancy has implied that women now live a third of their lives beyond the end of their ovarian function, increasing the need for new therapeutic strategies to facilitate successful aging (defined as low probability of disease), high cognitive and physical abilities, and active engagement in life [1].

Early intervention to maintain cognitive function and well-being may help prolong independent living in older adults. Effective prevention and delay of Alzheimer's disease (AD) will require intervention during the preclinical phase [2]. The practice of physical exercise has been consistently associated with maintaining function as well as preventing and reducing the physical deficits caused by aging [3]. Regarding cognitive function, physical exercises can provide multiple positive responses to older adults, including brain plasticity, that is the brain's ability to change and adapt both structurally and functionally [4]. Thus, researchers are seeking for a tool that can safely stimulate the different sensory systems of older adults, which resulted in the advent of multisensory exercises [5].

Multisensory exercises combine multiple forms of sensory stimulation together such as visual, auditory, touch, and motor. Studies have suggested that these exercises effectively improve balance and mobility, thereby decreasing fall risk of older adults [6].

Based on this information, the practice of multisensory exercises can promote postmenopausal women physical and mental health, especially those who reside in long-term care facility and are otherwise not sufficiently stimulated; in other words, offering physical or sensory stimuli is important for promoting their physical and mental health [7]. Hence the aim of this study was to investigate the efficacy of multisensory exercise programme on cognition and functionality in postmenopausal women.

MATERIALS AND METHODS

Subjects

This study was carried out on thirty postmenopausal women that were selected randomly from physiotherapy outpatient clinic at Al-Menshawy General Hospital. Their age ranged from 55-65 years and BMI was not exceeding 35 kg/m^2. They were randomly distributed into two equal groups (A & B). Control group (A) consisted of 15 post-menopausal women who received relaxation training programme for 30 minute/session, three sessions per week for 4 weeks. Study group (B) consisted of 15 post-menopausal women who received Multisensory exercise programme for 45 minutes/ session, three sessions per week for 4 weeks plus relaxation training programme as for group A.

Methods

All participants were given a full explanation of the protocol of the study and consent form was signed for each patient before participating in the study.

A) Evaluation procedures.

The subjects were interviewed face to face for exclusion and inclusion criteria, then, they completed the following

History taking: Date of the last menstrual cycle

Weight and height scale to calculate BMI. Weight and height were measured for each woman in both groups (A and B) before the treatment to calculate the body mass index (BMI) according to the following equation: BMI (kg/m^2) = weight (Kg) /height (m^2).

The Montreal cognitive assessment. It was used to evaluate the participants' cognition. It consists of a short-term memory test (5 points), space-time configuration function tests including a clock drawing test (3 points) and a 3-dimensional block drawing test (1 point), a trail-making test-B (1 point) to test for task performance, a language proficiency test (1 point), a 2-item verbal abstraction task (2 points), a concentration test (1 point), a number subtraction test (3 points), forward and backward digit span (2 points), and a time and space orientation test (6 points), animal naming test (3 points), repeating after complex sentences test (2 points).The total possible score is 30 points and the Cut off score is 26 [8].

The nine-item physical performance test. It was used to assess functional performance of daily living activities**.** The physical function test is a validated measure of functional performance of daily living activities in community living older adults consisting of nine tasks for each task, the time taken to complete was recorded. Participants were required to write a legible sentence, mimic eating by picking up kidney beans with a teaspoon from a bowl and placing them in another while they remain stationary, lifting a heavy book from waist level and placing on a cabinet at shoulder level while remaining seated, put on and remove a coat (a standard lab coat was used to maintain consistency), pick up a 50 cent coin from the floor, pivot 360, walk 15 meters and climb flights of stairs. Assistive devices are permitted in the locomotive tasks. Higher scores equated to better performances [9].

B) Treatment procedures

Control group (A). Each woman received relaxation training programme in form of breathing exercise and progressive muscle relaxation for 30 minute/ session, three sessions per week for 4 weeks. Each woman instructed briefly and clearly about the benefits of relaxation technique to gain their confidence and cooperation of all through the period of this study. Each woman was asked to evacuate her bladder before starting the session to be relaxed. The session included the following:

1) Breathing technique. Woman assumed comfortable long sitting position with her back fully supported and both knees were supported on a pillow, then she was asked to 1) Take a deep breath through her nose until she felt her stomach rise and chest expand; 2) Hold that breath for one to two seconds; 3) Exhale slowly through her mouse for at least 4 seconds; 4) Repeated for 5 times.

2) Progressive Muscle Relaxation (PMR). Following breathing exercises, the woman progressed to the following steps: 1) Close her eyes with deep breath for 10 seconds then exhale as she relaxed and open the eyes for 25 seconds; 2) Start at the toes and flex that muscle group for 10 seconds as she inhaled, then exhale as she relaxed the muscle group for 25 seconds; 3) Continue throughout the different parts of the body for 25 to 30 minutes, until she made it up her entire body.

Study group (B). Each woman received relaxation training programme as for group A plus multisensory exercise programme for 45 minutes/session, 3 sessions per week for 4 weeks. The multisensory exercise programme consisted of the following blocks:

Warm-up (10 min). The warm-up period included short walks and games with balls using the upper and lower limbs.

Strength (10 min). Strength period included free active exercises that was used with resistance of the body's own weight or rubber band that involved the major muscle groups (upper limbs, lower limbs, and trunk).

Multisensory stimulation coordination and balance (15 min). Balance and coordination movements between the lower and upper limbs that associated different positions of the head and neck (flexion, extension, and rotation) with and without visual stimulation and on stable and unstable surfaces, for example, on mats with bipedal support and a single leg. In addition, they were asked to transpose obstacles such as sticks, boxes, and a rope and cones in different directions (walk forward, backward, and sideways). Verbal encouragement to alternate the gait speed was provided by the same instructor during all of the walking exercises. The multisensory stimulation was composed of sensory stimulation together such as visual, auditory, touch, and motor (i.e., music, singing, storytelling, imagery, and soft/hard texture objects).

Flexibility and cool-down (10 min). Finally, stretching and cool-down exercises were performed both from standing and supine on mats to work the major muscle groups. Flexibility and cool-down in the form of deep breathing exercises followed by stretching exercises for hip, knee, ankle and para spinal muscles which was performed in supine lying, sitting and standing position.

Statistical design and data analysis

Results are expressed as mean ± standard deviation. Comparison between variables in the two groups was performed using unpaired t test. Analysis of covariance (ANCOVA) test was used to compare the pre-treatment values of the two groups and on the same time between post-treatment values on controlling the effect of pre-treatment values. Comparison between pre- and post-treatment data in the same group was performed using paired t test. Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value ≤ 0.05 was considered significant.

RESULTS

General characteristics of the patient

This study was conducted on 30 post-menopausal women. They were divided into two groups, control group (A) consisted of 15 women they received relaxation training programme for 30 minute/session, three sessions per week for 4 weeks and study group (B) consisted of 15 women they received multisensory exercise program for 45 minutes/session, three sessions per week for a period 4 weeks plus relaxation training program as done for group A. There was no statistically significant difference between the two groups as regards age (t value= 0.350, p= 0.729), weight (t value= -0.508; p=0.615), height (t value= -0.531; p= 0.600) and BMI (t value= -0.349; p= 0.730), respectively (Table 1).

Table 1. General characteristics of the two studied groups

Items	Group A (n= 15)	Group B (n= 15)	t value	P value
Age (yrs.)	60.00 ± 3.70	59.53 ± 3.60	0.350	0.729 (NS)
Weight (kg.)	76.93 ± 10.79	78.87 ± 10.03	-0.508	0.615 (NS)
Height (cm)	160.93 ± 5.44	162.00 ± 5.55	-0.531	0.600 (NS)
BMI (kg/m^2)	29.00 ± 3.25	29.40 ± 3.02	-0.349	0.730 (NS)

NS: non-significant

The Montreal cognitive assessment (MOCA)

In group A, there was no statistically significant difference between the mean value of MOCA measured at pre-treatment (26.47 ± 0.74) and its corresponding value measured at post-treatment (26.53 ± 0.92) with t value= -1.000 and p value = 0.334 (Table 2). While in group B, there was a statistically significant increase in the mean value of MOCA measured at post-treatment (28.73 ± 1.03) when compared with its corresponding value measured at pre-treatment (26.40 ± 0.51) with t value= -10.044 and p value = 0.001 (Table 2). The percent increase in MOCA value in groups A and B was 0.23% and 8.83%, respectively (Table 2).

Table 2. Comparison between mean values of MOCA in the two studied groups measured at pre- and post-treatment

Items	Group A (n= 15)	Group B (n= 15)	F value	P value
Pre-treatment	26.47 ± 0.74	26.40 ± 0.51	0.082	0.776 NS
Post-treatment	26.53 ± 0.92	28.73 ± 1.03	86.707	0.001 *
Mean difference	0.06	2.33		
% change	0.23 ↑↑	8.83 ↑↑		
t value	-1.000	-10.044		
p value	0.334 NS	0.001*		

NS: non-significant; *: significant (P<0.01)

The nine-item physical performance test (PPT)

In group A, there was no statistical significant difference between the mean value of PPT measured at pre-treatment (29.40 ± 1.80) and its corresponding value measured at post-treatment (29.53 ± 1.77) with t value= -1.468 and p value = 0.164 (Table 3). While in group B, there was a statistical significant increase in the mean value of PPT measured at post-treatment (33.33 ± 2.58) when compared with its corresponding value measured at pre-treatment (29.60 ± 1.88) with t value= -10.835 and p value = 0.001 (Table 3). The percent increase in PPT level in both groups A and B were 0.44% and 12.6%, respectively (Table 3).

Table 3. Comparison between mean values of PPT in the two studied groups measured at pre- and post-treatment.

Items	Group A (n= 15)	Group B (n= 15)	F value	P value
Pre-treatment	29.40 ± 1.80	29.60 ± 1.88	0.088	0.769 (NS)
Post-treatment	29.53 ± 1.77	33.33 ± 2.58	99.501	0.001 *
Mean difference	0.13	3.73		
% change	0.44 ↑↑	12.60 ↑↑		
t value	-1.468	-10.835		
p value	0.164 (NS)	0.001*		

NS: non-significant; *: significant (P<0.01)

DISCUSSION

Older adults often have cognitive and functional decreases [4] that can affect their health and ability to perform activities of daily living (ADLs), making them vulnerable to situations such as falls or dementia that represent an economic and social public health challenges [4].

Women are confronted with specific issues arising from their physiological conditions. One of these issues is the menopausal transition during which women experience additional problems due to the reduction in estrogen [10]. Therefore, deprivation of estrogen at menopause may contribute to the cognitive decline associated with neurological ageing in both executive and memory functions [11]. Early intervention to maintain cognitive function and well-being may help prolong independent living in older adults. Effective prevention and delay of Alzheimer's disease (AD) will require intervention during the preclinical phase [2]. The main finding of this study was the improvement in cognition and functional performance in postmenopausal women after a 4-week multisensory exercise programme, which is a good indicator for the prevention of cognitive and functional decline [4].

Regarding cognitive status, the multisensory exercises improved our participants' cognition. Such gains were also found in a similar study [6] and in studies that approached cognitive aspects in the intervention [12].

The cognitive improvement can be explained as a consequence of increased density and the number of cerebrovascular dendritic connections that, therefore, promotes improved cerebral oxygen intake and stimulates neurotransmitter synthesis and increases nerve conduction velocity [7]. Research also suggests that exercise can increase the brain oxidative capacity, have atrophic effect on the brain centers involved in motor sensory function, and improve older adults' cognitive functions. These factors were provided by multisensory stimulation, which possibly promoted brain plasticity in older women. In this sense, we emphasize the importance of the current findings, which presents multisensory exercises as an effective tool that can help stop this cycle and promote the older adults cognitive capacity without the use of medications.

Balance and mobility increased after the intervention period, which was also evidenced in studies with older adults and multisensory exercises [13], and with protocols that involved these variables [6]. An important factor that should be highlighted is the components of the multisensory exercise programme, that is, position changes; unstable surfaces with different head positions and exercises combined with the visual suppression are widely used. These components involve the visual, vestibular, somatosensory, and musculoskeletal systems, increasing the proprioceptive receptor sensitivity, providing better conditions for balance control and mobility [5], and justifying the findings of this study.

In the same way, the exercises performed in this study provided stimuli for the lower limbs and trunk strength and endurance as well as promoted neuromuscular adaptations. These adaptations may improve the muscle contraction coordination by increasing the reflex and motor responses, which contributed to the improvements in balance and mobility, making the older adults more agile and responsive to position changes and postural control [14]. Here, it highlights that both equity and mobility are important predictors of the fall risk and are directly associated with one's ability to perform ADLs such as those that involve movement and the activity of changing clothes [7]. These factors justify the participants' better functional performance after completion of the multisensory exercises.

Mostly older adults have limited cognitive resources and lower functional performance than young adults, which leaves ample room for physical and cognitive improvements [15]. In addition, studies show the interaction between the physical and cognitive aspects [16], which enriches the findings of this research. In other words, functional performance is directly associated with the ability to perform ADLs, and these activities are dependent on the nature's task as well as the ability to choose the best motor response and respond adequately to the challenge in the environmental context. This information reveals that cognitive improvement can positively affect the physical and functional aspects because it helps increase the information speed velocity and decrease the reaction time and allow the older adults to perform their activities more independently [17].

Thereafter, when postmenopausal women develop better balance (static and dynamic), agility, and speed to perform their activities, their safety, self-esteem, functionality, and independence, that is, functional performance, increase [18].

DECLARATIONS

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Authors' Contributions

All authors contributed equally to this work.

Conflict of interest

The authors have no conflict of interest

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