The Egyptian Journal of Hospital Medicine (January 2023) Vol. 90, Page 241-247

Effectiveness of Aerobic Exercise with Laughter Therapy on Functional, Cognitive, and Psychological Well-Being in The Elderly: A Randomized Controlled Clinical Trial

Marwa M. Elsayed*, Ebtesam N. Nagy
Department of Physical Therapy for Cardiovascular / Respiratory Disorder and Geriatrics,
Faculty of Physical Therapy, Cairo University, Egypt
***Corresponding author:** Marwa Mahmoud Elsayed, **Mobile:** (+20)01156033818, **Email:** marwa.elsaid@cu.edu.eg.

ABSTRACT

Background: Physical and mental abilities generally diminish with the natural process of aging. Exercise on a regular basis is essential for everyone. Adequate physical exercise in older adults is associated with a better life. Improvements in both physical and mental health are linked to laughter therapy. The aim of the current study was to examine the unrecognized combined effects of aerobic exercise and laughter therapy on functional, cognitive, and psychological well-being in the elderly.

Patients and methods: A total of 60 elderly individuals were divided into two groups; the experimental group (n=30), which received aerobic exercise with laughter therapy, and the control group (n=30), which received the identical experimental group's aerobic exercise program only, 3 times a week over 6 weeks. Body mass index, blood pressure, functional capacity (assessed by the 6-minute walk test distance), functional activity level (evaluated by the Functional Independence Measure), cognitive function (determined by the Mini-Mental State Examination), and psychological status (estimated by the Geriatric Depression Scale) were all assessed at baseline and after 6 weeks. All participants completed the study, and the outcome measure data were analyzed.

Results: By comparing the experimental group to the control group, all measured variables revealed a significant change in both groups ($p<0.001$) but in favor of the experimental group rather than the control.

Conclusions: The elderly may benefit physiologically and mentally from laughter therapy combined with exercise. Laughter therapy may be a powerful method for inspiring people to engage in physical activity and obtain greater results.

Keywords: Aged, Depression, Exercise therapy, Humor, Mental health, Walk test.

INTRODUCTION

The global population is rapidly getting older, with an astounding 50% predicted increase in the number of those 65 and older between 2015 and 2050, reaching more than 1.4 billion [(1)].

Compared to other age groups, older individuals have the quickest rate of population growth, the largest frequency of chronic diseases and disorders, and the highest extensive care costs [(2)]. Certain factors, like physical disability, deficits in seeing and hearing, cognition, and so forth, pose substantial barriers to the adoption of therapies that require deep intuition for issues of mental health because of the various psychosomatic issues that older individuals experience [(3)]. Global lifestyle guidelines for older individuals are linked to a slower deterioration in mental, physical, intellectual, and social attributes over time, ranging from 1.8% to 10.8% [(1)]. The advantages of living a generally healthy lifestyle were equally beneficial for men and women of all ages, and occasionally they were even greatest, a healthy lifestyle is thought to be a key component of preventing chronic diseases [(4)].

Regular exercise is associated with improved sleep quality and mood. Aerobic exercise also benefits cardiovascular health by increasing cardiorespiratory fitness, which is associated with cognitive and mental health [(5)].

Aerobic exercise, which involves the use of oxygen and the action of large groups of skeletal muscles over an extended period of time, may enhance executive function, speed of processing, cognition, and memorization in healthy elderly persons [(6)].

Also, the cardiovascular and neurological repairing processes, muscle endurance, improved psychological well-being, self-image, anti-inflammatory, and antioxidant effects [(4)].

Around the world, laughter therapy has been employed in a variety of participant groups and programs as a non-pharmacological therapy, an easily available, non-invasive, mental, and psychological rehabilitation [(7)].

It is a style of engagement that encourages smiles, radiant faces, and natural nonverbal communication through an emotional pathway that supports interpersonal communication. Unlike the conventional forms of therapy, laughter therapy adopts a different strategy that has a favorable impact on body processes, the immune system, increases the activity of natural killer cells, and lowers stress [(8)]. The results from earlier studies indicated laughter therapy as a positive influence on both psychological and physiological function, and it may be a useful treatment to enhance the quality of life (QOL) of elderly adults whose daily living tasks and mental state have deteriorated due to depressive symptoms,

Received: 23/09/2022
Accepted: 21/11/2022

cognitive dysfunction, decreased vitality, and poor leisure interaction [7,9].

Therefore, the current study aimed to detect the value of adding laughter therapy to aerobic exercise on functional, cognitive, and psychological well-being in the elderly. We hypothesized that aerobic exercise and laughter therapy have superior effects on functional, cognitive, and psychological well-being in the elderly compared to aerobic exercise alone.

PATIENTS AND METHODS

Study Design and Sampling Setting:

This randomized controlled clinical trial was carried out and reported in accordance with the CONSORT principles. A total of 60 elderly people (30 women and 30 men) were enlisted from the outpatient clinics of the Department of Internal Medicine at Cairo University Hospital.

Inclusion criteria:

Elderly participants, with ages ranging from 65 to 75, and whose body mass index (BMI) ranged from 25 to 29.9 kg/m^2 were included in the current study. They also had mild cognitive dysfunction defined by the Mini-Mental State Examination (MMSE) (with scores ranging from 20 to 25) [10], and a mild depressive level recognized by the Geriatric Depression Scale (GDS-long form) (with scores ranging from 10 to 19) [11].

Furthermore, sedentary participants (according to the physical activity index) with a functional activity level mean of 98.84 (SD 6.01) and a functional capacity mean of 405.48 (SD 18.35) m according to the 6-min walk test distance (6MWTD), in addition who completed their elementary education were included.

Exclusion criteria:

Patients with moderate to severe depressive or cognitive disorders, a historical background of neurological or cardiovascular/respiratory diseases, uncontrolled diabetes or hypertension, or cases of cancer that were diagnosed, treated, or in remission within a year of study enrollment, as well as those with serious health conditions that prevented them from taking part in this program, were excluded from the study. Additionally, patients using drugs that have an impact on study results were not included. Additionally, we disqualified people who had recently taken part in a clinical trial or another form of research, as well as people who had recently exercised regularly in the last six months.'

Sample size determination:

G*Power statistical software was used to compute the sample size before the study began (version 3.1.9.2; Franz Faul, Universitat Kiel, Germany) "t-tests - Means" Based on the difference between two independent means (two groups) and the Cohen's d effect size of 0.52 for the outcome of the 6MWTD, with error probabilities of 0.05 and 0.8, the required sample size for the study was found to be n = 60, predicting a 10% dropout rate.

Randomization and blinding:

The sequence of allocations was produced randomly by an online program (Randomization.com). Both the researcher (who assessed the outcomes) and the participants were unaware of the upcoming assignment because the randomization sequence was concealed by opaquely sealed, sequentially numbered envelopes, and a special identifier was issued to each participant. These numbers were divided into two groups of similar size (n=30) at random (1:1). Participants were divided into two groups after a blinded, independent research assistant opened the sealed envelopes and gave each of the participants a carefully chosen envelope. Unlike the control group (n=30), which solely followed an aerobic exercise program, the experimental group (n=30) engaged in both laughter therapy and aerobic exercise.

Eligibility:

Initially, 90 people were assessed for enrollment; approximately 26 were turned down (14 for identical exclusion criteria, 6 refusing to participate, and 6 for various causes). Due to personal reasons, four individuals were lost to follow-up; at the end, only 60 participants finished the study and were incorporated into the statistical data (**Figure 1**).

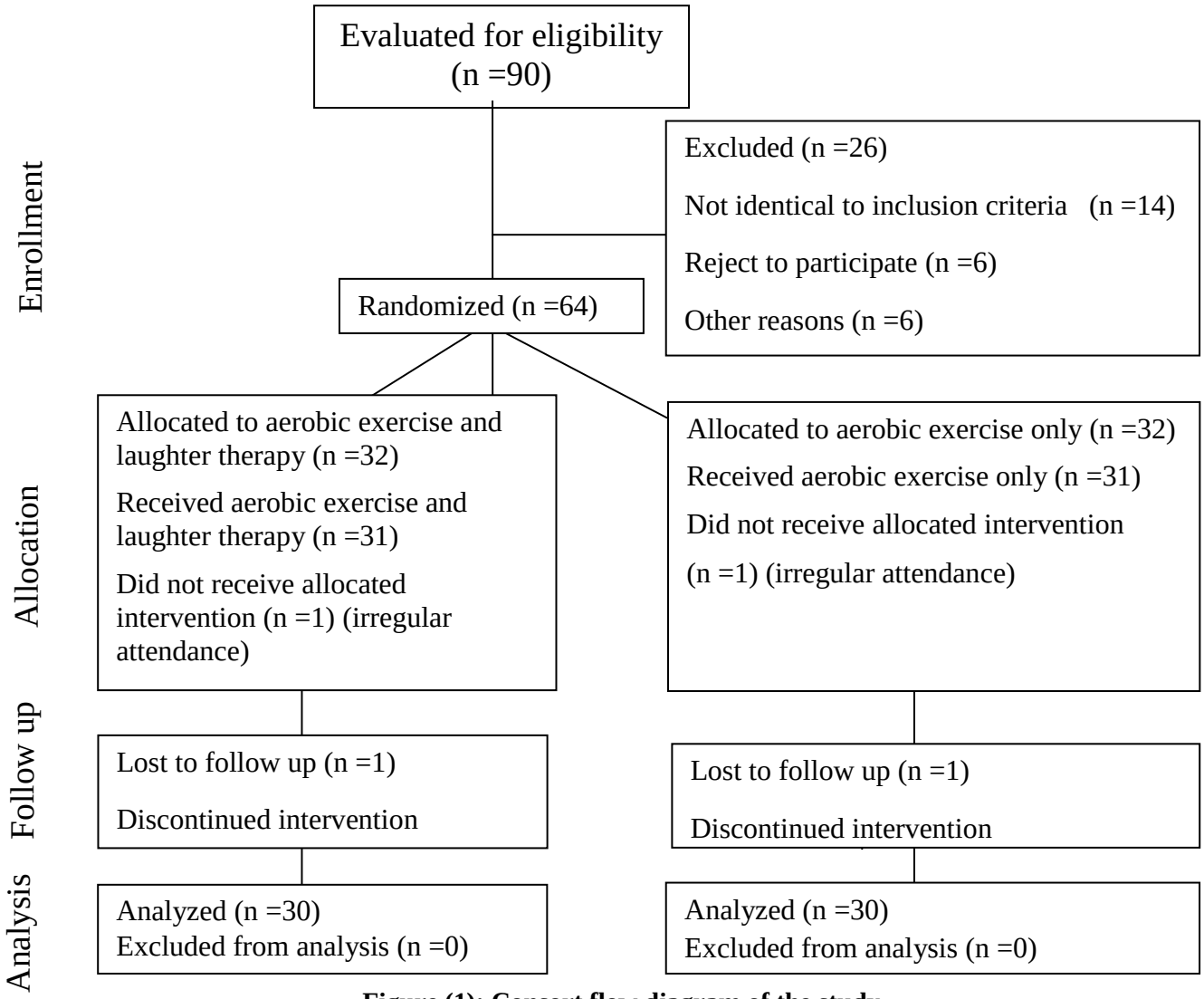

Figure (1): Consort flow diagram of the study.

Intervention:

The participants in the experimental and control groups completed a treadmill aerobic exercise program using the Fitness 3201EB MOTORIZED TREADMILL in accordance with the American College of Sports Medicine guidelines (ACSM) [(12)]. The participants exercised at 70% of their maximum heart rate (MHR), as determined by a symptom-limited submaximal treadmill test [(13)]. When participants complained of exertion, shortness of breath, exhaustion, or discomfort, the test was terminated, or when they reached 85% of their age-predicted peak heart rate (HR max = 220 - age) [(14)]. The modified Bruce treadmill protocol was used to determine each individual's peak heart rate (PHR) (i.e., the target exercise intensity) [(15)]. Pulse oximetry was used to measure HR (Beurer Pulse Oximeter with Heart Rate Monitor, Po30). Participants worked out three times per week for six weeks in the outpatient clinics at the Faculty of Physical Therapy. Participants were instructed to perform a 10-minute warm-up, followed by 20 minutes of exercising at higher intensity to reach the target training heart rate, and to cool down for 10 minutes at the end of the exercise session.

Laughter therapy:

Participants engaged in laughter therapy in the following order for 20 minutes [(16)]:

1. Clapping in a 1-2-3 time signature and yelling "Ho-Ho-Ha-Ha -Ha".
2. Breathing deeply while inhaling via the nose and exhaling slowly (5 times)
3. Exercise your shoulders and neck with stretching (five times for each).
4. Hearty Laughter: Laugh as though it is coming from your heart by raising both arms toward the heavens and cocking your head slightly backwards.
5. Greeting Laugh: Shaking hands in a group of at least 4-5 individuals and giggling at other members of the group.
6. Appreciation Laughter: While making movements that suggest you are both appreciating and laughing

with your company, join your pointing finger and thumb to form a little circle.

7. one-meter laughter: Extended the shoulder as if you were going to shoot a bow and arrow by placing one hand over the other sides stretched arm. Ae.....,Ae.....Aeee..... is chanted as the hand is jerked three times. Participants then break out in belly laughs while stretching out both arms and slightly cocking their heads back (four times).
8. Silent Laughter (no sound): open your mouth wide and make funny gestures while looking into other people's eyes.
9. Humming Laughter (with closed mouth) :shutting your mouth and laughing while generating a humming sound while moving about the group and shaking hands with others.
10. Swinging Laugh: While singing "Aee, Feee..... Uuuu ….Ooo....., stand together in a circle and walk towards the center.
11. Lion Laughter: stick out your entire tongue, open your eyes wide, and laugh from the stomach with your hands strained out like lion claws.
12. Cell Phone Laughter: Holding an imagined phone and attempting to chuckle while making various gestures and walking around in the group to interact with other people.

13A. Argument Laughter: Laughing while pointing fingers at various participants to simulate an argument.

13B. Forgiveness/Apology Laughter: lift both of your palms and laugh as apologizing.

14. Gradient Laughter: It begins with a smile, progresses to soft giggles, and then increases in intensity of laughter, then burst into hearty laughter, which was gradually reduced and ended.
15. Intimacy laughter: draw closer together, hold hands, and laugh. If it is more comfortable for you, you can exchange handshakes or embraces.

Affirmations like "I am the world's happiest individual" and "I am the fittest individual in the world" were repeated aloud by the participants at the end of the session.

OUTCOMES

Primary outcomes:

Six-minute walk test distance (6-MWTD):

(6-MWTD) was used to assess the participants' functional ability. It measures the distance walked in 6 minutes along a flat, 35-meter indoor corridor. If the distance walked is 300 meters or less, it is considered a bad prognosis [(17)].

Arterial blood pressure:

The participant's arm was wrapped around a mercury sphygmomanometer (BK 1001-3001, Germany) to measure their resting systolic and diastolic blood pressure (SBP&DBP) (mmHg). It was advised to abstain from caffeine, eating, and stress for at least two hours prior to taking their blood pressure.

Depression:

It was assessed by the Geriatric Depression Scale (GDS) long form questionnaire, which consists of 30 questions that determine the depression level in senior people using the following scoring systems: normal 0–9, mild depression 10–19, and severe depression 20–30 [(11)].

Cognitive function:

It was evaluated by the Mini-Mental State Examination (MMSE), which is a 30-question test that measures different aspects of cognitive function, including orientation and attention, registration, memory, calculation, language, recall, and the capacity to draw sophisticated polygons [(10)].

Assessment of functional activity level:

The Functional Independence Measure (FIM) is a scale consisting of 18 items to assess daily living skills such as communication, transfers, self-care, social cognition, and sphincter control. The sum of the scores for the tasks completed was calculated; 126 stands for the highest overall score and 18 for the lowest levels of independence. The scale's starting point is 1, which stands for total reliance, while the final score of 7 denotes complete independence [(18)].

Secondary outcomes:

Each participant's height and weight were assessed using the UGM-200 Health Scale (China), and BMI was calculated using the following formula: body weight (kg)/height (m^2).

Ethical consideration:

The Faculty of Physical Therapy (Cairo University) Ethical Board for Scientific Research approved it with No. (P.T.REC/012/004125). Written informed consent of all the participants was obtained. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

To examine the data, SPSS software, version 25, was utilized (IBM SPSS, Chicago, Illinois, USA). To ascertain whether the data were normally distributed, the Shapiro-Wilk test was applied. For continuous data, the mean and standard deviation (SD) were employed to summarize the data. The baseline characteristics of the two groups were compared using the independent sample t-test. Dependent and independent sample t-tests were used to look into the differences between the experimental and control groups as well as the changes in variables before and after the intervention. P-value was set at ≤ 0.05 for significant results.

RESULTS

Age, BMI, SBP, DBP, cognitive functions, functional activity and capacity, and GDS scores between the experimental and control groups at baseline were not statistically different (P >0.05), as shown in **Table 1**.

Table (1): Baseline characteristics of study participants mean ± standard deviation (SD).

Characteristics		Experimental group (N=30)	Control group (N=30)	P-value
Age (yrs)	Mean ± SD	66.21 ± 3.24	65.93 ± 2.38	0.821
	Range	65 -75	65 - 73	
BMI (kg/m^2)	Mean ± SD	27.11 ± 1.3	26.18 ± 2.11	0.754
	Range	26 - 29.9	26.3 - 29.9	
SBP (mmHg)	Mean ± SD	155 ± 4.28	153.56 ± 3.63	0.658
	Range	148 - 160	147 - 162	
DBP (mmHg)	Mean ± SD	95.52 ± 3.25	96.63 ± 2.37	0.812
	Range	93 - 99	92 – 99	
6-MWTD (m)	Mean ± SD	406.64 ± 19.18	404.32 ± 17.52	0.740
	Range	380 - 446	381 - 449	
GDS	Mean ± SD	15.35 ± 2.34	14.52 ± 2.61	0.523
	Range	10 - 19	10 - 19	
MMSE	Mean ± SD	20.24 ± 1.31	21.15 ± 1.8	0.623
	Range	20 - 23	20 - 23	
FIM	Mean ± SD	98.56 ± 5.72	99.12 ± 6.29	0.718
	Range	91 - 111	92 - 111	

BMI: body mass index, DBP: diastolic blood pressure, FIM: functional independence measure, GDS: geriatric Depression Scale, MMSE: Mini-Mental State Examination, SBP: Systolic blood pressure, 6-MWTD: 6-minute walk test distance.

According to Table 2, in each of the experimental and control groups, there were statistically significant differences in BMI, SBP, DBP, 6-MWTD, FIM, MMSE, and GDS scores pre- and post-intervention according to the paired sample t-test (p <0.001 and p <0.05, respectively). Also, statistically significant differences were detected between the two groups in terms of the measured outcomes post-intervention according to the P independent t-test (p <0.001) where the experimental group showed highly statistically significant differences compared with the control group with no adverse events related to the intervention being reported in both groups during the study.

Table (2): Comparison of BMI, SBP, DBP, 6-MWTD, FIM, MMSE and GDS scores before and after 6 weeks between both groups mean ± standard deviation (SD).

Variables	Experimental Group (N=30)		P Paired t-test – value	Control Group (N=30)		P Paired t-test – value	P Indep. t-test value
	Pre	Post		Pre	Post		
BMI (kg/m^2)	27.11±1.3	26.22±1.74	< 0.001*	26.18±2.11	25.23±2.01	< 0.05*	<0.001**
SBP (mmHg)	155.00±4.28	135.21±4.27	< 0.001*	153.56±3.63	147.61±5.13	< 0.05*	<0.001**
DBP (mmHg)	95.52±3.25	79.33±2.71	< 0.001*	96.63±2.37	93.77±2.58	< 0.05*	<0.001**
6-MWTD (m)	406.64±19.18	434.21±45.37	< 0.001*	404.32±17.52	415.77±20.78	< 0.05*	<0.001**
GDS	15.35±2.34	10.13±2.21	<0.001 *	14.52±2.61	12.27±2.13	< 0.05*	<0.001**
MMSE	20.24±1.31	26.11±2.10	< 0.001*	21.15±1.80	23.44±1.88	< 0.05*	<0.001**
FIM	98.56±5.72	115.63±3.82	< 0.001*	99.12±6.29	105.16±6.25	< 0.05*	<0.001**

BMI: body mass index, DBP: diastolic blood pressure, FIM: functional independence measure, GDS: Geriatric Depression Scale, MMSE: Mini-Mental State Examination, SBP: Systolic blood pressure. 6-MWTD: 6-minute walk test distance.

*: Statistically significant at P < 0.05 according to Paired Sample t-test.

**: Statistically significant at P < 0.05 according to Independent Sample t-test.

DISCUSSION

At the end of this study, it was discovered that 6-weeks of aerobic exercise and laughter therapy (the experimental group) had a significant reduction in BMI, SBP, DBP, and GDS compared to aerobic exercise alone (the control group) ($p < 0.001$), which is consistent with **Lima *et al.* [19],** who discovered a significant reduction in BMI, SBP, and DBP after moderate aerobic training in the elderly ($p = 0.01$). Also, **Funakubo *et al.* [20]** found that a laughter program reduced BMI in obese women ($p = 0.006$), and **Ponraj [21]** noticed that there was a statistically significant reduction in systolic and diastolic blood pressure ($p < 0.001$) within the laughter group in hypertensive patients.

Weight reduction and a decreased BMI occur as a result of aerobic exercise's increased metabolic rate and energy expenditure. Additionally, aerobic exercise enhances the lipid profile, micro- and macrovascular circulation, endothelial function, release of vasodilators, and parasympathetic nervous system [22]. Genuine vocal laughter, according to **Buchowski *et al.*[23],** increases energy expenditures by around 10–20%, and 10-15 minutes of laughter per day is proven to raise overall energy output by 10–40 kcal. **Tanaka *et al.* [24]** also found that deep breathing procedures, like yoga, reduced blood pressure and heart rate in 14 elderly people who were experiencing stress by lowering the pressure rate product, a measure of myocardial oxygen uptake, and increasing parasympathetic nerve activity.

In keeping with the findings of this trial, **Rao *et al.* [25]** demonstrated a substantial benefit of 8 weeks of moderate intensity aerobic exercise on the reduction of depression symptoms in adults. A number of mechanisms of action, including hormonal changes, effects on neurogenesis, inflammation, and oxidative stress, have also been shown to cooperate to lessen depressive symptoms in older adults after aerobic exercise [26]. Additionally, **Ko and Youn [3]** reported that, after a month, senior patients receiving laughter therapy experienced a significantly lower depression level ($P = 0.027$), which is consistent with the current study. It's possible that the pleasurable sensation elicited by laughing or joking could reduce anxiety and stress and improve the psychological functioning of people suffering from dementia or melancholy. Furthermore, laughter therapy has been shown to improve the immune system, increase the activity of natural killer cells, and reduce stress [7]. Adrenaline, 3,4-dihydrophenylacetic acid (a key dopamine catabolite), growth hormone, and cortisol are all reduced in laughter, reversing the stress response [28].

Six-weeks of aerobic exercise and laughter therapy resulted in a significant increase in 6-MWTD, FIM, and MMSE scores ($p < 0.001$) when compared to aerobic exercise alone ($p < 0.001$), as noticed in this study, which is consistent with **Dos Anjos *et al.* [29],** who reported a significant impact of moderate intensity aerobic exercise on functional capacity in diabetic elderly ($p < 0.001$), and **Elsayed *et al.* [30]** results, which showed a significant effect of aerobic exercise on functional and cognitive level in elderly women ($p < 0.05$).

Increased functional ability and enhanced capillarization of muscle, flow of blood, and oxygen use are all benefits of aerobic exercise that reduce muscle atrophy and local inflammation [31]. Numerous physiological and psychological advantages of aerobic exercise include increased grey matter volume in the hippocampal and frontal areas, stimulation of serotonin, neurotrophic factors, and norepinephrine release; improved neural plasticity with greater synapses interconnection; improved cerebrovascular vessel integrity and function; and increased blood flow with much more oxygen and nourishment to brain circuits through improved metabolism of glucose and lipids [32].

According to **Ji and Kim [27],** who reported that older patients who received laughter therapy combined with program of cognitive reinforcement for two month experienced a substantial improvement on the cognitive scale ($p < 0.001$), the current study's findings are congruent. An extensive network of brain circuits involving attention, executive functions, adaptability of thought, word meaning extraction, and a good mood are needed to appreciate humor. Jokes, puns, and comics engage several brain regions [33]. Laughter causes the ventromedial prefrontal cortex to fire, resulting in the release of endorphins. It promotes decision-making, self-control, and cognition, has a strong enhancing effect on learning and memory, and can induce a natural increase in serotonin levels. The discharge of a large quantity of serotonin promotes synaptic transmitting and memory storage. Endorphin and serotonin both regulate mood and brain chemistry[34].

Furthermore, many studies have discovered that laughter therapy is beneficial not only for psychological status but also for functional performance. As laughter therapy enhances immunity, lung circulation, function of the endothelium, circulation, muscular function, bone density, and lessens glycated hemoglobin [7,9].

LIMITATION OF THE STUDY

Despite the fact that our study had successful results, there are some drawbacks to be aware of. The involved participants were only those without any cardiovascular conditions or other uncontrolled health issues, as well as only people with low levels of education, which may have limited the variability in the study's findings. Additionally, only one particular exercise style with a particular intensity was used. Finally, we advise investigating various exercise types and intensities with varied ages as well as a larger sample size with more variation in the demographic data.

CONCLUSION

Laughter therapy paired with aerobic exercise has a superior impact on senior individuals' functional, cognitive, and psychological well-being. So, in this study, we described these non-invasive procedures and suggested including laughter therapy as a productive, secure, and non-pharmacological strategy in a geriatric rehabilitation program.

Conflict of interest: The authors have no conflicts of interest.

Funding sources: Public, private, and not-for-profit funding organizations did not provide any particular grants for this research.

Author contribution: Equal contributions from all authors were made to the study.

REFERENCES

1. **McNicoll G (2002):** World population ageing 1950-2050. Population and Development Review, 28(4):814-6.
2. **Bull F, Al-Ansari S, Biddle S *et al.* (2020):** World Health Organization 2020 guidelines on physical activity and sedentary behaviour. British Journal of Sports Medicine, 54(24):1451-62.
3. **Ko H, Youn C (2013):** Effects of laughter therapy on depression, cognition and sleep among the community-dwelling elderly. Geriatric Gerontol Int., 11:267-74.
4. **Visser M, Wijnhoven H, Comijs H *et al.* (2019):** A Healthy Lifestyle in Old Age and Prospective Change in Four Domains of Functioning. J Aging Health, 31(7):1297-314.
5. **Young J, Angevaren M, Rusted J *et al.* (2015):** Aerobic exercise to improve cognitive function in older people without known cognitive impairment. Cochrane Database Syst Rev., (4):CD005381. doi: 10.1002/14651858.CD005381.pub4.
6. **Castells-Sánchez A, Roig-Coll F, Lamonja-Vicente N *et al.* (2019):** Effects and Mechanisms of Cognitive, Aerobic Exercise, and Combined Training on Cognition, Health, and Brain Outcomes in Physically Inactive Older Adults: The Projecte Moviment Protocol. Front Aging Neurosci., 11:216-40.
7. **Yoshikawa Y, Ohmaki E, Kawahata H *et al.* (2018):** Beneficial effect of laughter therapy on physiological and psychological function in elders. Nurs Open, 6(1):93-9.
8. **Schultz T, Horibe F (2012):** Development of the appreciation of verbal jokes. Am Develop Psychol J., 10:13-20.
9. **Ghodsbin F, Sharif A, Jahanbin I *et al.* (2015):** The effects of laughter therapy on general health of elderly people referring to Jahandidegan community center in Shiraz, Iran, 2014: A randomized controlled trial. Int J Community Based Nurs Midwifery, 3(1):31-8.
10. **Eftychios A, Nektarios S, Nikoleta G (2021):** Alzheimer Disease and Music-Therapy: An Interesting Therapeutic Challenge and Proposal. Advances in Alzheimer's Disease, 10(1):1-8.
11. **Zhang Y (2019):** Multiple factor analysis of neuropsychology in elderly patients with depression. Matrix Science Medica, 3(2):34-7.
12. **Donnelly E, Blair S, Jakicic J *et al.* (2009):** Appropriate PA intervention strategies for weight loss and prevention of weight regain for adults. Med. Sci. Sports Exerc., 41:459-71.
13. **Gappmaier E (2012):** The submaximal clinical exercise tolerance test (SXTT) to establish safe exercise prescription parameters for patients with chronic disease and disability. Cardiopulm Phys Ther J., 23(2):19-29.
14. **Fox S, Naughton J, Haskell W (1971):** Physical activity and the prevention of coronary heart disease. Ann Clin Res., 3:404-32.
15. **Kozlov S, Caprnda M, Chernova O *et al.* (2020):** Peak responses during exercise treadmill testing using individualized ramp protocol and modified Bruce protocol in elderly patients. Folia Med., 62(1):76-81.
16. **Salunke S, Shah M (2019):** Effectiveness of laughter therapy in smartphone addicts on insomnia, lung functions and flexibility. Int J Health Sci Res., 9:76-83.
17. **Bautmans I, Lambert M, Mets T (2004):** The six-minute walk test in community dwelling elderly: influence of health status. BMC Geriatr., 4:6-15.
18. **Linacre J, Heinemann A, Wright B *et al.* (1994):** The structure and stability of the Functional Independence Measure. Archives of Physical Medicine and Rehabilitation, 75(2):127-32.
19. **Lima LG, Maria J, Bonardi T *et al.* (2014):** Effect of an exercise program on blood pressure, body mass index and abdominal circumference in elderly hypertensive patients. Journal of the American Society of Hypertension, 8(4):116. DOI:10.1016/j.jash.2014.03.261
20. **Funakubo N, Eguchi E, Hayashi R *et al.* (2022):** Effects of a laughter program on body weight and mental health among Japanese people with metabolic syndrome risk factors: a randomized controlled trial. BMC Geriatr., 22(1):361-73.
21. **Ponraj M (2016):** Effectiveness of Laughter Therapy on Blood Pressure Among Patients with Primary Hypertension. TNNMC Journal of Medical & Surgical Nursing, 4(2):12-3.
22. **Monteiro L, Fiani C, Freitas M *et al.* (2010):** Decrease in blood pressure, body mass index and glycemia after aerobic training in elderly women with type 2 diabetes. Arq Bras Cardiol., 95(5):563-70.
23. **Buchowski M, Majchrzak K, Blomquist K *et al.* (2007):** Energy expenditure of genuine laughter. Int J Obes., (31):131-7.
24. **Tanaka M, Nagasaka M, Yano T *et al.* (2011):** Autonomic nervous responses during the controlled abdominal breathing using the diaphragm in the elderly. Struct Funct., 10:8-16.
25. **Rao U, Noronha J, Adiga K (2020):** Effect of aerobic exercises on depressive symptoms, anxiety, self-esteem, and quality of life among adults with depression. Clinical Epidemiology and Global Health, 8(4):1147-51.
26. **Schuch F, Vancampfort D, Rosenbaum S *et al.* (2016):** Exercise for depression in older adults: a meta-analysis of randomized controlled trials adjusting for publication bias. Rev Bras Psiquiatr., 38(3):247-54.
27. **Ji E, Kim O (2014):** Effect of the laughter therapy combined with cognitive reinforcement program for the elderly with mild cognitive impairment. Korean J Adult Nurs., 26(1):34-45.
28. **Yim J (2016):** Therapeutic benefits of laughter in mental health: a theoretical review. The Tohoku Journal of Experimental Medicine, 239(3):243-9.
29. **Dos Anjos D, de Souza Moreira B, Kirkwood R *et al.* (2017):** Effects of aerobic exercise on functional capacity, anthropometric measurements and inflammatory markers in diabetic elderly women. Journal of Bodywork and Movement Therapies, 21(3):509-16.
30. **Elsayed M, Rabiee A, El Refaye G *et al.* (2022):** Aerobic Exercise with Mediterranean-DASH Intervention for Neurodegenerative Delay Diet Promotes Brain Cells' Longevity despite Sex Hormone Deficiency in Postmenopausal Women: A Randomized Controlled Trial. Oxid Med Cell Longev., 22:4146742. doi: 10.1155/2022/4146742.
31. **Campos J, Fernandes T, Bechara L *et al.* (2015):** Increased clearance of reactive aldehydes and damaged proteins in hypertension-induced compensated cardiac hypertrophy: impact of exercise training. Oxid Med Cell Longev., 15:464195. doi: 10.1155/2015/464195.
32. **Gomez-Pinilla F, Hillman C (2013):** The influence of exercise on cognitive abilities. Compr Physiol., 3(1):403-28.
33. **Iwase M, Ouchi Y, Okada H *et al.* (2002):** Neural Substrates of Human Facial Expression of Pleasant Emotion Induced by Comic Films: A PET Study. NeuroImage , 17:758-68.
34. **Berk L, Tan S, Fry W *et al.* (1989):** Neuroendocrine and stress hormone changes during mirthful laughter. Am J Med Sci., 298(6):390-6.