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Effects of Dual-Task Training, Physiotherapy, and Combined Therapy on Balance Performance in Stroke Patients

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ABSTRACT

Stroke is the worldwide third cause of death and the foremost cause of adult disability, affecting all body functions including balance performance. **The study aimed** to compare the effects of dual-task training, physiotherapy, and combined therapy on balance performance in stroke patients. **Methodology:** A quasi-experimental research design was utilized to conduct this study at the neurological departments of Ain-Shams University Hospitals and Suez Canal University Hospitals, from February to October 2021. A purposive **sample** of 210 adult stroke patients was divided equally into three groups (physiotherapy, dual-task training, and combined therapy) was included in the study. **Four tools were used to collect the data**: A structured interview questionnaire to assess patients' demographics and clinical health history; a Postural Assessment Scale to assess balance in different positions; a Timed Up and Go test to assess mobility, balance, and locomotors performance; and a Falls Risk Assessment Tool to assess fall risk factors. **Results**: A statistically significant improvement in postural assessment scores, risk of fall scores, and timed up and go scores was observed in (44.3%, 81.4%, and 64.3%) patients of the combined therapy group, respectively, at the post-intervention phase. **Conclusion:** Stroke patients should be encouraged to undergo combined therapy of physiotherapy and dual-task training exercises by nurses as a routine practice to improve balance performance and reduce the risk of falls. **Recommendation:** Tailored combined therapy training programs for each patient are mandatory to optimize care outcomes.

Keywords: Dual-task, Physiotherapy, Balance, Risk of Fall, and Stroke.

Introduction

A stroke is a cerebrovascular accident that occurs when a blood clot, constriction, or rupture of blood vessels interrupts the continuous supply of blood and oxygen to brain cells, causing their death within a few minutes. Ischemic strokes, which account for 80–90% of all strokes and are caused by a blockage in the blood supply to the brain, are more severe and are associated with higher early mortality than hemorrhagic strokes **(Brainin & Heiss, 2019. P:38)**. Stroke is enhanced by modifiable lifestyle risk factors such as smoking, physical inactivity, alcohol misuse, and obesity, in addition to medical risk factors such as hypertension, diabetes mellitus, high cholesterol, and some heart diseases. Also, non-modifiable risk factors include age, gender, family history, and ethnicity **(American Heart Association, 2017)**.

The consequences of a stroke vary depending on which section of the brain is harmed, how severe the lesion is, and the patient's overall condition. Myocardial infarction, epilepsy, urinary/bowel incontinence, constipation, urinary tract infections, complex pain, mood disorders, and thromboembolism are all examples of post-stroke complications **(Hussein et al., 2018)**. Stroke patients with cognitive disabilities have trouble absorbing relevant stimuli from their surroundings, making it difficult for them to self-structure and arrange their surroundings, especially if they have balance issues **(Shin et al., 2015).**

A variety of treatments, including physiotherapy, improve balance in stroke patients **(Cho & Cha, 2016)**. Exercises are structured physical activities that are done to develop physical and psychosocial fitness, as patients have deficits to varying degrees post-stroke **(Saunders et al., 2014)**. Tandem stands, semi-tandem stands, one-and two-legged stands, dynamic movements such as tandem walks and circle turns to disturb the center of gravity, heel or toe stands for postural muscle groups, and exercises to reduce sensory input such as standing with eyes closed are all examples of balance training exercises that are combined with concurrent cognitive activities in dual-task training to improve balance in stroke patients (**Uzinkulaolu et al., 2019)**. Dual-task training and physiotherapy can be delivered in hospitals, rehabilitation centers, outpatient practices, nursing homes, and individuals' homes for two-to-six weeks, one to five times per week **(Wang et al., 2015)**. A typical exercise session that lasts 20 to 45 minutes is perfect for improving patients' balance **(Shin, 2014)**.

Stroke is the world's second leading cause of morbidity, the third leading cause of death, and the first leading cause of acquired adult impairment, making improving post-stroke outcomes an important healthcare goal **(Benjamin et al., 2017; Hugues et al., 2017)**. In 2030, it is estimated that 23 million people will have their first stroke, with 7.8 million deaths worldwide **(Mendis and Shanthi, 2013)**. Nurses play a critical role in all phases of stroke care to improve patient outcomes. reduce hospital stay time and costs predict and prevent possible complications and serve as

educators for patients and their families to support and encourage active participation in all aspects of self-care for improved outcomes and health promotion **(Elbqry et al., 2019).**

The significance of the study:

Stroke is a significant public health issue in Egypt **(El-Hajj et al., 2016)**. Furthermore, Egypt is the Middle East's most populated country, with a stroke incidence and prevalence of 613/100,000 and 202/100,000 people, respectively **(Abd-Allah et al., 2019)**. Mobility, balance, cognition, attention, memory, feelings, perception, and emotions are all affected by post-stroke disorders, with over half of surviving stroke patients reporting that their needs relating to these issues are not being fulfilled **(Yoon-Hee et al., 2020).** The current study will help patients restore and control their balance quickly, resulting in improved disease outcomes, shorter hospital stays, and shorter convalescence periods. It will also lessen the burden of follow-up and treatment by providing nurses with a higher level of understanding about prevention and treatment options.

Aim:

The current study aimed to compare the effects of dual-task training, physiotherapy, and combined therapy on balance performance in stroke patients.

Hypothesis

Stroke patients who will undergo combined therapy of physiotherapy and dual-task training, will have an improved level of balance performance.

Subjects and Methodology

Research design:

This study was conducted using a quasi-experimental design, as the researchers didn't follow the random pick up of the sample at first, but used random assignment of the chosen sample into the three different study groups.

Setting:

The current study was implemented at the neurological departments of Ain-Shams University Hospitals and Suez Canal University Hospitals, Egypt. The included hospitals are educational hospitals, that introduce trusted and authorized healthcare services without funding to the population.

Subjects:

A purposive sample included 210 male and female patients with stroke from the previously listed settings were included and randomly divided into three equal groups (70 patients for each group of physiotherapy, dual-task training, and combined therapy). Recommended inclusion criteria for participation in this study included patients ranging in age from < 50 to > 60 years old, confirmed diagnosis of stroke with an unwavering medical condition to allow patients follow instructions. But, patients with a history of other disorders affecting balance, movement, or cooperation; patients with vascular disorders such as deep vein thrombosis, and patients with affected senses (vision, speaking, or hearing) are excluded from the study.

Sample Size:

Based on data from **Tetik Aydoğdu et al. (2018)**, considering a level of significance of 5%, and a power of study of 80%, the sample size can be calculated using the following formula: n = [(Zα/2 + Zβ)2 × {2(SD)2}]/ (expected difference)2, where, SD = standard deviation obtained from the previous study; Zα/2, for 5% this is 1.96; and Zβ, for 80% this is 0.84. Therefore, n= [(1.96 + 0.84)2 × {2(10.0)2}]/ (4.75)2=69.5. Based on the above formula, the sample size required is 70 per group.

Tools of data collection: Four tools were used in data collection for the current study:

Tool (I): Structured Interview Questionnaire:

The questionnaire was adopted from (**Abdelhamed, 2021**) to assess demographic data and clinical health history of stroke patients. It consists of two parts:

Part I: Demographic Characteristics included six questions asking about age, gender, education level, residence, income, and smoking habits.

Part II: Patient Clinical Health History: Seven questions were asked to assess body mass index (BMI), stroke type, affected side, post-stroke duration/days, admission date, medical history (e.g., pneumonia, diabetes mellitus, aphasia, hypertension, and/or cardiac disease), and family history of stroke.

Tool (II): Postural Assessment Scale for Stroke Patients (PASS):

It is comprised of 12 items of increasing difficulty that measure balance and the patient's ability to maintain stable postures as well as equilibrium in changes of position (in lying, sitting, and standing positions). Items were graded by difficulty originally by **Benaim et al. (1999**), whereby lying and sitting items are easier than standing items. Item 6 (supine to the affected side lateral) and 7 (supine to the non-affected side lateral) are the easiest items; item 5 (standing on the paretic leg) is the most difficult item of the assessment. The scale was completed in around 10 minutes and was filled by the researchers for all patients throughout the study phases. The scale contained two major parts, called "maintaining posture" (5 items) and "changing posture" (7 items).

Part 1: Maintaining Posture (**Static PASS):** assess the patients' ability to maintain posture as sitting without support (feet touching the floor while sitting on the edge of an examination table 50 cm high), standing with support but feet free positioned, standing without support as feet free positioned, standing on the non-paretic leg without constraints, standing on the paretic leg without constraints.

Part 2: Changing Posture (Dynamic PASS): To assess patients' ability to change posture from supine to the affected side, supine to the non-affected side laterally, supine to sitting up on the edge of the table, sitting on the edge of the

table to supine, sit-to-stand without other support or constraints, stand-to-sit without other support or constraints, and standing while picking up a simple thing from the floor

PASS scoring:

The scale is a four-point grade, as each item is scored from 0 to 3, with zero meaning completely unable and three meaning completely able, with a total scoring range of 0 to 36. So, the higher score of more than 65% meant a high balance level, the scores ranging from 50 to 65% meant a moderate level of balance, and the lower score of less than 50% meant a low balance level.

Tool (III): Timed Up and Go (TUG) Test:

It is a general physical performance test that was adapted from **Podsiadlo and Richardson (1991)** to assess the ability to perform motor tasks virtually like turning and walking. It measures the time that a person takes to rise from a chair, walk three meters, turn around, walk back to the chair, and sit down. All of these movements were implemented according to the instructions of the researchers and performed at a comfortable and safe pace, lasting 1 to 2 minutes. The patient can wear secure footwear and is allowed to use their walking aids without giving physical assistance.

Scoring of the TUG test

Performance of the TUG is rated on a scale from 1 to 5, where 5 indicates "severely abnormal function", and 1 indicates "normal function". The score consists of the time taken to complete the test activities in seconds. The time interpreted as 10 seconds or less is normal, 11 to 19 seconds shows that the patient has good mobility with a low risk of falling, 20 to 29 seconds shows that the patient has mobility problems with a moderate risk of falling, and 30 seconds or more shows that the patient has impaired mobility with a high risk of falling.

Tool (IV): The Falls Risk Assessment Tool (FRAT):

It was developed by the Peninsula Health Falls Prevention Service for a DH-funded project **(Peninsula Health, 1999)**. It is divided into three sections: Section 1: Falls risk status (16 items); Section 2: Risk factor checklist (11 items); and Section 3: An action plan for risk factors identified in Sections 1 and 2.In the present study, the researchers used section one only, as it is the only part that serves the purpose of the study. It assesses risk factors for falls such as recent falls (4 items) with four different responses, medications such as sedatives, anti-depressants, anti-Parkinson's, diuretics, anti-hypertensive, or hypnotics (4 items), and psychological (4 items) anxiety, depression, cooperation, insight or judgment, and cognitive status (4 items).

Scoring of FRAT :

The full score of the tool (part 1) is 20, classified into three levels ranging from low to high risk. The low risk is identified as patients scoring 5–11, the medium-risk patients scoring 12–15, and in the high risk, patients scoring 16–20.

Validity and reliability tests

Tools were tested by a jury of seven experts in the medical and nursing specialties, to ensure that tools served the aim of the study. No major modifications were carried out. Tool One is the only one in the Arabic language, but the others are used in their original form. The reliability value of tool I using Cronbach's Alpha was 0.839. Tool II has excellent ICC (0.97) at a 95% confidence interval (CL 0.95-0.98), the ICC for tool III TUG test is 0.87 with (95% CL: 0.82-0.91), and tool IV has high reliability with internal consistency (ICC = 0.79).

Pilot study

It was carried out on 21 patients who represented 10% of the total study sample to assess the clarity and applicability of the proposed tools. Those patients were included in the main results as no modifications were approved. It was implemented through January 2021.

Ethical consideration:

Ethical approval was obtained from the research ethics committee of the Faculty of Nursing at Ain-Shams University after obtaining official approval from the official managers of both the included faculties and hospitals for steering the study. Consent was obtained orally from the participants and their caregivers, with confirmation of confidentiality and rights to be included or withdrawn from the study. The researchers clarified the pros and cons of the study with the desired objectives for the participants and the healthcare team.

Working method:

1. Phases of preparation and assessment

The researchers prepared tools to collect data and the training program used for the intervention phase after reviewing the recent related kinds of literature and theoretical knowledge of various aspects of this study. Then the researchers started to collect data after piloting the predetermined tools of data collection, assessing baseline data using all tools without providing any interventions, and developing the training program.

2. Intervention phase:

Data was collected over ten months from February to October 2021, and the researchers were available at the study settings four days a week from 5:00 pm to 10:00 pm. The researchers randomly classified the participants into three groups. For the physiotherapy, dual-task training, and combined therapy (physiotherapy, dual-task training) groups, each participant received a personalized two training sessions per week with a total of 12 sessions distributed over six weeks. Sessions were administered by the researchers with the attendance of the physiotherapist and a specialized nurse to help follow-up patients' progress. The researchers started with a simple level of each type of therapy, and then graduated to the next level of difficulty based on the patients' responses and general health.

Every training session lasted for around 30 minutes, either for physiotherapy or dual-task training. For the combined therapy, the session lasted one hour (30 minutes for physiotherapy, and 30 minutes for dual-task training), with a break

period in between. The duration and frequency were determined based on a study by **Plummer et al. (2014),** as they found that 12 sessions of dual-task training, 30 minutes for each, are effective in improving patients' level of balance. The researchers used simple and clear language, fortified with pictures and videos, to be clear for the patients and their caregivers. Equipment needed during sessions includes a chair, a watch, a thermometer, a glucometer, a sphygmomanometer, and a stethoscope. Before starting any session, patients were advised to empty their bowels and bladder. Sessions started with 3-5 minute warm-up exercises, then the needed training with two sets of ten repetitions, and finally 3-5 minute cool-down exercises.

The theoretical sessions explained the anatomy, physiology, and pathophysiology of the brain, as well as risk factors, causes, complications, and warning signs of stroke. The practical parts included different types of dual-task training (Single-Task Balance Exercises, Cognitive-Motor Dual-Task Balance Exercises, Motor-Motor Dual-Task Balance Exercises, and Imitated Activities of Daily Living) for the dual-task training group. For the physiotherapy group, there are different physiotherapy exercises for the upper and lower extremities**.** For the combined therapy group, the training included different types of dual-task training and physiotherapy for the upper and lower extremities.

All patients were encouraged to follow the training program religiously throughout the week between sessions with the help of their caregivers to get the best results from it. The researchers provided each patient with a booklet they developed in simple Arabic language with the guidance of **(Hugues, 2017; Hugues et al., 2017; Uzunkulaoğlu et al., 2019; Yoon-Hee et al., 2020)** to explain training to be implemented at times outside of sessions, with the needed instructions to be followed during implementation. All patients throughout the study received routine nursing care in addition to the intervention, either physiotherapy, dual-task training, or combined therapy for six weeks.

3. Evaluation phase:

After completion of the intervention phase; the researchers evaluated the effects of different intervention methods on balance and the risk of falling. The evaluation was implemented once after completing the program using tools (II, III, and IV) for all patients.

Statistical analysis:

The statistical analysis was performed using the SPSS program version 23. Numbers, frequencies, and mean standard deviation were used to test descriptive data. The comparisons were determined using the Fisherman test and Chi-square according to categories of data. The statistical significance level was set at p 0.05.

Results

Table 1, shows no significance in the demographic characteristics and clinical history of patients with stroke in all the studied groups. The mean age is (57.2 ±8.0, 58.1 ±7.8, and 56.0 ±7.6), respectively, in the physiotherapy, dual-task training, and combined therapy groups. Males make up 87.1%, 84.3%, and 90.0% of patients; 70.0%, 60.0%, and 65.7% of the population are illiterate, and 57.1%, 52.9%, and 51.4% of the patients have insufficient income. The mean BMI in kg/m2 is (21.4 ±2.2, 21.8 ±1.9, and 21.7 ±2.2). Ischemic stroke is the main type, as it represents 54.3%, 42.9%, and 51.4% of patients. The dominant affected side is the left by (57.1%, 50.0%, and 40.0%) of patients. The major represented medical history among all groups was hypertension in 22.9%, 11.4%, and 21.4% of patients, followed by diabetes mellitus in 12.9%, 11.4%, and 12.9% of patients, respectively.

Table 2, represents no statistically significant difference in all categories of balance level among the studied group at the pre-intervention phase, but the intervention shows a significant difference with $p<0.05$. The static, dynamic, and total PASS score mean levels are higher among the combined therapy group. The risk of fall means was decreased with a highly significant difference in the combined therapy group to be 7.2 ±3.6 compared with 11.2 ±3.9, and 8.7 ±4.1 in the physiotherapy and dual-task training groups, respectively, as $P<0.001$. Timed Up and Go scores were decreased with a highly significant difference in the combined therapy group at 10.2 ±5.0 compared with 13.7 ±5.8, and 11.8 ±5.5 in the physiotherapy and dual-task training groups, respectively, $P<0.001$.

Figure 1, illustrates a statistically significant difference in the post-intervention phase with $p<0.05$. A high level of balance is present in 44.3% of the combined therapy group, followed by 40% in the dual-task training group, and 28.6% in the physiotherapy group.

Figure 2, represents a statistically significant difference in the post-intervention phase with $p<0.001$. The low risk of fall is present in 81.4% of the combined therapy group, followed by 67.1% in the dual-task training group, and 52.9% in the physiotherapy group.

Figure 3, illustrates a statistically significant difference at the post-intervention phase with $p=0.010$. Time Up and Go is completely independent in 64.3% of the combined therapy group, followed by 58.6% of the dual-task training group, and 35.7% of the physiotherapy group.

Table 3, revealed no statistically significant association between the demographic characteristics of patients with PASS scores at the pre-intervention phase.

Table 4, showed no statistically significant association between the demographic characteristics of patients with PASS scores among the studied groups at the post-intervention phase; except in the relationship between residence and

patients in the physiotherapy group; where 77.8% of patients living in rural areas had moderate PASS scores in the physiotherapy group.

In **Table 5**, no statistically significant association was revealed between the demographic characteristics of patients with Time Up and Go Score among the studied groups in the pre-intervention phase.

Table 6, showed no statistically significant association between the demographic characteristics of patients with Time Up and Go scores among the studied groups in the post-intervention phase**.**

Table 1. Frequency and percentage distribution of the demographic characteristics and clinical history in the studied groups (n=210)

Demographic characteristics and clinical history	Physiotherapy group (n=70)		Dual -task group (n=70)		Combined therapy group (n=70)		p
	n	%	n	%	n	%	
Age (years)							
< 50	18	25.7	14	20.0	21	30.0	X^2=3.361, P=0.499
50 – 60	24	34.3	22	31.4	25	35.7	F=1.217, P=0.298
> 60	28	40.0	34	48.6	24	34.3	
Mean ±SD	57.2 ±8.0		58.1 ±7.8		56.0 ±7.6		
Gender							
Female	9	12.9	11	15.7	7	10.0	X^2=1.020, P=0.600
Male	61	87.1	59	84.3	63	90.0	
Educational Level							
Illiterate	49	70.0	42	60.0	46	65.7	X^2=1.566, P=0.814
Basic	7	10.0	9	12.9	8	11.4	
Above	14	20.0	19	27.1	16	22.9	
Residence							
Urban	28	40.0	35	50.0	39	55.7	X^2=3.546, P=0.169
Rural	42	60.0	35	50.0	31	44.3	
Income							
Sufficient	30	42.9	33	47.1	34	48.6	X^2=0.498, P=0.779
Insufficient	40	57.1	37	52.9	36	51.4	
Currently Smokers	4	5.7	4	5.7	3	4.3	X^2=0.192, P=0.909
BMI (kg/m^2) (Mean ±SD)	21.4 ±2.2		21.8 ±1.9		21.7 ±2.2		F=0.971, P=0.380
Stroke type							
Ischemic	38	54.3	30	42.9	36	51.4	X^2=1.981, P=0.371
Hemorrhagic	32	45.7	40	57.1	34	48.6	
Affected Side							
Left	40	57.1	35	50.0	28	40.0	X^2=4.154, P=0.125
Right	30	42.9	35	50.0	42	60.0	
Post-Stroke Duration (Days) (Mean ±SD)	7.0 ±2.8		6.5 ±3.9		7.8 ±2.7		F=0.471, P=0.625
Admission date (Mean ±SD)	7.1 ±5.0		6.8 ±4.7		7.3 ±4.8		F=0.182, P=0.833
Medical history							
Pneumonia	3	4.3	5	7.1	4	5.7	X^2=0.530, P=0.767
Diabetes mellitus	9	12.9	8	11.4	9	12.9	X^2=0.088, P=0.957
Hypertension	16	22.9	15	21.4	15	21.4	X^2=0.056, P=0.973
Cardiac disease	3	4.3	5	7.1	5	7.1	X^2=0.656, P=0.720
Aphasia	5	7.1	4	5.7	4	5.7	X^2=0.164, P=0.921
Family history of stroke	3	4.3	3	4.3	2	2.9	X^2=0.260, P=0.878

Table 2. Mean balance level in patients with stroke among the studied groups (n=210)

Balance level	Physiotherapy group (n=70)	Dual-task group (n=70)	Combined therapy group (n=70)	Test	
	Mean ±SD	Mean ±SD	Mean ±SD	f	p
Pre-intervention					
Postural Assessment Scale (PASS) Score					
Static PASS Score	4.3 ±2.5	4.4 ±2.6	4.1 ±2.7	0.261	0.771
Dynamic PASS Score	5.3 ±3.1	5.4 ±3.2	5.0 ±3.3	0.274	0.761
Total PASS Score	9.6 ±5.6	9.9 ±5.7	9.1 ±6.0	0.270	0.764
Risk of fall score	15.3 ±2.1	15.2 ±2.1	14.9 ±2.1	0.701	0.497
Timed Up and Go (TUG) Score	23.1 ±10.7	22.9 ±11.5	26.5 ±11.9	2.291	0.104
Post-intervention					
Postural Assessment Scale (PASS) Score					
Static PASS Score	5.6 ±2.6	6.6 ±2.8	7.1 ±3.0	5.273	0.006
Dynamic PASS Score	6.7 ±4.1	7.7 ±3.3	8.4 ±3.2	3.943	0.021
Total PASS Score	12.3 ±4.7	14.3 ±4.0	15.5 ±4.5	9.295	<0.001
Risk of fall score	11.2 ±3.9	8.7 ±4.1	7.2 ±3.6	19.433	<0.001
Timed Up and Go (TUG) Score	13.7 ±5.8	11.8 ±5.5	10.2 ±5.0	7.253	<0.001

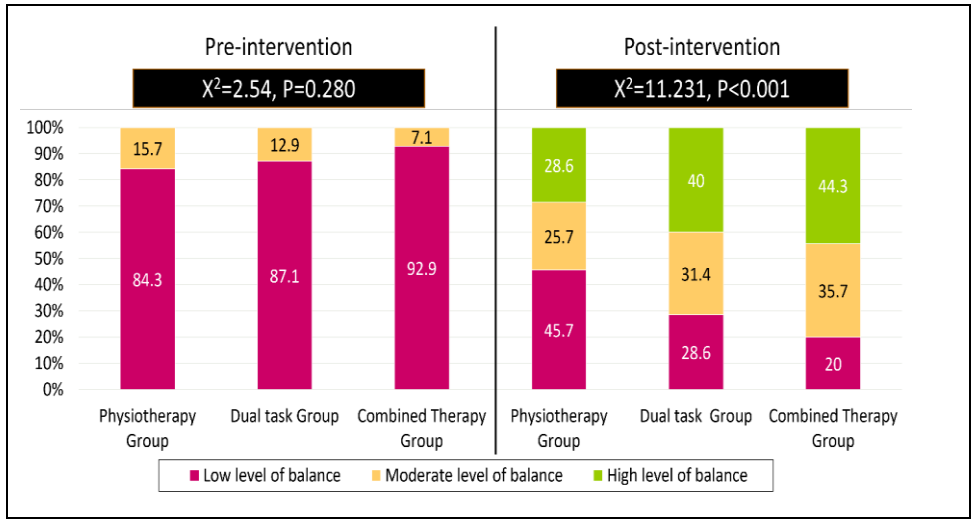

Figure 1. Distribution of Total PASS Score among groups pre- and post-intervention

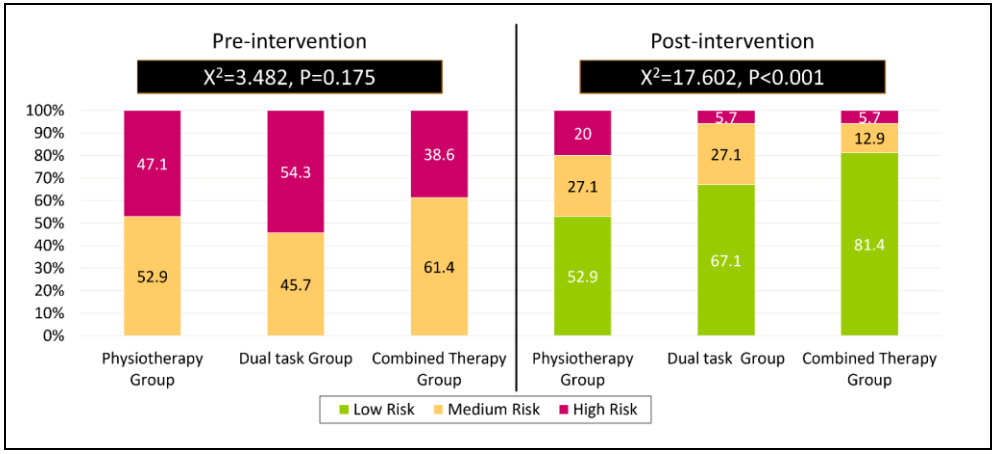

Figure 2. Distribution of Risk of fall Score among groups pre- and post-intervention

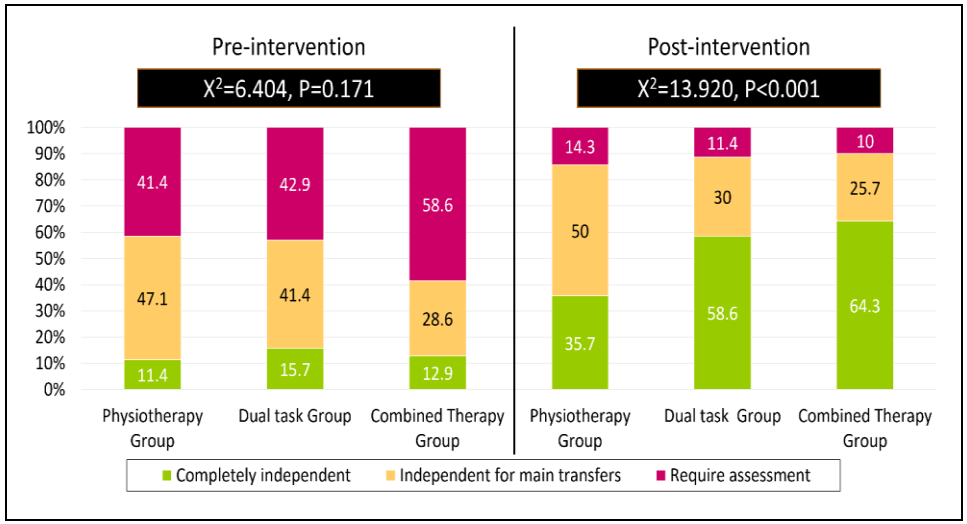

Figure 3. Distribution of Total TUG Score among groups pre- and post-intervention

Table 3. Association between the demographic characteristics of patient with PASS score among the studied groups pre-intervention

Demographic characteristics	Physiotherapy group (n=70)				Dual-task group (n=70)				Combined therapy group (n=70)			
	Low		Moderate		Low		Moderate		Low		Moderate	
	n	%	n	%	n	%	n	%	n	%	n	%
Age (years)												
< 50	17	28.8	1	9.1	14	23.0	0	0.0	21	32.3	0	0.0
50 – 60	19	32.2	5	45.5	18	29.5	4	44.4	23	35.4	2	40.0
> 60	23	39.0	5	45.5	29	47.5	5	55.6	21	32.3	3	60.0
Chi-Square	X^2=1.974		P=0.373		X^2=2.726		P=0.256		X^2=2.682		P=0.262	
Gender												
Female	52	88.1	9	81.8	50	82.0	9	100.0	58	89.2	5	100.0
Male	7	11.9	2	18.2	11	18.0	0	0.0	7	10.8	0	0.0
Chi-Square	X^2=0.330		P=0.566		X^2=1.926		P=0.165		X^2=0.598		P=0.439	
Educational Level												
Illiterate	42	71.2	7	63.6	36	59.0	6	66.7	41	63.1	5	100.0
Basic	6	10.2	1	9.1	9	14.8	0	0.0	8	12.3	0	0.0
Above	11	18.6	3	27.3	16	26.2	3	33.3	16	24.6	0	0.0
Chi-Square	X^2=0.431		P=0.806		X^2=1.550		P=0.461		X^2=2.809		P=0.245	
Residence												
Urban	23	39.0	5	45.5	32	52.5	3	33.3	34	52.3	5	100.0
Rural	36	61.0	6	54.5	29	47.5	6	66.7	31	47.7	0	0.0
Chi-Square	X^2=0.162		P=0.688		X^2=1.148		P=0.284		X^2=4.280		P=0.039	
Income												
Sufficient	25	42.4	5	45.5	30	49.2	3	33.3	30	46.2	4	80.0
Insufficient	34	57.6	6	54.5	31	50.8	6	66.7	35	53.8	1	20.0
Chi-Square	X^2=0.036		P=0.850		X^2=0.790		P=0.374		X^2=2.129		P=0.145	

Table 4. Association between the demographic characteristics of patient with PASS score among the studied groups post-intervention

Demographic characteristics	Physiotherapy group (n=70)						Dual-task group (n=70)						Combined therapy group (n=70)					
	Low		Moderate		High		Low		Moderate		High		Low		Moderate		High	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age (years)																		
< 50	7	21.9	5	27.8	6	30.0	7	35.0	3	13.6	4	14.3	3	21.4	8	32.0	10	32.3
50 – 60	10	31.3	10	55.6	4	20.0	2	10.0	10	45.5	10	35.7	7	50.0	8	32.0	10	32.3
> 60	15	46.9	3	16.7	10	50.0	11	55.0	9	40.9	14	50.0	4	28.6	9	36.0	11	35.5
Chi-Square	X^2=7.336		P=0.119				X^2=8.063		P=0.089				X^2=1.597		P=0.809			
Gender																		
Female	28	87.5	16	88.9	17	85.0	17	85.0	19	86.4	23	82.1	14	100	24	96.0	25	80.6
Male	4	12.5	2	11.1	3	15.0	3	15.0	3	13.6	5	17.9	0	0.0	1	4.0	6	19.4
Chi-Square	X2=0.135		P=0.935				X2=0.176		P=0.916				X2=5.570		P=0.062			
Educational Level																		
Illiterate	20	62.5	13	72.2	16	80.0	13	65.0	13	59.1	16	57.1	8	57.1	19	76.0	19	61.3
Basic	3	9.4	3	16.7	1	5.0	1	5.0	2	9.1	6	21.4	2	14.3	2	8.0	4	12.9
Above	9	28.1	2	11.1	3	15.0	6	30.0	7	31.8	6	21.4	4	28.6	4	16.0	8	25.8
Chi-Square	X^2=3.885		P=0.422				X^2=3.502		P=0.478				X^2=1.900		P=0.754			
Residence																		
Urban	12	37.5	4	22.2	12	60.0	12	60.0	9	40.9	14	50.0	6	42.9	17	68.0	16	51.6
Rural	20	62.5	14	77.8	8	40.0	8	40.0	13	59.1	14	50.0	8	57.1	8	32.0	15	48.4
Chi-Square	X^2=5.787		P=0.055*				X^2=1.527		P=0.466				X^2=2.679		P=0.262			
Income																		
Sufficient	13	40.6	5	27.8	12	60.0	10	50.0	9	40.9	14	50.0	4	28.6	15	60.0	15	48.4
Insufficient	19	59.4	13	72.2	8	40.0	10	50.0	13	59.1	14	50.0	10	71.4	10	40.0	16	51.6
Chi-Square	X^2=4.136		P=0.126				X^2=0.500		P=0.779				X^2=3.549		P=0.170			

Table 5. Association between the demographic characteristics of patient with TUG score among the studied groups pre-intervention

Demographic characteristics	Physiotherapy group (n=70)						Dual-task group (n=70)						Combined therapy group (n=70)					
	Require Assessment		Independent for main transfers		Completely independent		Require Assessment		Independent for main transfers		Completely independent		Require Assessment		Independent for main transfers		Completely independent	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age (years)																		
< 50	2	25.0	7	21.2	9	31.0	3	27.3	5	17.2	6	20.0	4	44.4	3	15.0	14	34.1
50 – 60	3	37.5	8	24.2	13	44.8	3	27.3	7	24.1	12	40.0	4	44.4	9	45.0	12	29.3
> 60	3	37.5	18	54.5	7	24.1	5	45.5	17	58.6	12	40.0	1	11.1	8	40.0	15	36.6
Chi-Square	**X^2=6.098**		**P=0.192**				**X^2=2.732**		**P=0.604**				**X^2=5.176**		**P=0.270**			
Gender																		
Female	7	87.5	27	81.8	27	93.1	9	81.8	23	79.3	27	90.0	8	88.9	19	95.0	36	87.8
Male	1	12.5	6	18.2	2	6.9	2	18.2	6	20.7	3	10.0	1	11.1	1	5.0	5	12.2
Chi-Square	**X^2=1.756**		**P=0.416**				**X^2=1.332**		**P=0.514**				**X^2=0.787**		**P=0.675**			
Educational Level																		
Illiterate	6	75.0	22	66.7	21	72.4	6	54.5	18	62.1	18	60.0	5	55.6	14	70.0	27	65.9
Basic	1	12.5	1	3.0	5	17.2	1	9.1	2	6.9	6	20.0	0	0.0	3	15.0	5	12.2
Above	1	12.5	10	30.3	3	10.3	4	36.4	9	31.0	6	20.0	4	44.4	3	15.0	9	22.0
Chi-Square	**X^2=6.607**		**P=0.158**				**X^2=3.259**		**P=0.515**				**X^2=3.860**		**P=0.425**			
Residence																		
Urban	2	25.0	12	36.4	14	48.3	5	45.5	16	55.2	14	46.7	5	55.6	12	60.0	22	53.7
Rural	6	75.0	21	63.6	15	51.7	6	54.5	13	44.8	16	53.3	4	44.4	8	40.0	19	46.3
Chi-Square	**X^2=1.759**		**P=0.415**				**X^2=0.535**		**P=0.765**				**X^2=0.219**		**P=0.896**			
Income																		
Sufficient	3	37.5	13	39.4	14	48.3	5	45.5	14	48.3	14	46.7	4	44.4	11	55.0	19	46.3
Insufficient	5	62.5	20	60.6	15	51.7	6	54.5	15	51.7	16	53.3	5	55.6	9	45.0	22	53.7
Chi-Square	**X^2=0.603**		**P=0.740**				**X^2=0.030**		**P=0.985**				**X^2=0.474**		**P=0.789**			

Table 6. Association between the demographic characteristics of patient with TUG score among the studied groups post-intervention

Demographic characteristics	Physiotherapy group (n=70)						Dual-task group (n=70)						Combined therapy group (n=70)					
	Require Assessment		Independent for main transfers		Completely independent		Require Assessment		Independent for main transfers		Completely independent		Require Assessment		Independent for main transfers		Completely independent	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Age (years)																		
< 50	4	16.0	9	25.7	5	50.0	10	24.4	1	4.8	3	37.5	12	26.7	6	33.3	3	42.9
50 – 60	10	40.0	11	31.4	3	30.0	11	26.8	8	38.1	3	37.5	16	35.6	8	44.4	1	14.3
> 60	11	44.0	15	42.9	2	20.0	20	48.8	12	57.1	2	25.0	17	37.8	4	22.2	3	42.9
Chi-Square	X^2=4.758		P=0.313				X^2=5.958		P=0.202				X^2=2.978		P=0.562			
Gender																		
Female	23	92.0	30	85.7	8	80.0	32	78.0	20	95.2	7	87.5	40	88.9	17	94.4	6	85.7
Male	2	8.0	5	14.3	2	20.0	9	22.0	1	4.8	1	12.5	5	11.1	1	5.6	1	14.3
Chi-Square	X^2=1.046		P=0.593				X^2=3.168		P=0.205				X^2=0.600		P=0.741			
Educational Level																		
Illiterate	19	76.0	23	65.7	7	70.0	24	58.5	14	66.7	4	50.0	29	64.4	13	72.2	4	57.1
Basic	2	8.0	4	11.4	1	10.0	3	7.3	3	14.3	3	37.5	5	11.1	1	5.6	2	28.6
Above	4	16.0	8	22.9	2	20.0	14	34.1	4	19.0	1	12.5	11	24.4	4	22.2	1	14.3
Chi-Square	X^2=0.735		P=0.947				X^2=6.974		P=0.137				X^2=2.830		P=0.587			
Residence																		
Urban	7	28.0	15	42.9	6	60.0	21	51.2	12	57.1	2	25.0	25	55.6	10	55.6	4	57.1
Rural	18	72.0	20	57.1	4	40.0	20	48.8	9	42.9	6	75.0	20	44.4	8	44.4	3	42.9
Chi-Square	X^2=3.286		P=0.193				X^2=2.453		P=0.293				X^2=0.006		P=0.997			
Income																		
Sufficient	9	36.0	15	42.9	6	60.0	19	46.3	12	57.1	2	25.0	22	48.9	9	50.0	3	42.9
Insufficient	16	64.0	20	57.1	4	40.0	22	53.7	9	42.9	6	75.0	23	51.1	9	50.0	4	57.1
Chi-Square	X^2=1.680		P=0.432				X^2=2.427		P=0.297				X^2=0.108		P=0.947			

Discussion

Stroke is a serious public health issue in developing countries, and the prevalence of stroke in Egyptians was much greater than in other Arab countries **(Khedr et al., 2018**). It is also a cause of long-term disability, such as balance and perceptual problems, aphasia, paralysis of body parts, depression, and other cognitive function changes **(Mozaffarian et al., 2016)**. The purpose of the present study was to compare the effects of physiotherapy, dual-task training, and combined therapy on balance performance in stroke patients.

Demographic characteristics of the present study revealed no significant differences between all the studied groups, with age being the predominant factor; the majority of patients were in their sixth decade of life, and more than half were male. This could be related to the high incidence of the disease with ageing as a result of arteriosclerotic changes occurring in the brain, and males are projected to have higher risk factors than females. This finding is consistent with the studies done by **Qin et al. (2020**) and **Farghaly et al. (2013)**; as they found that the mean age was high, and the incidence of stroke was higher in males. Also, **Dabilgou et al. (2020)** and **Yi et al. (2020)** found that the majority of the studied patients were male. However, these findings are contradicted by **Zhang et al. (2017) and Guan et al. (2017),** who identified a high prevalence of stroke among adults in their fourth decade of life. Also**, Baye et al. (2020)** and **Mansour et al. (2020)** found that more than half of the patients were female. In addition, **Williams and Hopper (2015)** stated that women have additional risks of stroke due to hormone changes in pregnancy and menopause.

Concerning educational level, the results of the present study showed that almost all of the participants in all groups were illiterate, with the majority being from rural areas. This could be related to the low dissemination of education throughout most rural areas of Egypt, which leads to the incidence of many diseases as a result of decreased personal awareness. This finding is in line with **Yi et al. (2020),** who found that stroke is more prevalent in individuals with a primary school level of education. Also, **Zhaoqing et al. (2013)** stated that the incidence of stroke in rural areas was higher than that found in urban areas.

In the present study, almost all of the patients reported having insufficient income to cover the cost of treatment. The researchers think that for individuals with chronic diseases, healthcare costs could account for a significant portion of their monthly expenses, as cost and income are interrelated factors. Also, cost is a crucial issue in patient compliance, especially for patients with chronic diseases, as the treatment period could be life-long. In the same line, **Vardanjani et al. (2013)** found that more than half of the studied patients were of average economic status.

In this study, the majority of studied patients had hemorrhagic strokes as the dominant type, with the majority having their right side affected. This could be related to the presence of

hypertension in around one-quarter of the patients as a co-factor for the occurrence of stroke, which in turn induces brain hemorrhage. This is going in the same line as **Obembe et al. (2014),** who reported that hemorrhagic types of strokes were nearly three times more common than ischemic strokes, and about two-thirds of patients had right-sided paresis. This study's findings, however, contradicted those of **Paik and Wolff (2017) and Yi et al. (2020)**, who reported that ischemic stroke accounted for the majority of their studies. Also, **Yu and Jeon (2015)** confirmed that more than half of the studied groups were affected on the left side of the body.

According to the family history of stroke, it was noticed that the minority of the studied patients had a family history of stroke, which could be related to the high availability of modified risk factors, inducing the occurrence of the disease without the need for family history. This is in line with **Fekadu et al. (2019),** who found that only 2 of the study sample had a family history of stroke. On the other hand, **Boehme et al. (2017)** revealed that a family history of stroke increases stroke risk by 30% and younger stroke patients are more likely to have a first-degree relative with stroke.

The current study showed statistically significant post-intervention improvement in the static and dynamic balance levels in the studied patients. The static, dynamic, and total PASS score mean levels were higher among the combined therapy group, with a low risk of fall. This could be interpreted as the use of combined therapy providing a double effect for patients as it is done for the double amount of time spent practicing different types of training, leading to rapid progress with better outcomes.

This finding comes in line with that of **De Luca et al. (2020),** who reported that the experimental group showed a statistical improvement in their balance score that was maintained at follow-up. Similarly, **Sim and Oh (2015)** reported improved static and dynamic balance abilities with significant differences after training with dual-task training compared to single-task training. Also, **Jung et al. (2012)** confirmed that balance was significantly higher in the experimental group, with a significant increase after 3 weeks. Moreover, **Cortés-Pérez et al. (2020)** found that the patients in the intervention group showed a larger improvement in their risk of falls. But, **Meester et al. (2019)** found that balance confidence improved relatively in the control group with a statistically significant difference.

Concerning Timed Up and Go scores, there was a statistically significant difference in the total score among the studied groups at the post-intervention phase. This could be due to the clarity and simplicity of the planned exercises that are based on the patient's needs, with the priority being to resume normal walking habits. The findings of the current study were congruent with those of **Jayabalan and Prakash (2014),** who reported a

significant improvement in TUG from the beginning of the intervention to discharge.

Conclusion

There was a statistically significant post-intervention improvement in postural assessment scale scores, risk of fall scores, and timed up and go scores in stroke patients in the combined therapy group.

Recommendation:

The current study recommended a compulsory, tailored combined therapy training program for each patient to optimize care outcomes. Combined therapy should being a basic cornerstone of a rehabilitation strategy for stroke patients by nurses to improve balance performance and reduce the risk of fall. Also, the availability of booklets for patients and nurses on the types and techniques of dual-task training and physiotherapy, in addition to methods of assessment and evaluation of their outcomes on patients.

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