Effectiveness of Regular Resistance Exercise on Muscle Strength of Patients with Stroke

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Abstract
Background: Stroke is the third-ranking cause of death, with an overall mortality rate of 18 % to 37 %. There are approximately two million people surviving strokes that need assistance with activities of daily living. Stroke is the second leading cause of disability, after dementia. A disability may include loss of vision and/or speech, muscle weakness, and confusion. Methods: The present study was carried out by using a quasi-experimental design with two groups and consisted of four assessments (Pre-resistance exercise test, and three tests after implementation of regular resistance exercise) for experimental and comparison groups, in the period from 13th March to 10th December, 2022, with objective of assessing regular resistance exercise effectiveness in improving muscle strength among patient with stroke at Middle Euphrates Neuroscience Center. A total of (82) stroke patients were divided into experimental and comparison groups, which were included by non-probability purposive sampling methods. Results: After conducting regular resistance exercise (post-tests) revealed a significant improve muscle strength and enhance endurance by increasing the delivery of oxygen and nutrients to tissues and helping the cardiovascular system and musculoskeletal system work more and more efficiently and when heart and lung function improves, which increases energy for daily activity. Therefore, muscle performance will be increased. Conclusion: the study concluded application of the regular resistance exercise for at least six weeks is an effective approach to improving the muscle strength of patients with stroke compared to the comparison group. Recommendations: The study recommended further studies to prove the efficacy of alternative nursing rehabilitation techniques in minimizing stroke-related problems and nurses recommended to use the regular resistance exercises for stroke patients who suffer from muscle weakness.
Keywords: Regular Resistance Exercise, Muscle Strength, Stroke.

1. Introduction

Cerebrovascular diseases are an umbrella term that refers to a functional anomaly of the central nervous system (CNS) that occurs when the normal blood flow to the brain is disturbed. Cerebrovascular disorders are most often associated with stroke and traumatic brain injury. Stroke is the most common cerebrovascular disorder in the United States, and it is the third leading cause of mortality in the country, after heart disease and cancer[1]. One in every five persons who have a stroke dies within the first 30 days, and more than 40% of those who survive are left functionally dependent at six months. In most cases, these individuals have an atherosclerotic disease as well as conventional vascular risk factors such as hypertension, diabetes, dyslipidemia, obesity, and physical inactivity, which are also present in patients with coronary heart disease (CHD), [2]. Stroke has been depicted as a deadly illness with high death and recidivism rates, as well as the potential for life-ending consequences. Among adults, the sequelae of stroke are considered the most common causes of disability [3]. 80% of first-time stroke patients have reduced stability, which is linked to poor recovery of daily living activities and mobility as well as a higher risk of falling. Stiffness and difficulty transferring weight to the afflicted side while sitting or standing are all signs of stroke-related asymmetry in the trunk and pelvis. They also have a lower degree of trunk performance compared to healthy people. Disruption of the patient's ability to maintain a stable/dynamic equilibrium and to engage in fundamental physical activities diminishes their quality of life [4]. The loss of strength after a stroke is a common and important impairment. The average strength of the affected upper and lower limb in people who have had a significant stroke ranges from 30 to 50% of age-matched controls. This lack of strength may have a significant impact on one's ability to engage in previously possible activities. Therefore, it is important to know which interventions are effective for improving strength after a stroke. In persons without disabilities, progressive resistance exercise may be used to increase strength. In those who have had a stroke, it can be used to increase strength [5].

Objectives of the study

1. To evaluate muscle strength of upper and

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lower extremities using Muscle Strength Testing.

2. To determine the effectiveness of regular resistance exercise on muscle strength by comparing the muscle strength before and after using regular resistance exercise.
3. To determine the effect of demographics on the effectiveness of the regular resistance exercise.

2. Methodology

A quasi-experimental design was implemented in the present study by which the patients are assigned into two groups (experimental and comparison groups) to determine the effectiveness of regular resistance exercise on muscle strength of patients with stroke. The current study consists of four assessments (Pre-resistance exercise test, and three tests after implantation of regular resistance exercise) for experimental and comparison groups. The study has been carried out during the period from 13th March to 10th December, 2022. The study is conducted in Al-Najaf City/ Al-Najaf Al-Ashraf Health Directorate at Middle Euphrates Neuroscience Center. A non-probability (homogenous purposive sample) technique selected 90 patients are included in the present study. All patients are medically diagnosed with stroke disease, those who visit the Middle Euphrates Neuroscience Center. The sample is distributed in two groups; (42) patients as the experimental group are exposed to the regular resistance exercise, and the other (38) patients are not exposed to the resistance training exercise as the comparison group. The researcher uses the following factors to determine the adequate sample size through the G power program in the present study. Can be shown clearly in (figure 1); power (99%), significant 0.01, and middle effect size (0.32). Therefore, the sample size is equal to (90).

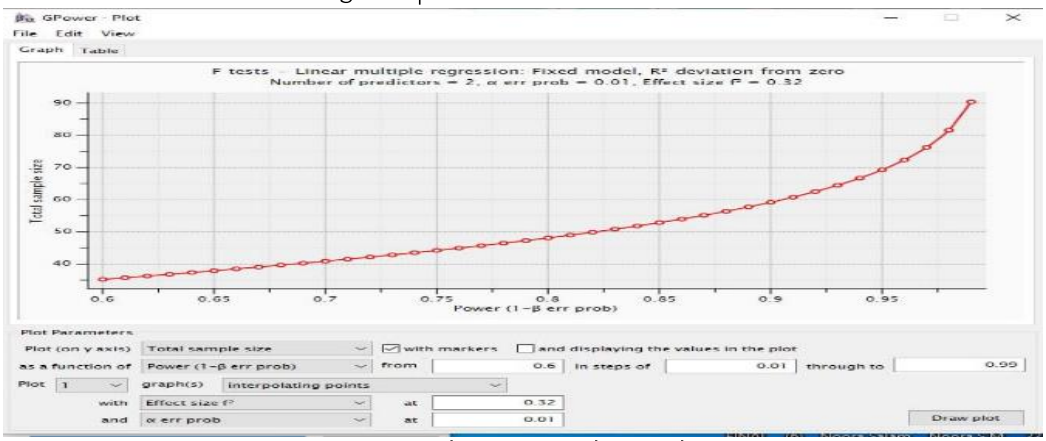

Figure 1: Appropriate sample size according to the G-power program

All participants underwent the same tests before starting the program's implementation, after a proper explanation of the test procedure and they were fully aware of the study's goals and procedures, agreed to participate in the current study, and signed written informed consent at the beginning of this study that was carried out between from 13th March to 10th December, 2022, according to the ethical principles and guidelines for the protection of human subjects and approved by the ethics committee of College of Nursing, University of Babylon. The interventions were compared to the comparison group, such as usual care or no-exercise care, consisting of medical care. The comparison group continued their normal daily activities and did not receive social or other activities specifically for this study. In order to achieve the present study objectives, a regular resistance exercise was constructed and a questionnaire has been created and developed as an instrument for data collection. The study instrument consists of the following Part I: Socio-Demographic Characteristics: The first part of the questionnaire involved patients' socio-demographic data obtained from the patients with muscle weakness after stroke using an interview. This part included (6) items, which included age, gender, Residency, level of education, marital status, and Occupational status before the stroke. Part II: Clinical Characteristics: The second part of the questionnaire this part is concerned with the collection of clinical characteristics. Part III: Muscle Strength Testing: This part of the questionnaire focuses on measuring muscle strength, in which a special scale consisting of six degrees was used.

The face validity of the nursing intervention program and the study instrument is determined through the use of a panel of (14) experts. After the data are prepared for statistical analysis, the descriptive and inferential statistics employ for data analysis using the Statistical Package of the Social Sciences (SPSS), version (IBM 22) as follows:

Descriptive statistics

1. Frequency and percentage tables.
2. Mean and standard deviation.
3. Bar chart and line

Inferential statistics

1. Mann-Whitney U test, to test the difference between two independent groups.
2. Pearson chi-square, to determine the impact of the study sample demographic and clinical data on the effectiveness of the study program.
3. Friedman Test, to investigate the difference between the muscle strength at different periods of measurement.

3. Results

Table (1) Study Sample Demographic Data with a Comparison Significance:				
Demographic Data	Rating and Intervals	Statistics	Groups	
			Experimental Group	Comparison Group
Age	<= 29	Freq.	0	1
		%	0.0%	2.6%
	30 - 39	Freq.	4	1
		%	9.3%	2.6%
	40 - 49	Freq.	4	4
		%	9.3%	10.3%
	50 - 59	Freq.	15	8
		%	34.9%	20.5%
	60+	Freq.	20	25
		%	46.5%	64.0%
Gender	Male	Freq.	28	24
		%	65.1%	61.5%
	Female	Freq.	15	15
		%	34.9%	38.5%
Residency	Rural	Freq.	12	15
		%	27.9%	38.5%
	Urban	Freq.	31	24
		%	72.1%	61.5%
Marital Status	Single	Freq.	2	0
		%	4.7%	0.0%
	Married	Freq.	33	30
		%	76.7%	76.9%
	Widowed/widow	Freq.	8	9
		%	18.6%	23.1%
Occupational status before the stroke	Governmental employee	Freq.	8	2
		%	18.6%	5.1%
	Private or self employed	Freq.	6	6
		%	14.0%	15.4%
	Retired	Freq.	6	8
		%	14.0%	20.5%
	Housewife	Freq.	8	11
		%	18.6%	28.2%
	Jobless	Freq.	15	12
		%	34.8%	30.8%

Table (1) show the statistical distribution of the study sample according to their socio-demographic data. Regarding the Experimental group, the study result indicates that the majority of the Experimental group participants are 60 and more years old (46.5%), male (65.1%), urban residents (72.1%), married (76.7%), and high percentage of study group are jobless (34.9%) in related to their occupational status before the stroke.

While the comparison group, the study results indicate that the majority of participants are 60 and more years old (64.1%), male (61.5%), urban residents (61.5%), married (76.9%), and there jobless (30.8%) in related to the occupational status before a stroke.

Table (2) Assessment of Muscle Strength at the Pre-test for both Experimental and Comparison Groups:				
Muscle Strength Score	Muscle strength assessment	Statistics	Groups	
			Experimental group	Comparison group
No Palpable or visible contraction	No muscle contraction	Freq.	0	0
		%	0.0%	0.0%
Palpable or visible contraction	Trace Activity	Freq.	21	14
		%	48.8%	35.9%
Active movement, gravity eliminated	Poor Muscle Contraction	Freq.	21	22
		%	48.8%	56.4%
Active movement against gravity	Fair Muscle Contraction	Freq.	1	3
		%	2.3%	7.7%
Active movement against some resistance	Good Muscle Contraction	Freq.	0	0
		%	0.0%	0.0%
Active movement against full resistance	Normal Muscle Contraction	Freq.	0	0
		%	0.0%	0.0%
Total		Freq.	43	39
		%	100.0%	100.0%

Table (2): shows that the score of muscle strength for experimental and comparison groups at pre-test. The study result indicates that the patients in experimental group distributed between palpable or visible contraction (Trace Activity) and Active movement, gravity eliminated (Poor Muscle Contraction) 48.8% according to muscle strength testing.
While the majority of comparison group have active movement, gravity eliminated (Poor Muscle Contraction) 56.4% according to muscle strength testing.

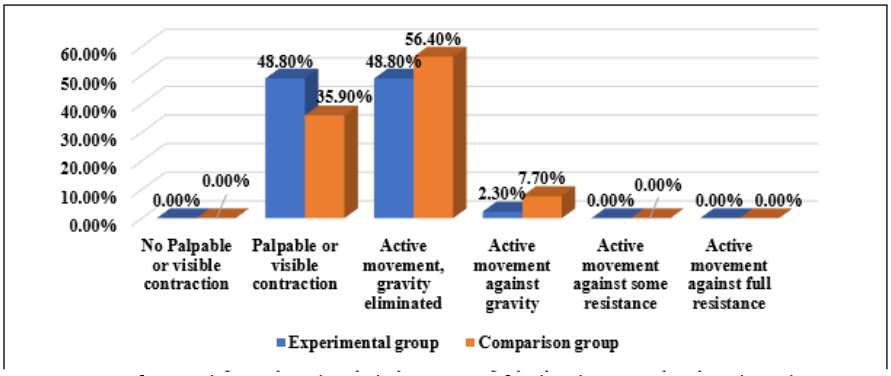

Figure (2) Assessment of Muscle Strength at the Pre-test for both Experimental and Comparison Groups

Table (3) Assessment of Muscle Strength at the Post-test 1 for both Experimental and Comparison Groups:				
Muscle Strength Score	Assessment of muscle strength	Statistics	Groups	
			Experimental group	Comparison group
No Palpable or visible contraction	No muscle contraction	Freq.	0	0
		%	0.0%	0.0%
Palpable or visible contraction	Trace Activity	Freq.	0	20
		%	0.0%	51.3%
Active movement, gravity eliminated	Poor Muscle Contraction	Freq.	15	18
		%	34.9%	46.2%
Active movement against gravity	Fair Muscle Contraction	Freq.	12	1
		%	27.9%	2.6%
Active movement against some resistance	Good Muscle Contraction	Freq.	16	0
		%	37.2%	0.0%
Active movement against full resistance	Normal Muscle Contraction	Freq.	0	0
		%	0.0%	0.0%
Total		Freq.	43	39
		%	100.0%	100.0%

Table (3): this table shows the score of muscle strength for experimental and comparison groups at the post-test 1. The results indicate that a high percentage of study group has active movement against some resistance (Good Muscle Contraction) 37.2% in post-test 1 after receiving a regular resistance exercise.
While the majority of comparison group remain at level one of muscle strength testing (Trace Activity) 51.3%. at post-test 1.

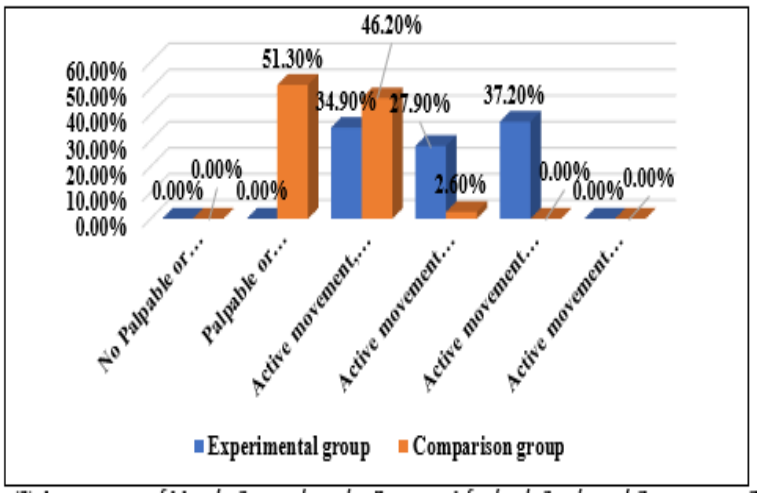

Figure (3) Assessment of Muscle Strength at the Post-test1 for both Study and Comparison Groups

Table (4) Assessment of Muscle Strength at the Post-test 2 for both Experimental and Comparison Groups:				
Muscle Strength Score	Assessment of muscle strength	Statistics	Groups	
			Experimental group	Comparison group
No Palpable or visible contraction	No muscle contraction	Freq.	0	1
		%	0.0%	2.6%
Palpable or visible contraction	Trace Activity	Freq.	0	31
		%	0.0%	79.5%
Active movement, gravity eliminated	Poor Muscle Contraction	Freq.	0	5
		%	0.0%	12.8%
Active movement against gravity	Fair Muscle Contraction	Freq.	11	1
		%	25.6%	2.6%
Active movement against some resistance	Good Muscle Contraction	Freq.	24	1
		%	55.8%	2.6%
Active movement against full resistance	Normal Muscle Contraction	Freq.	8	0
		%	18.6%	0.0%
Total		Freq.	43	39
		%	100.0%	100.0%

Table (4): illustrates the score of muscle strength for experimental and comparison groups at the post-test 2. The results indicate that the most of patients in experimental group have a (Good Muscle Contraction) according to muscle strength testing.

While the majority of the patient in comparison group deteriorated and their muscle strength returned to level one (Trace Activity), the percentage of patients in this group changed from 51.3% at post-test 1 to 79.5% at post-test 2.

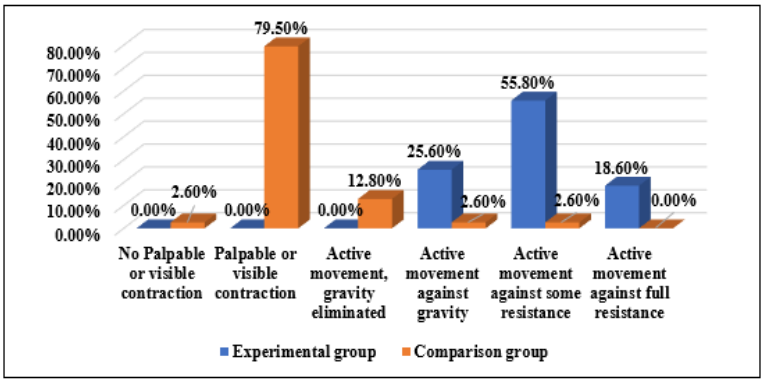

Figure (4) Assessment of Muscle Strength at the Post-test2 for both Study and Comparison Groups

Table (5) Assessment of Muscle Strength at the Post-test 3 for both Experimental and Comparison Groups:				
Muscle Strength Score	Assessment of muscle strength	Statistics	Groups	
			Experimental group	Comparison group
No Palpable or visible contraction	No muscle contraction	Freq.	0	5
		%	0.0%	12.8%
Palpable or visible contraction	Trace Activity	Freq.	0	32
		%	0.0%	82.1%
Active movement, gravity eliminated	Poor Muscle Contraction	Freq.	0	0
		%	0.0%	0.0%
Active movement against gravity	Fair Muscle Contraction	Freq.	0	0
		%	0.0%	0.0%
Active movement against some resistance	Good Muscle Contraction	Freq.	14	1
		%	32.6%	2.6%
Active movement against full resistance	Normal Muscle Contraction	Freq.	29	1
		%	67.4%	2.6%
Total		Freq.	43	39
		%	100.0%	100.0%

Table (5): illustrates the score of muscle strength for experimental and comparison groups at the post-test 3. The study results indicate that the majority of patients in experimental group improve muscle strength and have active movement against full resistance (Normal Muscle Contraction) 67.4% according to muscle strength testing.

While the majority of patient in comparison group remain at level one (Trace Activity) according of muscle strength testing 82.1% and some patients deteriorated to score zero (**No muscle contraction**) at post-test 3.

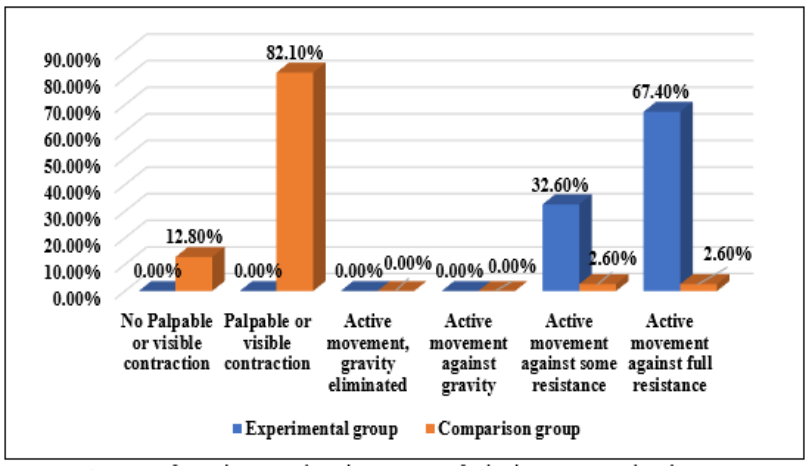

Figure (5) Assessment of Muscle Strength at the Post-test3 for both Experimental and Comparison Groups

Table (6) Comparison of the Experimental and Comparison Groups Participants' Muscle Strength at different Periods of Measurements using the Mann-Whitney Test:						
Periods of Measurements	Groups	N	Mean Rank	Sum of Ranks	Mann-Whitney U	p-value
Pre-test	Experimental group	43	38.50	1655.50	709.5	177 NS
	Comparison group	39	44.81	1747.50		
	Total	82				
Post-test 1	Experimental group	43	57.37	2467.00	156.0	0.001 S
	Comparison group	39	24.00	936.00		
	Total	82				
Post-test 2	Experimental group	43	60.34	2594.50	28.5	0.001 S
	Comparison group	39	20.73	808.50		
	Total	82				
Post-test 3	Experimental group	43	60.17	2587.50	35.5	0.001 S
	Comparison group	39	20.91	815.50		
	Total	82				

Table (6) shows the comparison of the experimental and comparison groups participants' muscle strength at different Periods of Measurements. The study results indicate there is a non-significant differences in muscle strength between experimental and comparison groups at pre-test.

While the results indicate a significant differences between both groups at the different period of measurement (Post-test 1, Post-test 2 and Post-test 3) at p- value less than 0.01.

In addition, to that the difference in mean indicate that an improve in muscle strength of patients in experimental group compared with patients in comparison group as a response to study program.

Table (7) Relationship between the Experimental Group Participants' Muscle Strength and their Demographic Data:			
Demographic Data	Chi-Square Value	df	p-value
Age / Years	3.992	3	.262 NS
Gender	.891	1	.345 NS
Residency	.000	1	1.00 NS
Levels of Education	2.250	5	.814 NS
Marital Status	3.207	2	.201 NS
Occupational Status before the Stroke	5.440	4	.245 NS

Table (7): this table shows there is a non-significant association between an experimental group and their socio-demographic data at a p-value more than 0.05.

4. Discussion of the Results

Exercise is an integral part of the rehabilitation program. It is considered an essential method for treating many medical disorders and chronic diseases, and it can also have a positive effect on the improvement of conditions [6]. Rehabilitation and patient education should be provided because it is a crucial pathway to ensuring that patients can be taught to engage in to resume as much self-management of their stroke disease risks as possible [7]. The current study is conducted to use the regular resistance exercise method as a rehabilitation technique to improve the muscle strength of patients with stroke.

Part One: Discussion for Patients' Socio-Demographic Data

Stroke is becoming a serious health issue in developing countries. It is a disorder that affects millions of individuals around the globe, and its incidence is influenced by patients' socio-

demographic information. The results of the present study indicated that the ages of most of the study members are of advanced age. This confirms that the incidence of stroke disease rises with age and vice versa. [8,9]. They found that patients aged 67 and older are the most commonly vulnerable age group for stroke. In addition, Dehno, et al., (2021) [10]: they have studied the "Unilateral Strength Training of the Less Affected Hand Improves Cortical Excitability and Clinical Outcomes in Patients With Subacute Stroke: A Randomized Controlled Trial" They discovered that the majority of patients are elderly (53 years old and more). The prevalence of stroke disease increases markedly with old age. The reason for this is that elderly individuals may suffer from systemic conditions and stress. Moreover, aged individuals are afflicted with atherosclerosis, which causes ailments that are exacerbated by the aging process, such as hypertension. The present study also describes gender. The findings indicate that male is the dominant gender for study sample. This validates that the incidence of stroke increased in males compared with females. [11,8]; They claimed that male made up the bulk of the research sample. Additionally, substantial research has been done on gender disparities in a wide range of health and illness, and nursing is now paying more attention to these issues. The male is more prone to stroke than the female due to the action of the sex hormone, the naturalness of the employment, stress displaying, and chronic illness distribution. Additionally, lifestyle variations like drinking and smoking may also contribute to the explanation of this gender disparity. Regarding the study subjects the marital status and residency of the "present study results indicate that the majority of the study subjects are married and are urban residents. This may be because the urban environment is more stressful, noisy, pollutant compared with the rural environment. So the incidence of a stroke may increase in urban residents compared with rural residents. In addition, these results might occur because the stroke refers to a modern scourge of industrialized society. Moreover, the stroke may increase in incidence among those persons in an urban residential area, than in those from rural areas. Also, those persons in a rural residential area often experience physical exercises every day as compared with those in urban, which make them less risky to get a stroke. Furthermore, the individuals in rural residential areas are less prone to get stroke due to the risk factors that are more focused in urban than in rural areas such as the psychological stress. For the marital status, concerning the eastern population, they tend to marry early as compared with other populations. So, we may see that the majority of the study subjects are married" [8]. Concerning the study sample, the level of education in the present study results shows that the majority of the study sample don't read and write. Al-Ibraheemi and AL-Bayati, (2018); Pandit, (2020) [12]: in his study "Health Related Quality of Life of Cerebrovascular Accident Patient: A Descriptive Study" they found in their results that the majority of the study samples were unable to read and write only. This might be due to the fact that the majority of the people who participated in the research are of advanced age, and the living, social, and cultural situations in which they were raised did not let them to attend a school or finish their education. In addition, this conclusion may have been brought about as a consequence of the ongoing economic and political problems as well as conflicts that our nation has been experiencing ever since the beginning of the eighties. Regards to occupational status, the study result indicates that a high percentage of study participants were jobless. These results are similar to other studies done by Ribeiro Lima, et al., (2020) [13], the study entitled "Socio-demographic factors associated with quality of life after a multicomponent aphasia group therapy in people with sub-acute and chronic poststroke aphasia" they mentioned that most of the study sample were unable to work. When compared to patients of a younger age, this outcome may have occurred because more than one-third of the patients who participated in the study are at an elderly age for which they are unable to work. And this may be because the sickness and its treatment for other chronic diseases have an influence on the lifestyle and everyday activities of the patients.

Part Two: Discussion of the Effectiveness of the Regular Resistance Exercise on Patients' Muscle Strength

The study showed that a regular resistance exercise can improve muscle strength and enhance endurance by increasing the delivery of oxygen and nutrients to tissues and help the cardiovascular system and musculoskeletal system work more and more efficiently and when heart and lung function improves, that increases energy for daily activity. Therefore, muscle performance will be increased. The majority of stroke patients will face restrictions on their ability to do activities, which will result in a loss of muscle and joint strength. Along with the rise in stroke cases, hemiparesis incidence is also rising. Every year, there is a rise in the number of stroke victims. This is not only a problem for the elderly; strokes may also happen to persons who are young and active [14]. Patients recovering from stroke sometimes struggle with movement issues. Due to injuries in the motor cortex, movement problems are caused by a loss of strength in the muscles of the extremities. Stroke patients may have interruptions or challenges with walking and other activities due to muscular strength and balance issues [15]. Because their limb muscles can no longer move as easily, stroke sufferers experience weakness on one side of their bodies.

Alkhaqani and AL-Bayati, (2021), they stated that the promotion of resistance exercise training should assume a more prominent position in exercise guidelines especially for older patients with chronic

disease. In a scoping review of previous studies, Asadzadeh et al., (2021) concluded that there is an evidence of the effectiveness of exercise therapy to improve patients health status.

Part Three: Discussion the Effect of Socio-Demographic and Clinical Characteristics on the Effectiveness of the Regular Resistance Exercise

The study result indicates that there is an association between muscle strength and the body side that is affected by stroke in experimental group participants. This result comes because of the muscle strength in the right side handers is strong compared with the muscle strength on the left side and vice versa. Abe and Loenneke, (2015) [16], mentioned that the right hand was stronger when compared side by side, with a 10.2% difference in handgrip strength for the right-handed group. The left hand of the left-handed group, however, was 7.8% stronger than the right. The connection between side-by-side differences in handgrip strength and forearm-ulna muscle thickness (r = 0.765) and forearm-radius muscle thickness (r = 0.622) was statistically significant. In addition, Jeon et al., (2016) [17], they stated that asymmetrical muscular strength in the ankle joint may result in counterbalancing muscle strength in the knee joint in order to preserve the body's center of mass. Therefore, the body side that is affected by stroke affects the muscle strength.

5. Conclusion and recommendation

The regular resistance exercise implemented for at least six weeks is an effective approach to improving the muscle strength of patients with stroke compared to the comparison group. In addition, the study concluded the incidence of stroke is increased in male patients, compared with female patients and diabetic mellitus and high blood pressure are the most common comorbidities with stroke.

The study recommended, it is necessary to perform further studies to prove the efficacy of alternative nursing rehabilitation techniques in minimizing stroke-related problems and a nursing rehabilitation guideline should be prepared and up to date under the supervision of nursing experts to use by the health staff in the ministry of health as a standard in the management of patients with stroke, in addition, the nurses recommended using the regular resistance exercises for stroke patients who suffer from muscle weakness.

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