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Efficacy of Nurse-Led Cardiac Rehabilitation Program on Improving the Metabolic Equivalent of Tasks of Patients with Heart Disease: A Randomized Controlled Trial

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ABSTRACT

Background:*Nurse-lead Cardiac rehabilitation is a program designed to improve health of patients with heart disease, including those recovering from myocardial infarction, heart failure, coronary artery bypass grafting, percutaneous coronary intervention, or valve surgery.* ***Objective:*** *the study is conducted to assess the METs among patients with heart disease using the TMT measurement and to determine the efficacy of nurse-lead cardiac rehabilitation program on the METs levels.* ***Methodology:*** *A Randomized Controlled Trial is used to evaluate the efficacy of Nurse-Led Cardiac Rehabilitation Program on improving the Metabolic Equivalent of Tasks of patients with heart disease. A non-probability (purposive) sample of 65 patients were selected for the purpose of the study. The study started from 5 November 2024 to 8 January 2025. Data collection tools were treadmill test. Data were analyzed by using SPSS software version 20 and Microsoft Excel 2010 using the descriptive and inferential statistical methods.* ***Results:*** *The study result indicates that the METs in the experimental group participants increased after application of the study program compared with the METs levels at the control group participants, with a significant statistical difference less than 0.05. Additionally, there is a significant statistical difference between the pre-test and post-test among the experimental group participants, while there is a non-significant statistical difference among the control group participants.* ***Conclusion:*** *The cardiac rehabilitation program is an effective method on improving the Metabolic Equivalent of Tasks levels of patients with heart disease.*

Keywords: *Efficacy, Nurse-Led, Cardiac Rehabilitation, Metabolic Equivalent of Tasks.*

INTRODUCTION

Cardiovascular disease (CVD) is the main cause of death globally. They are frequently the cause of patient hospitalization, incapacity for work, and disability. These diseases place a significant socioeconomic burden on both the medical system and sufferers' families. Additionally, CVD accounts for 31% of all deaths globally. In Europe, it rises to 39-47% (for males and females, respectively), while CVD accounts for the majority of deaths in the United States. Every year, 17.9 million people worldwide succumb to cardiovascular disease [1,2].Cardiac Rehabilitation (CR), also known as cardiovascular rehabilitation, is a multidisciplinary, methodical, but tailored strategy to offering evidence-based secondary prevention therapy for individuals with cardiovascular disease and improve a quality of life (Winning *et al.*,2021). Moreover, CR is an effective secondary preventive approach that emphasizes the positive effects of regular physical activity [3,4,] Programs of CR help the patients in achieving the objectives to increasing physical activity, enhancing their Metabolic Equivalent of Tasks (METs), maintaining a healthy diet, attaining optimal medication adherence, regulating their body weight, stopping smoking, and reaching optimal psychological well-being in order to minimize their risk of recurrent the cardiovascular events [5].The higher METs level is indicative of improved cardiovascular fitness and increased capacity to withstand physical effort. A higher MET score may indicate improvement enhanced by cardiac rehabilitation for people with heart disease, it indicating that the heart is more effective at supplying blood and oxygen to all the body when they are exercising. It is a good sign of recuperation and better health (American heart

association. While, the decrease in MET indicates a worsening of the patient's cardiovascular health or physical deconditioning. This might occur if a patient's heart condition worsens, they suffer a setback in rehabilitation, or they become less physically active. A lower MET score for heart disease patients often suggests an elevate the risk of cardiovascular events such cardiac attacks or indications of heart failure [6]. Nurses make contributions ranging from prevention and education to acute treatment and long-term management and rehabilitation. They actively screen patients for CVD risk factors such as hypertension, high cholesterol, CVD risk factors as high cholesterol, hypertension, diabetes, smoking, obesity. They provide education on lifestyle changes like diet, exercise, and smoking cessation to lower risk [7].

METHODOLOGY

Design of the Study: A randomized control trial (RCT) was conducted on peoples who were allocated to the study, and control groups is used to determine the efficacy of nurse led cardiac rehabilitation program on improving the metabolic equivalent of tasks of patients with heart disease.

Selection of the Study Participants: The members in the current study about 85 pts who were planned to cardiac rehabilitation after being referred by the specialist physician, the patients were then selected according to the sample specifications on each day and their consent was obtained. After that, the pre-test was conducted and the patient's personal and clinical characteristics were taken. After that, they were divided into two groups. After that, the program was applied to the experimental group and so on for each day until the full sample size achieved. During time of the study period disseminate to take after: 10 patients for pilot study are prohibited or excluded of a study. Three employee pts did not complete the program because they did not receive a monthly leave from their departments to complete the program are excluded from the study. One of the patients had swelling during the exercise in his left foot, and after diagnosis by use the doppler it was found that a blockage in one of the arteries in the left foot also excluded from the study. six patients did not complete the program, three of them are females who are unable to come alone to the center to complete the remaining sessions, and three from distant governorates. The remaining 65 eligible pt participate at current study (the complete study sample).

Study Sample and Sampling Technique: A non-probability (purposive sampling) technique for 65 pts are within a current study. All patients are medically diagnosed with CVD and those patients are visit Najaf Center to The Cardiac Surgery and Catheterization for Cardiac Rehabilitation section. The study sample was dividing into experimental and control groups utilizing block randomization and the criteria led to the selection of the study sample.

Sample Size and Power Analysis: In the current study the researcher employments the taking after parameters for decide of the satisfactory sample size; the power (95%), the significancy 0.05, and the high impact size 0.50. Therefore, sample size is equal to (37). To increment or increase of the power to 99%, the researcher doing increment or increases of the sample size for (65).

Study Instrument: To investigate the phenomenon the researcher employments the study tool based on the previous literature scientific and academic. The three components of the study tool are as:

Part I: Demographic characteristic
Part II: Clinical Characteristics
Part III: Treadmill test (TMT).

Ethical Consideration: Before starting a study, the researcher gets the formal assertion of Medical Research Ethics Committee (MREC) to molar study endorsement in the compliance with the prerequisites for conduct the human research. Before starting data collection, it is necessary to protect participant rights through informed consent for sharing rights. The researcher presents himself to the participant, explains the purpose of the study and its advantages, ensures the confidentiality of the patient's name and information, and solicits their voluntary participation in the study; and the participant is free to withdraw from the study whenever they choose.

Method of Data Collection: A researcher utilizes face to face interviews for demographic & clinical data. the Regarding measurement of METs, the researcher used a treadmill test (TMT) device to measure the METs of patients before and after program application. The information collection method begins from 5 November 2024 for 8 January 2025.

Statistical Analysis: The current study's information was examined using Microsoft Excel 2016 and together with version 20 of the Statistical Package for the Social Sciences (SPSS). The statistician utilizes the following techniques for both descriptive and inferential data analysis:

Analysis of Descriptive Data: The data was summarized using statistical tables, which include frequencies (F) and percentages (%), Standard deviation (SD) and mean of score (M.S.) are included in statistical tables.

Analysis of Inferential Data: T-test, the independent sample T- test is one in which there aren't affiliation or connection between a scores of the groups that are being watched (e.g. an experimental group and the control group are compared), **ANOVA** is used to determine the least significant difference (LSD) between the means of the several independent groups. The F-distribution was used in this test.

RESULTS

Table (1): Distribution of study sample according to the Sociodemographic Characteristics.

Sociodemographic Characteristics		Experimental n=35	Control n=30
		f (%)	f (%)
Age (years)	30– 39	3 (8.6)	5 (16.7)
	40 – 49	5 (14.3)	10 (33.3)
	50 – 59	14 (40)	7 (23.3)
	60 +	13 (37.1)	8 (26.7)
	Mean ± SD	**54.8 ± 8.1**	**50.5 ± 9.4**
Sex	Male	32 (91.4)	20 (66.7)
	Female	3 (8.6)	10 (33.3)
Educational Levels	Does not read and write	2 (5.7)	1 (3.3)
	Read and Write	9 (25.7)	15 (50)
	Primary School	4 (11.4)	2 (6.7)
	Intermediate School	5 (14.3)	5 (16.7)
	Secondary School	7 (20)	5 (16.7)
	Institute Graduate	6 (17.1)	2 (6.7)
	College Graduate	2 (5.7)	0 (0)
Residence	Urban	31 (88.6)	22 (73.3)
	Rural	4 (11.4)	8 (26.7)
Working Status	Retired	10 (28.6)	4 (13.3)
	Housewife	2 (5.7)	10 (33.3)
	Government Employed	15 (42.9)	7 (23.3)
	Jobless/ disable	0 (0)	3 (10)
	Own working	8 (22.9)	6 (20)
Total		**35 (100)**	**35 (100)**

***f=frequency, %= percentage, n= number**

Table (1) indicate to statistical distribution about the participants according to the socio-demographic data. regarding the experimental group, the study result indicates that the majority of the experimental group participants are 50-59 years old 14(40) %, male 32(91.4) %, dose read and write 9(25.7) %, residence is urban 31(88.6) %, and their working status is government employed 15(42.9) %.

While for the control group, the study results show that the majority of the control group participants are. 40-49 years old is 10(33.3) %, male 20(66) %, does read and write 15(50) %, and residence is urban 22(73.3) %, and their working status is housewife 10(33.3) %.

The Table (2): Distribution of study sample according to the Clinical Characteristics.

Clinical Data		Experimental n=35	Control n=30
		f (%)	f (%)
Disease Duration Since Diagnosis	3 and less	14 (40)	8 (26.7)
	4-6	14 (40)	18 (60)
	6 and more	7(20)	4 (13.3)
Diagnosis	MI	25 (71.4)	20 (66.7)
	PCI	9 (25.7)	10 (33.3)
	HF	1 (2.9)	0 (0)
Take Treatment Regularly	Yes	33 (94.3)	26 (86.7)
	No	2 (5.7)	4 (13.3)
Smoking	Yes	15 (42.9)	9 (30)
	No	18 (51.4)	18 (60)
	Past Smoker	2 (5.7)	3 (10)
Comorbidities	Hypertension	14 (40)	14 (46.7)
	Diabetes mellitus	8 (22.9)	5(16.7)
	Hypertension + Diabetes mellitus	4 (11.4)	6(20)
	No Comorbidities	9 (25.7)	5(16.7)
Body Mass Index	Normal weight (18.5-24.9)	4 (11.4)	0 (0)
	Overweight (25-29.9)	15 (42.9)	8 (26.7)
	Obese (30-34.9)	11 (31.4)	16 (53.3)
	Extremely Obese (>35)	5 (14.3)	6 (20)

***f=frequency, %= percentage, n= number**

The findings Table (2) Show statistical distribution of the study sample through the clinical characteristics of cardiovascular disease (CVD), it explains that the highest percentage of the participants in the experimental group have CVD since 3 months and less 14(40) %, followed by diagnosis with M.I 25(71.4) %, and taking a treatment 33(94.3) % and Nonsmoking 18(51.4) % and comorbidity with hypertension 14(40) % and BMI is overweight (25-29.9) was 15(42.9) %. While the majority of the control group have MI 20(66.7) %, followed by taking a treatment 26(86.7) %, and Nonsmoking 18(60) % and comorbidity with hypertension 14(46.7) % and BMI is Obese (30-34.9) was 16(53.3) %.

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Table (3): Assessment of Patients' Metabolic Equivalent of Tasks for Experimental Group at the Pre-test, n=35

Sex		Poor f (%)	Fair f (%)	Average f (%)	Good f (%)	High f (%)	Mean ± SD
Male	30 – 39	1(3.1)	1(3.1)	0 (0)	0 (0)	0 (0)	**5.83 ± 1.95**
	40 – 49	4(12.5)	1(3.1)	0 (0)	0 (0)	0 (0)	
	50 – 59	7 (21.9)	1(3.1)	4 (12.5)	0 (0)	0 (0)	
	> 60	7 (21.9)	4(12.5)	2 (6.3)	0 (0)	0 (0)	
Total		19 (59.3)	7 (21.9)	6 (18.7)	0	0	
Female	30 – 39	1(33.3)	0 (0)	0 (0)	0 (0)	0 (0)	**5.20± 0.98**
	50 – 59	2 (66.7)	0 (0)	0 (0)	0 (0)	0 (0)	
Total		3(100)	0 (0)	0 (0)	0 (0)	0 (0)	

***f = frequency, % = percentage, n= number**

The table (3) shows that the majority of the male in experimental group METs is poor 19 (59.3%). Also, in female patients the METs is poor 3(100) %.

Table (4): Assessment of Patients' Metabolic Equivalent of Tasks for Experimental Group the Post-test, n=35

***f=frequency, %= percentage, n= number**

Sex	Age Group	MET Levels					Mean ± SD
		Poor f (%)	Fair f (%)	Average f (%)	Good f (%)	High f (%)	
Male	30 – 39	0 (0)	1(3.1)	1(3.1)	0 (0)	0 (0)	**8.60 ±1.57**
	40 – 49	0 (0)	1(3.1)	5(15.6)	0 (0)	0 (0)	
	50 – 59	0 (0)	4 (12.5)	7 (21.9)	1(3.1)	0 (0)	
	> 60	1(3.1)	2 (6.3)	7 (21.9)	3(9.3)	0 (0)	
Total		1(3.1)	8(25)	20(62.5)	4 (12.5)	0	
Female	30 – 39	0 (0)	1(33.3)	0 (0)	0 (0)	0 (0)	**6.93±0.55**
	50 – 59	0 (0)	1(33.3)	1(33.3)	0 (0)	0 (0)	
Total		1(33.3)	1(33.3)	1(33.3)	0 (0)	0 (0)	

The table (4) shows that the majority of the male in experimental group METs is Average 20 (62.5%). While, in female patients the METs is equal in poor, fair, average is 1(33.3%).

Table (5): Mean Difference (Paired t-Test) for Female Patients' Metabolic Equivalent of Tasks the Pre & Post-test in Experimental Group, n=3

Main Domain	Periods	Met Levels	Statistical Parameters		Paired Sample T-Test Df. =2	
			F (%)	Mean ± Sd	T-Value	P-Value
Metabolic Equivalent Of Tasks	Pre-Test	Poor	3(100)	5.20± 0.98	5.769	0.029 S
		Fair	0(0)			
		Average	0(0)			
		Good	0(0)			
	Post-Test	Poor	1(33.3)	6.93± 0.55		
		Fair	1(33.3)			
		Average	1(33.3)			
		Good	0(0)			
Improvement Rate (1.73 Mets Equal To 6055 L/O2/1kg/ 1 Minuet)						

***f=frequency, %= percentage, n= number, *S= Significant, N. S= non-significant.**

The Table (5) appears there a significant distinction at METs in female patients in experimental group (i.e. the METs is increased after the application of the rehabilitation program, therefore, the study program is affected). With an improvement rate equal to 1.73 METs equal to 6055 L/O2/1Kg/1 minutes.

Table (6): Assessment the Patients' Metabolic Equivalent of Tasks for Control Group the Pre-test, n=30

Sex	Age Group	MET Levels			Mean ± SD
		Poor f (%)	Fair f (%)	Average f (%)	
Male	30 – 39	2(10)	2(10)	0(0)	6.64 ± 1.44
	40 – 49	5(25)	0(0)	0(0)	
	50 – 59	3(15)	1(5)	1(5)	
	> 60	1(5)	4(20)	1(5)	
Total		11(55)	7(35)	2(10)	
Female	30 – 39	1(10)	0(0)	0(0)	5.29 ± 0.64
	40 – 49	4(40)	1(10)	0(0)	
	50 – 59	0(0)	2(20)	0(0)	
	> 60	2(20)	0(0)	0(0)	
Total		7(70)	3(30)	0(0)	

***f=frequency, %= percentage, n= number**

The table (6) shows that the majority of the male in control group METs is poor 11 (55%). Also, in female patients the METs is poor 7(70%).

Table (7): Assessment the Patients' Metabolic Equivalent of Tasks for Control Group at Post-test Measurement n=30

Sex	Age Group	MET Levels			Mean ± SD
		Poor f (%)	Fair f (%)	Average f (%)	
Male	30 – 39	1(5)	3(15)	0(0)	6.54 ± 1.24
	40 – 49	5(25)	0(0)	0(0)	
	50 – 59	1(5)	3(15)	1(5)	
	> 60	0(0)	4(20)	2(0)	
Total		9(45)	10(50)	1(5)	
Female	30 – 39	1(10)	0(0)	0(0)	5.70 ± 0.60
	40 – 49	3(30)	1(10)	0(0)	
	50 – 59	2(20)	1(10)	0(0)	
	> 60	0(0)	2(20)	0(0)	
Total		6(60)	4(40)	0(0)	

***f=frequency, %= percentage, n= number,**

The table (7) shows that the majority of the male in control group METs is fair 10 (50%). while, in female patients the METs is poor 6(60%).

DISCUSSION

The efficacy of nurse-led cardiac rehabilitation program on improving the metabolic equivalent of tasks of patients with heart disease:

The current study is conducted by use the Cardiac Rehabilitation Program as a rehabilitation technique to improve the Metabolic Equivalent of Tasks of patients with CVDs. It tries to improve the patients' physical status and METs associated with heart diseases. Furthermore, the patients' self-care abilities are also improved because patients with heart diseases can apply that method.

The findings of the study indicate that a majority of patients are 50 years old. This result comes because that the advanced age individuals are more vulnerable for CVDs. Therefore, the prevalence of cardiovascular diseases increases markedly as the age increased and vice versa. The reasons behind that are the aging process by which the individuals are become low immunity and high susceptibility to be a diseased, and advanced aged individual they may suffer of the systemic and chronic diseases as atherosclerosis & high blood pressure that may predispose the CVDs.found that 58% of CVD patients were aged ≥50 years, aligning with global trends of aging as a key risk factor. Also, The Global Burden of Disease Study (2020) confirmed that CVD risk doubles every decade after age 50 due to arterial stiffness and cumulative oxidative stress [8]Regarding the patients' sex. The findings of the study indicate that a majority of experimental and the control groups participants are males. In fact, the sex contrasts in a wide range of the wellbeing and illness have been a subject of the broad explores and that right now getting more prominent consideration in the Nursing. The acting of the sex hormone, neutrality of the occupation, stretch showing, and the chronic disease distribution all of these variables making the male is more helpless for CVD compared with female. Moreover, the differences in way of life, as smoking cigarettes and the expending alcohol, may too over assistance to the explain of this sex difference in case of CVDs. Men exhibit higher prevalence of hypertension and atherosclerosis earlier in life [9], Through

the Behavioral & Lifestyle Factors the men are more likely to engage in smoking, excessive alcohol consumption, and delayed healthcare-seeking. And through the occupational & psychosocial stress the high-stress occupations (predominantly male-dominated) correlate with increased CVD incidence. In addition, to the chronic disease distribution the diabetes and metabolic syndrome impact men more severely in midlife [10,11].Moreover, concerning to level of the education, the study outcomes uncover that the most noteworthy rate of the study sample does read & write. Studies indicate or show that a significant portion of older adults with cardiovascular diseases (CVD) have limited formal education, often only achieving basic literacy. Research suggests this is linked to historical socioeconomic barriers, as many grew up in eras with limited access to schooling. For example, a 2023 study in Journal of Aging and Health found that older CVD patients in low-resource settings were 3 times more likely to be illiterate due to poverty and cultural norms prioritizing labor over education [12], Older age is strongly associated with lower educational attainment in CVD populations. A 2024 BMC Public Health analysis highlighted that 60% of CVD patients over 70 in developing regions had no formal schooling, citing childhood economic hardships and gender disparities as key barriers [13]. Also, the patients participating in the study were more urban than rural residents, for both the experimental group and the control group, it is believed that this back to the greatest number of participants who are accepted the exercise program from urban as they can continue up. Furthermore, the rise in number of patients from urban residency is due to rise in the number of individuals distributed in urban residency compared with rural areas. This result agrees with study conducted in 2023 that include the study participants were predominantly urban residents in both the experimental and control groups [14]. In relation to the Working status, most of participants are government employed this result agree with study which is conducted in 2023 it confirms that government-employed individuals had higher percentage [12].

The study results reveal that the disease duration since diagnosis for patient is 3 months and less for the study group and 4-6 month for the control group, this finding agree with [15], The most them are diagnosed with M.I, they taking their medications regularly, they are past smokers. Another clinical factors which play a role in heart diseases progress is comorbidities, the study results found the major percentage of comorbidities that associated with heart diseases are hypertension and diabetes mellitus. Many studies indicate or show that lift of the blood pressure leads to the left ventricular hypertrophy that cause an increment in the myocardial rigidity, this makes myocardium less compliant for changes that happen on blood volume this lead to its failure [16]. Additionally, study stated that structural and functional changes that characterize diabetic cardiomyopathy and interrelated pathophysiology combined diabetes mellitus assist in heart failure occurring [17].Concerning the Body Mass record or Index, the outcomes about study shows that a majority of patients in the experimental group are overweight, while in control group are obese may outcome in heart diseases through actuating the hemodynamic and myocardial changes that can lead to the cardiac dysfunction, or due to an expanded inclination to the other heart disease risk factors. Moreover, these patients lost their opportunity to reduce their weight because they are unable to carry out exercise due to their age and the problems associated with heart diseases, additionally with the sedentary life style. This lack of exercise prevents meaningful weight loss, worsening cardiovascular outcomes [18].The study result indicates that the METs levels among patients with the heart diseases is poor in a pre-test of both (experimental & control groups participants). A study by [12],"Pre-Rehabilitation Metabolic Equivalent Capacity as a Predictor of Functional Outcomes in Cardiovascular Disease Patients" found that patients with cardiovascular diseases (CVD) often exhibit low Metabolic Equivalent of Task (MET) levels before starting cardiac rehabilitation (CR), showing poor baseline MET capacity in both experimental and control groups. Suggesting widespread physical deconditioning among heart disease patients' pre-rehabilitation. The study results indicating poor MET levels among heart disease patients at baseline testing for cardiac rehabilitation can be inherent nature of cardiovascular disease impairs cardiac function, reducing the heart's ability to pump blood efficiently during physical activity. This diminished cardiac output directly limits oxygen delivery to working muscles, resulting in lower exercise capacity and MET scores. Additionally, many patients develop a sedentary lifestyle due to symptoms like angina or dyspnea, or due to fear of triggering cardiac events, leading to significant physical deconditioning over

time. The situation is further compounded by common comorbidities such as diabetes, obesity, and chronic kidney disease, which independently impair metabolic and vascular function. Psychological factors including depression and anxiety, which are prevalent in cardiac patients, also contribute to reduced physical activity levels. Furthermore, certain cardiac medications like beta-blockers may artificially suppress exercise performance by limiting heart rate response. Together, these physiological, behavioral, and pharmacological factors explain why patients typically demonstrate poor MET levels before starting cardiac rehabilitation, highlighting the critical importance of structured exercise programs to improve their functional capacity and overall prognosis. In addition, Research by [19,20]"Reduced Pre-Cardiac Rehabilitation Metabolic Equivalent Levels Predict Disease Severity and Functional Limitations in Patients with Cardiovascular Disease." confirmed that pre-CR MET levels are significantly reduced in CVD patients, correlating with disease severity and sedentary lifestyles.The results of the study uncover or appears there a non-significant distinction in pts' METs levels between experimental and the control groups in the pre-test. Whereas, there a significant difference, is determined in the post- test. Moreover, the study results indicate that the MET levels among an experimental group patient are going to the superior or to better after support in a study program compared with the control group (i.e. the Nurse – lead Cardiac Rehabilitation Program is the effective way in increase of the levels of METs of patients with heart diseases). This indicates that the study program is effective in improving patients' functional capacity (as measured by METs), suggesting that structured exercise and rehabilitation can enhance physical fitness and quality of life in cardiac patients. are conducted a study about "Structured Cardiac Rehabilitation Programs Enhance Functional Capacity: A Randomized Controlled Trial on MET Level Changes [21,22].

CONCLUSION

The cardiac rehabilitation program is an effective method on improving the Metabolic Equivalent of Tasks levels of patients with heart disease.

Recommends: There is a need for activate the nursing rehabilitation in different health organizations for improving the health status of patients especially those with heart diseases, and focusing on Nursing Rehabilitation in the curriculum of Nursing Colleges.

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