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EVALUATION OF FUNCTIONAL CAPACITY AND METABOLIC EQUILENTS IN PATIENTS WITH CORONARY ARTERY DISEASE A CROSS SECTIONAL STUDY

Running Head: Functional Capacity and Metabolic Equilents of Coronary Artery Disease Patients

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ABSTRACT

Background: Heart diseases are major cause of mortality around the globe. Inthese diseases, metabolic equivalent and functional capacity reduce.

Objective: To examine the functional capacity and metabolic equivalent in patient with coronary artery diseases.

Methods: A cross-sectional research was undertaken between June 2021 and January 2022. Non probability convenient sampling was used to select a sample of 385 patients of coronary artery disease based on the selection criteria. Data were collected from Wazirabad Institute of Cardiology, Aziz Bhatti Shaheed and Teaching Hospital Gujrat, Pakistan. The Duke Activity Status Index (DASI) standard questionnaire was utilized for obtaining data from patients. Data were entered and analyzed through SPSS.

Results: Out of 385 coronary artery patients, 212(55.1%) were males. Average age and BMI of patients was 48.50±06.28 years and 22.74±3.21 kg/m2 respectively. Functional Capacity and Metabolic Equilents was found 11.28±0.89 vo2 max and 3.31±1.34 METS respectively.

Conclusion: Patients of coronary artery disease had compromised functional capacity and metabolic equilents.

Keywords: Cardiovascular disease, Coronary Artery Disease, Cross sectional study, Functional Capacity, Metabolic Equilents.

INTRODUCTION

The organ which we talk about the maximum in human body is heart. It is not only themost systematic organ but it is responsible for many diseases of human body and its demise too in the world. It's complex and mandatory to understand its anatomy and pathophysiology. Understanding the architecture of the heart's major vessels is essential for cardiology practice (1). Atherosclerosis is described by the pathophysiologic system, which begins with the illness. In the context of atherosclerosis of the heart, such progressive growth might end up in the progressive hardening inside the internal layer of the arteries in the heart, narrowing out the interior of the coronary artery to varying extents over time. Serious AMI and SCD syndromes produced by atherosclerotic exhibit a propensity for the nearby regions of important arteries in the heart, typically near vascular bifurcation locations causing changes in inflow in the vessel (2). Interconnection of genetic and environmental elements causes cardiovascular diseases (CVDs). They are thought of as a health problem for the community, having a detrimental impact on our standard of living and functionality. High blood pressure, cardiovascular disease, heart failure, cerebrovascular accident, and vascular disease of the peripheral arteries account for a great deal of prevalent CVD. Congestive cardiac failure represents an increasing threat to public health and a contributor of significant illness and mortality. The primary cause of congestive cardiac failure is a condition called coronary artery disease, which has become a significant driver for heart illness and mortality worldwide (3).

Coronary artery disease, also known as CAD, is the leading cause of mortality in Egypt as well as many advanced nations. The incidence of coronary heart disease in Greek people aged 35 to 64 wasalready projected to be five point eight percent in males and 5percent in females, with the rateof increase predicted to be rapid. In the U.s, the incidence rate of cardiovascular disease in men was 6.9percent in 2002 and 6.0 percent in females. The Greek Organization of

Cardiologist is already conducting the Greek Adolescent Health Risk Study in 1990, and it predicts that over 2 million people around the world in Turkey have cardiovascular disease. Males die from CAD at an incidence of 0.51 % per year, while females die at a rate of 0.33 %(4). The screening of mechanical adaptation among individuals with cardiac problems is an important therapeutic technique for determining diagnosis, severity of manifestations, future outcomes, and responsiveness to treatment. The state of functioning can be defined as an individual's capacity to carry out tasks under his or her usual conditions, as opposed to the capacity for functioning, that can be characterised as a someone's maximum capability to do tasks (5)

A healthy cardiovascular system is critical to well-being and overall health. The objective evaluation of cardiac health is laborious, costly, and not readily accessible. Cardiorespiratory strength (CRF), usually described as peak oxygen ingestion (VO2peak), is regarded as a significant indication, playing a critical impact in both health outcomes and quality of living. Reduced CRF is associated to fatalities from all causes. Increasing peak oxygen consumption by merely 3.5 ml•kg-1•min-1 has been shown to be associated with an estimated 8 to 35% survivability benefit in several research populations. Admitted to surveys, such as the Duke Activity Status Index (DASI), are one method for evaluating CRF. Another way to accesses VO2max is calculated with CPET but unluckily, CPET is an expensive, labor-intensive, not extensively available test (6**).** The intention of DASI is to deal with the shortcomings of previous measures, including the New York Heart Association Scale as well as the Canadian Cardiovascular Society. This is a twelve item survey which assesses routine activities including caring for oneself, mobility home duties, sexual activity, and leisure based on physiological cost. Every single thing possesses a certain weight depending on its metabolic cost. The participants were given the task to identify all the actions they're qualified for performing. The final score varies from 0 to 58 scores. The functional capacity gets betterwith the maximization of score (7)

A new investigation published in 2018 found that reduced physical capacity, as judged by the stated Duke Activity Status Index (DASI), has been linked with negative results. The diminished digitally reactive hyperemia index (RHI), a measure of peripheral arterial disease, has additionally been associated to negative results. In individuals with persistent CAD, impaired physical ability is linked to microvascular dysfunction, indicating a possible mechanism through which poor functional capacity raises cardiovascular risk. More research is needed to see if improving functional ability through exercise/rehabilitation programmes improves microvascularfunction (8,9).

METHODS

Study Design and Population:

This cross-sectional investigation was performed utilizing non probability convenient sampling on 385 coronary artery patients from Gujrat and Wazirabad, in clinical settings of Wazirabad Institute of Cardiology, Aziz Bhatti Shaheed and Teaching Hospital Gujrat from the month of September to December. Patients diagnosed with arterial disease, chest pain, myocardial infarct, or cardiac failure, past/current history of CABG and oriented and volunteering individuals with age 25-55 were included. Participants with severe physical limitation and emergency care, cognitive impairment, patients being evaluate for other cardiac disease (valvular disease, cardiomyopathy) and neurological disorders were excluded. The Duke Activity Status Index survey was used to gauge functioning and metabolic equilibration in individuals with cardiovascular disease (CAD). The physical tools including a weight machine along with measuring tape were used to measure weight and height respectively. Following formula was used for measuring sample size

$$n = \frac{Z^2 (1-\frac{\alpha}{2}) P (1-P)}{d^2}$$

Statistical Analysis:

Dataset were input and evaluated using the SPSS versions 24. The categorical information was

shown in frequencies and percentages. The test known as the Shapiro-Wilk test was employed to determine the normal distribution of data. The mean as well as the S.D have been calculated for quantitative data. A prevalence of ≤ 0.05 is deemed statistically significant. All findings have been computed using a confidence interval of 95 percent.

RESULTS:

The results have been obtained after analyzing the data collection to evaluate the functional capacity and METS in patient with coronary artery disease and premises by using non-probability convenient sampling technique. The mean age and standard deviation of the coronary artery patients was 48.50±6.282. In the study other variables such as age group and gender of the participant were taken into account. Total coronary artery patients n=385 out of which 212 were male while 173 were female. Age of which range from 25-55 years. The highest prevalence was found in age-group of 46-55years.

Table 1 shows Mean and Standard Deviation of variables

Variables	Mean±Standard deviation
Age in years	48.4987±6.28164
Body Mass Index (BMI) of participants (kg/m2)	22.74±3.207
Functional Capacity of the participants	11.28±.887
Metabolic Equilents of the participants	3.31±1.340

Table 2 shows the distribution of Age, Body Mass Index and Diagnosis and Gender of participants.

Variables		n(%)
Age Groups (Years)	25-35	16(4.2%)
	36-45	85(22.1%)
	46-55	284(73.8%)
Body Mass Index of participants	18.5-24.9(Normal)	308(80.0%)
	25.0-29.9(Overweight)	66(17.1%)
	30.0-34.9(Obese-1)	11(2.9%)
Diagnosis of participants	Myocardial infarction	198(51.4%)

	Ischemic heart disease	87(22.6%)
	Coronary artery bypass grafting	65(16.9%)
	Angioplasty	35(9.1%)
Gender of participants	Male	212(55.1%)
	Female	173(44.9%)
	Total	385(100%)

Table 3. Association between Age vs Metabolic Equilents, Functional capacity And Body Mass Index vs Metabolic Equilents, Functional capacity.

Variables	Pearson (R)	p-value
Association of Age vs Metabolic Equilents	-0.122	.017
Association of Age vs Functional Capacity	-0.516	<0.001
Association of Body Mass Index vs Metabolic Equilents	.093	.069
Association of Body Mass Index vs Functional Capacity	.015	.767

Table 1 demonstrates statistical analysis of all variables. All data were calculated using SPSS, mean and standard deviation for each variable given in this table has been calculated using spss. Mean age was 48.4 with SD of 6.28 for all 385 patients, BMI was calculated using formula kg/m² and its mean for 385 patients calculated was 22.7 and SD 3.2, mean for functional capacity was 11.28 and SD .887. Mean for METS was 3.31 with standard deviation of 1.34. Table 2 reveals demographic characteristics of participants. There were 173 female patients that count for 44.9% of all population and 212 male patients participated in this study who fulfilled the inclusion criteria and agreed to participate. The Age of the subjects has been split into three distinct categories: the first group, from age 25 to 35, contains 16 individuals (4.2%), the second group, from 36 to 45, has 45 85 (22.1%), and the third group, from 46 to 55 years old, has 284 (73.8%) participants. The third part of the table is regarding the diagnosis of patients separated into four groups, which include 198(51.4%) Myocardial

infarction that is the highest percentage of all diagnosis categories, 87(22.6%) Ischemic heart disease, 65(16.9%) Coronary artery bypass grafting and 35(9.1%) Angioplasty. BMI was computed employing the kg/m² method and split into four groups. Standard bmi individuals have a BMI between 18.5 percent and 24.9, with 308 (80.8%) individuals falling into this category. Overweight people with a body mass index ranging from twenty five to 29.9 percent belong into the second group, which includes 66 (17.1%) clients, whereas 11 (2.9%) people were obese in the third group. Table 3 shows Association between Age vs Metabolic Equilents, Functional capacity And Body Mass Index vs Metabolic Equilents, Functional capacity in which values for Age vs metabolic equilents using Pearson (R) was -0.122, and Approximate significance was .017 it indicate that no association between age and METS but with functionalcapacity there were moderate inverse association that is statistically significant with p value <

0.001. Similarly for BMI with METS it was .093 shows no association and lastly.015 indicate no association between BMI and functional capacity.

DISCUSSION

This study included 385 participants from 2 hospital settings with age group of 25-55 and with mean age and standard deviation of 48.49 and 6.28164 respectively.

According to a previous study which consistence with our finding that as people got older, their functional capacity deteriorated (10). By comparing the values of functional capacity in age groups in our study, results show moderate inverse association and p values for functional capacity in age groups were < 0.001.

Timothy R. Wessel conduct a study, in which 19 percent of the 906 women with complete data were nonwhite, 76 percent were overweight, 70 percent had low functional capacity (DASI scores of 25, corresponding to 7 metabolic equivalents, and 39 percent had obstructive CAD. Women who ranked poorly on the DASI had substantially higher WISE CAD intensity levels and were much more prone to have both obstructive and severe electrocardiographic CAD(11).

According to previous literature, adolescent to middle-aged participantswere most prone to be male, smokers, and have a significantly higher level than geriatricindividuals(12). In our study, in comparison between genders i.e. male and female, male weremostly prevalent showing that they were more prone by 55.1% and this may be due to thereason that most of the participants selected for this study were randomly males.

Philip A. Ades, Mary L. Waldmann et al, concluded that, older cardiac patients (45-65), had a reduced functional capacity as well as a higher incidence of monitored fitness programs disfigurement increase cardiovascular fitness in middle-aged cardiac victims by increasing both cardiac output and peripheral o2 absorption(13). When the age group for our study were compared in which DASI score and METS were calculated. The highest prevalence was found in age-group of 46-55years i.e. out of 385 participants 284 belonged to this age-group hence result outcomes were mostly seen in association with this age-group.

According to R Arena and his collegue, Patients with CAD who had a prior heart attack with impaired functional capacity seems to have a lower life expectancy than those who have had a similar decreased ability without an attack(14). In our study, among all the participants in which DASI scoring and METS were observed were diagnosed with MI when compared with other diseased CAD pathology by prevalence rate of (51.40%).

Mariana A claims that the DASI has proven to be a helpful instrument in clinical practice and research, with the ability to distinguish between illness severity, analyze the effects of medical treatment, cardiac rehabilitation, and provide important information to therapeutic judgments(15). According to our experience with this tool in patients with heart issues is a vital clinical tool for diagnosis, amount of symptoms, and assessment of response to cure. The DASI had a stronger association with VO2 determined via utilizing the aerobic activity than other tools which also estimate functional ability, including the Veterans Specific Activity Questionnaire (VSAQ), the Specific Activity Questionnaire (SAQ), and the Specific Activity Scale of Goldman (SAS). Being used as an assessment, the association among DASI and

VO2peak was good to excellent, and moderate when self-administered, which was better than the association between peak VO2 and SCCS and SAS in participants with DCV(15). Other populations, including patients suffering respiratory disease(16) and renal disease(17), have used the same questionnaire in current researches. In a separate study, Tavares et al (18), examined the contextual adaptability and repeatability of the DASI in a group of COPD patients in Portugal. Important guidance is available by the DASI, which specifies what tasks are restricted by illness and the effect on the person's health. DASI demonstrated sufficient properties in this study to be deemed a reliable instrument in the treatment sector.

CONCLUSION

Functional Capacity and Metabolic equilents was limited in patient with coronary artery disease. Association of functional capacity with age was observed statistically significant withp value < 0.001. IN future experimental study should be conducted to improve functional capacity and metabolic equilents.

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Declaration of patient consent: Written consent was taken from all study participants.

Use of AI: None

Ethical approval: Written consent was taken from patients. Ethical approval was taken from Wazirabad Institutional of Cardiology and Aziz Bhatti Shaheed teaching hospital

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Authors' Contribution

NE contributed to conception & design and data collection, ZA contributed to conception & design and data search, AH contributed to data analysis and interpretation, SS contributed to article drafting, critical analysis and proofreading of article. All authors have read and approved the final version of manuscript.

REFERENCES

1. Shah S, Gnanasegaran G, Sundberg-Cohon J, Buscombe JR. The heart: Anatomy, physiology and exercise physiology. Integrating cardiology for nuclear medicine physicians: Springer; 2009. p. 3-22.
2. Ambrose JA, Singh M. Pathophysiology of coronary artery disease leading to acute coronarysyndromes. F1000prime reports. 2015;7.
3. Tenenbaum A, Motro M, Fisman EZ, Leor J, Boyko V, Mandelzweig L, et al. Functional capacity impairment in patients with coronary artery disease: prevalence, risk factors and prognosis.Cardiology. 2003;100(4):207-15.
4. Salavati M, Falahinia G, Vardanjani AE, Rafiei H, Moosavi S, Torkamani M. Comparison between effects of home based cardiac rehabilitation programs versus usual care on the patients' health related quality of life after coronary artery bypass graft. Global journal of health science. 2016;8(4):196.
5. Fan X, Lee KS, Frazier SK, Lennie TA, Moser DK. Psychometric testing of the Duke Activity Status Index in patients with heart failure. European Journal of Cardiovascular Nursing. 2015;14(3):214-21.
6. Dhara S, Chatterjee K. A study of VO2 max in relation with body mass index (BMI) of physical education students. Research Journal of Physical Education Sciences ISSN. 2015;2320:9011.
7. Polese JC, Servio TC, Chaves GS, Teixeira-Salmela LF. Functional capacity of patients withchronic stroke based upon their physical activity levels. Fisioterapia Brasil. 2017;18(4).
8. Kim JH, Al-Badri A, Hammadah M, Al Mheid I, Wilmot K, Ramadan R, et al. Abstract P296: Poor Functional Capacity is Associated With Peripheral Microvascular Dysfunction in Coronary ArteryDisease. Circulation. 2018;137(suppl_1):AP296-AP.
9. Gaziano T, Reddy KS, Paccaud F, Horton S, Chaturvedi V. Cardiovascular disease. DiseaseControl Priorities in Developing Countries 2nd edition. 2006.
10. Nelson CL, Herndon JE, Mark DB, Pryor DB, Califf RM, Hlatky MA. Relation of clinical and angiographic factors to functional capacity as measured by the Duke Activity Status Index. The American journal of cardiology. 1991;68(9):973-5.
11. Wessel TR, Arant CB, Olson MB, Johnson BD, Reis SE, Sharaf BL, et al. Relationship of physical fitness vs body mass index with coronary artery disease and cardiovascular events in women. Jama. 2004;292(10):1179-87.

12. Garshick MS, Vaidean GD, Vani A, Underberg JA, Newman JD, Berger JS, et al. Cardiovascular risk factor control and lifestyle factors in young to middle-aged adults with newly diagnosed obstructive coronary artery disease. Cardiology. 2019;142(2):83-90.

13. Ades PA, Waldmann ML, Meyer WL, Brown KA, Poehlman ET, Pendlebury WW, et al. Skeletal muscle and cardiovascular adaptations to exercise conditioning in older coronary patients. Circulation. 1996;94(3):323-30.

14. Arena R, Myers J, Williams MA, Gulati M, Kligfield P, Balady GJ, et al. Assessment of functional capacity in clinical and research settings: a scientific statement from the American Heart Association Committee on Exercise, Rehabilitation, and Prevention of the Council on Clinical Cardiology and the Council on Cardiovascular Nursing. Circulation. 2007;116(3):329-43.

15. Coutinho-Myrrha MA, Dias RC, Fernandes AA, Araújo CG, Hlatky MA, Pereira DG, et al. Duke Activity Status Index for cardiovascular diseases: validation of the Portuguese translation. Arquivos brasileiros de cardiologia. 2014;102:383-90.

16. Carter R, Holiday DB, Grothues C, Nwasuruba C, Stocks J, Tiep B. Criterion validity of the Duke Activity Status Index for assessing functional capacity in patients with chronic obstructive pulmonary disease. Journal of Cardiopulmonary Rehabilitation and Prevention. 2002;22(4):298-308.

17. Ravani P, Kilb B, Bedi H, Groeneveld S, Yilmaz S, Mustata S, et al. The Duke Activity Status Index in patients with chronic kidney disease: a reliability study. Clinical Journal of the American Society of Nephrology. 2012;7(4):573-80.

18. Tavares LdA, Barreto Neto J, Jardim JR, Souza GMdC, Hlatky MA, Nascimento OA. Cross- cultural adaptation and assessment of reproducibility of the Duke Activity Status Index for COPD patients in Brazil. Jornal Brasileiro de Pneumologia. 2012;38:684-91.