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"Correlation Analysis Of Exercise Tests: Sensitivity And Specificity In Coronary Bypass Patients"

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Abstract Background: About 60,000 coronary bypass surgeries are done annually in India(Kaul & Bhatia 2010). . The objective of this study is to correlate the Specificity and sensitivity of 6 min walk test, Harvard step test and 12 min cooper test in patients undergone Coronary Artery Bypass Grafting surgery.

Methods: A total of 50 post- CABG recovered patients were recruited in the study. The research took place at Santosh Hospital in Ghaziabad, following approval from the Institute's Ethical Committee.all the patient were asked to perform all three exercise tests and Spo2, blood pressure and heart rate was measured using oximetere and sphygmomanometer. Vo2max was calculated us in formulaes (1) in 6 min walk test, (2) in Harvard step test, and (3) in cooper 12 min test

Results: The significant results were seen in the following variables on the basis of comparison and correlation of three tests (6 min walk, 12 min copper, Harvard step) with resting SpO2 (%) scores,lowest spo2(%) ,resting HR (bpm) ,peak heart rate, vo2max by dependent t test and by Karl Pearson's correlation coefficient.

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Keywords: 6 min walk test, Harvard step test, cooper 12 min test, coronary artery bypass Grafting

INTRODUCTION

One of the most serious illnesses nowadays with significant rates of morbidity and death worldwide is coronary artery disease (CAD), also known as coronary heart disease (CHD). CHD is the greatest cause of mortality worldwide, according to the World Health Organization, responsible for at least nine million fatalities in 2019 (Hu et al.,2019). About 60,000 coronary bypass surgeries are done annually in India(Kaul & Bhatia 2010). The coronary artery bypass grafting (CABG) aims to increase survival, to relieve symptoms of myocardial ischemia, to improve ventricular function, to prevent myocardial infarction, to recover the patient physically, psychologically, and socially, as well as to prolong patient's life and QOL (Baptista et al.,2012). Endurance as a basic physical characteristic can be defined as the body's ability to resist fatigue during physical exertion. It is particularly affected by the condition of the respiratory and circulatory systems, muscle metabolism and the functioning of the nervous system. The most common way to determine endurance characteristics is to measure maximum oxygen carrying capacity by direct or indirect methods. (Keskinen, Häkkinen, & Kallinen, 2004)

The 6-min walk test (6MWT), as a functional walking test, is a tool for assessing exercise capacity that nowadays with the growing attention to functional and inexpensive outcome measures in therapeutic

interventions, and for its ease of performance, has become a more applicable approach. 6-minute walk test (6MWT) is safe. The step test is one such test and is considered to be a practical field test for assessing individual aerobic fitness. Harvard Step Test (HST) is a test for measuring physical fitness (cardiovascular endurance) of a human being by using a mathematical formula for determining an Index Number, called Physical Efficiency Index (PEI) and Cooper's 12 minute run test (Cooper, 1968) is a popular field test used for measuring aerobic fitness. This fitness test was initially used to estimate the VO2 max. Dr. Cooper found that there is a very high correlation between the distance someone can run (or walk) in 12 minutes and their VO2 max value, which measure the efficiency with which someone can use oxygen while exercising. The objective of this study is to correlate the Specificity and sensitivity of 6 min walk test, Harvard step test and 12 min cooper test in patients undergone Coronary Artery Bypass Grafting surgery.

METHODS

Basic demographic data included age, gender, marital status, and have coronary artery bypass grafting in past 2 month. Inclusion criteria included patients age above 40 yrs,Cabg surgery during last 2 month, and no serious psychiatric disorders. Exclusion criteria included patients unwillingness to cooperate ,contraindication of test (unstable angina, myocardial infarction, in previous month),resting heart rate more than 120 ppm,systolic blood pressure more than 180 mmhg and diastolic blood pressure more than 110 mmhg

A total of 50 post- CABG recovered patients were recruited in the study. The research took place at Santosh Hospital in Ghaziabad, following approval from the Institute's Ethical Committee. After obtaining informed consent, every post- CABG patient willing to participate in the study underwent all exercise tests. A detailed history including age, gender, symptoms, and duration of Cabg was recorded. Spo2, blood pressure and heart rate was measured using oximetere and sphygmomanometer. Vo2max was calculated us in formulaes (1) in 6 min walk test, (2) in Harvard step test, and (3) in cooper 12 min test :

- VO2max (mL/kg/min) = –9.824 + (0.072 × 6MWDm) . (1)
- VO2 max (ml/kg/min)= 15* HR max/ HR resting. (2)
- VO2 max (ml/kg/min) = (distance covered in meters-504.9) /44.73.(3)
- Table: Age and gender wise distribution of participants

	No of participants	% of participants
Age groups		
41-50yrs	9	18.00
51-60yrs	11	22.00
61-70yrs	14	28.00
>=81yrs	16	32.00
Mean age	62.90	
SD age	11.64	
Gender		
Male	36	72.00
Female	14	28.00
Total	50	100.00

Figure: Age and gender wise distribution of participants

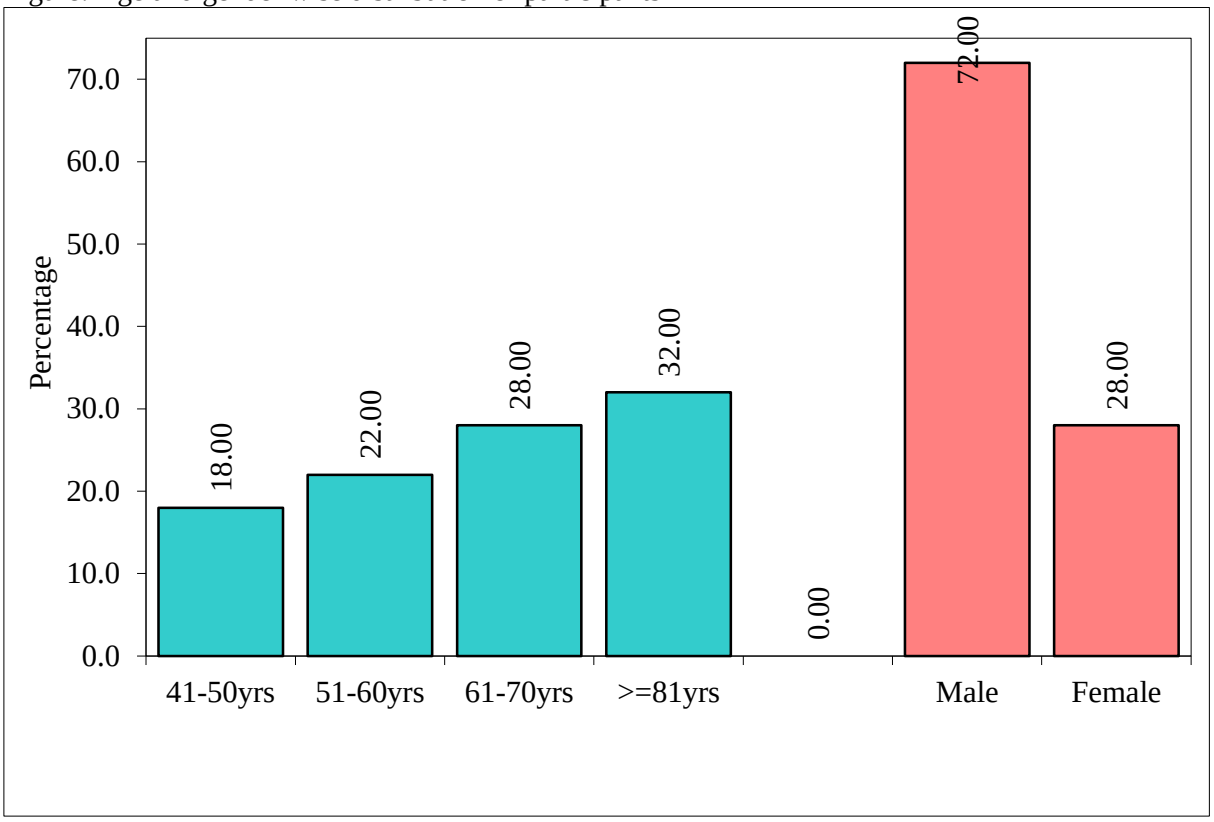


Table: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with resting SpO2 (%) scores by dependent t test

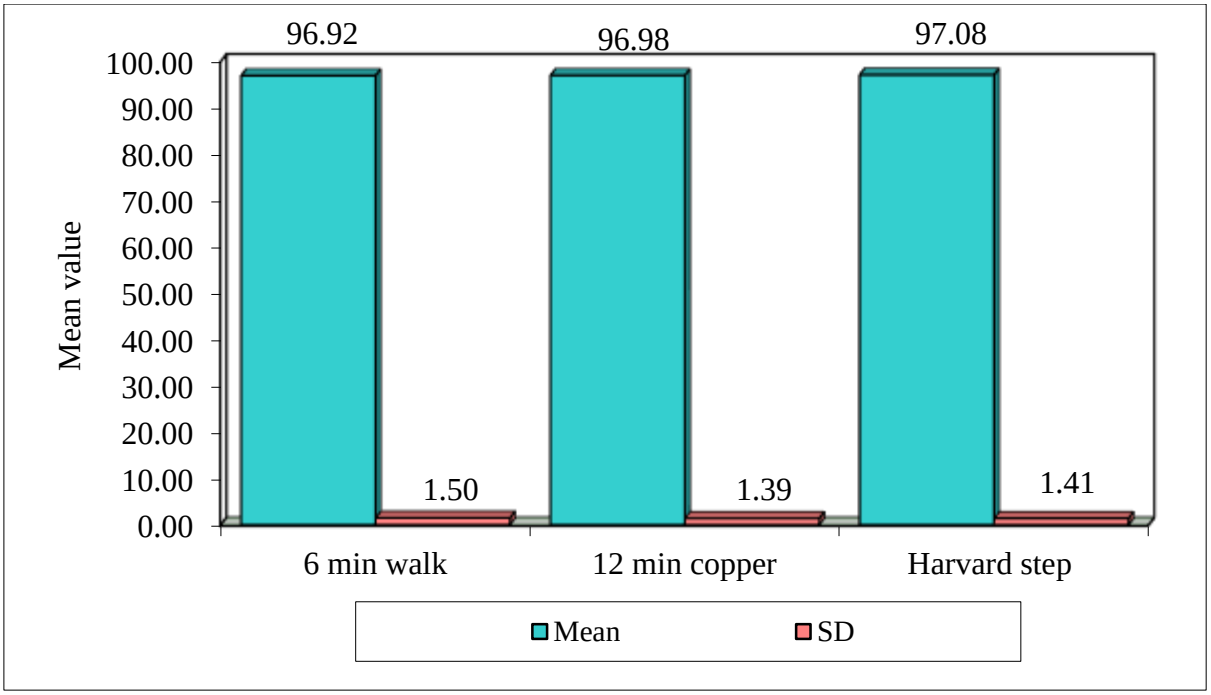
Tests	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
6 min walk	96.92	1.50					
12 min copper	96.98	1.39	-0.06	0.42	-0.06	-1.0000	0.3222
6 min walk	96.92	1.50					
Harvard step	97.08	1.41	-0.16	0.55	-0.17	-2.0642	0.0443*
12 min copper	96.98	1.39					
Harvard step	97.08	1.41	-0.10	0.42	-0.10	-1.6977	0.0959

- *p<0.05
- Table: Correlation between three tests (6 min walk, 12 min copper, Harvard step) with resting SpO2 (%) scores by Karl Pearson's correlation coefficient

Test	Correlation between three tests		
	r-value	r^2value	p-value
6 min walk vs 12 min copper	0.9594	0.9204	0.0001*
6 min walk vs Harvard step	0.9306	0.8660	0.0001*
12 min copper vs Harvard step	0.9560	0.9139	0.0001*

- *p<0.05

- Figure: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with resting SpO2 (%) scores



- Table: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with lowest SpO2 (%) scores by dependent t test

Tests	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
6 min walk	94.36	2.41					
12 min copper	94.20	2.07	0.16	1.09	0.17	1.0335	0.3064
6 min walk	94.36	2.41					
Harvard step	94.08	2.41	0.28	0.81	0.30	2.4469	0.0180*
12 min copper	94.20	2.07					
Harvard step	94.08	2.41	0.12	1.19	0.13	0.7136	0.4789

- *p<0.05
- Table: Correlation between three tests (6 min walk, 12 min copper, Harvard step) with lowest SpO2 (%) scores by Karl Pearson's correlation coefficient
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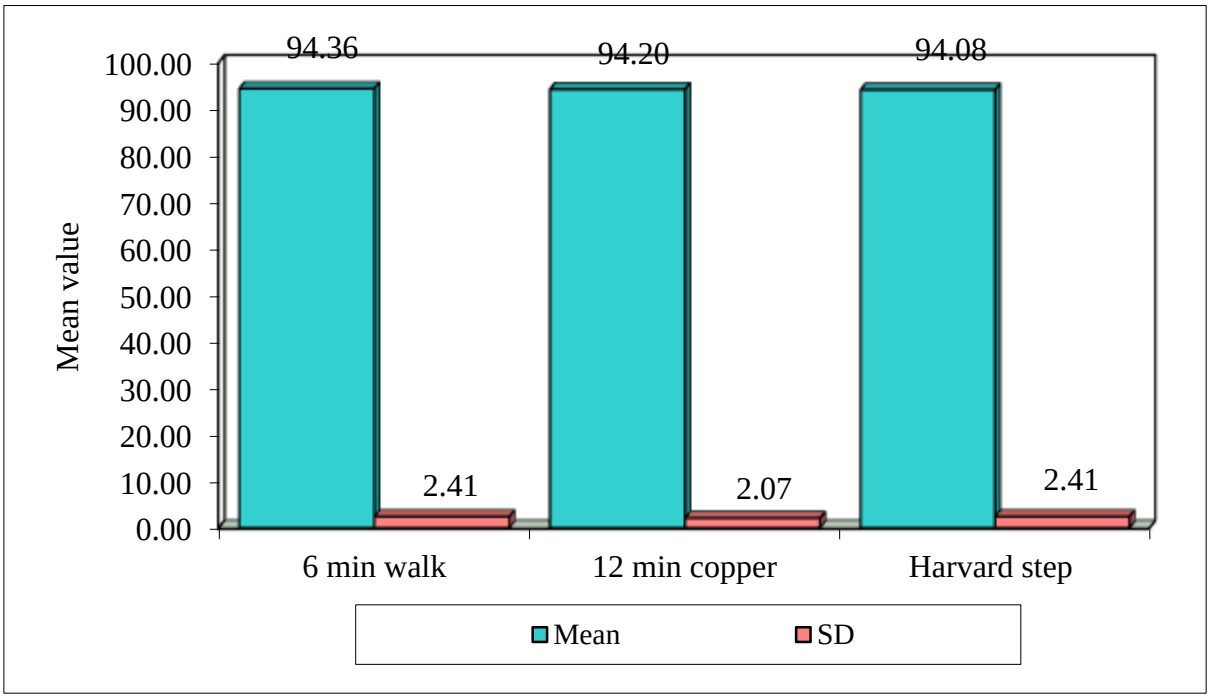
Test	Correlation between three tests		
	r-value	r^2value	p-value
6 min walk vs 12 min copper	0.8919	0.7955	0.0001*
6 min walk vs Harvard step	0.9438	0.8908	0.0001*
12 min copper vs Harvard step	0.8704	0.7577	0.0001*

- *p<0.05
- Figure: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with lowest SpO2 (%) scores



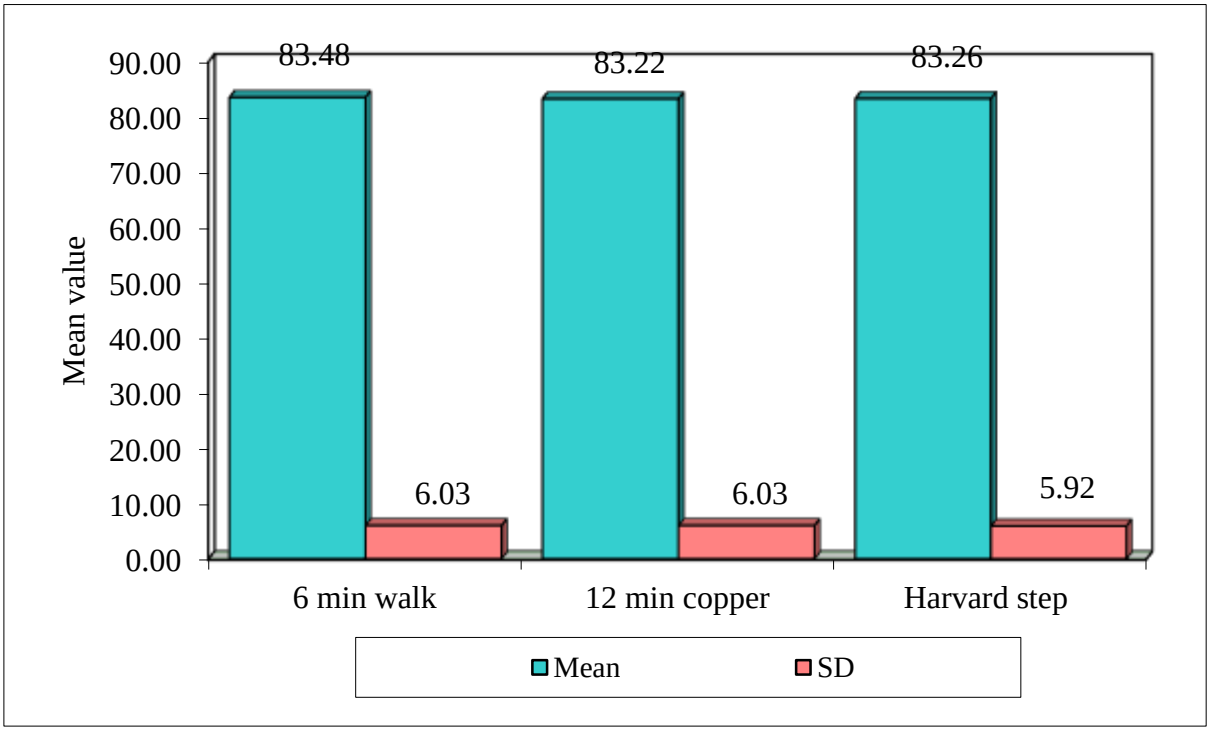
- Table: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with resting HR (bpm) scores by dependent t test

Tests	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
6 min walk	83.48	6.03					
12 min copper	83.22	6.03	0.26	6.51	0.31	0.2822	0.7790
6 min walk	83.48	6.03					
Harvard step	83.26	5.92	0.22	6.31	0.26	0.2467	0.8062
12 min copper	83.22	6.03					
Harvard step	83.26	5.92	-0.04	0.67	-0.05	-0.4229	0.6742

- Table: Correlation between three tests (6 min walk, 12 min copper, Harvard step) with resting HR (bpm) scores by Karl Pearson's correlation coefficient

Test	Correlation between three tests		
	r-value	r^2value	p-value
6 min walk vs 12 min copper	0.4163	0.1733	0.0026*
6 min walk vs Harvard step	0.4430	0.1963	0.0013*
12 min copper vs Harvard step	0.9939	0.9878	0.0001*

- *p<0.05
- Figure: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with resting HR (bpm) scores



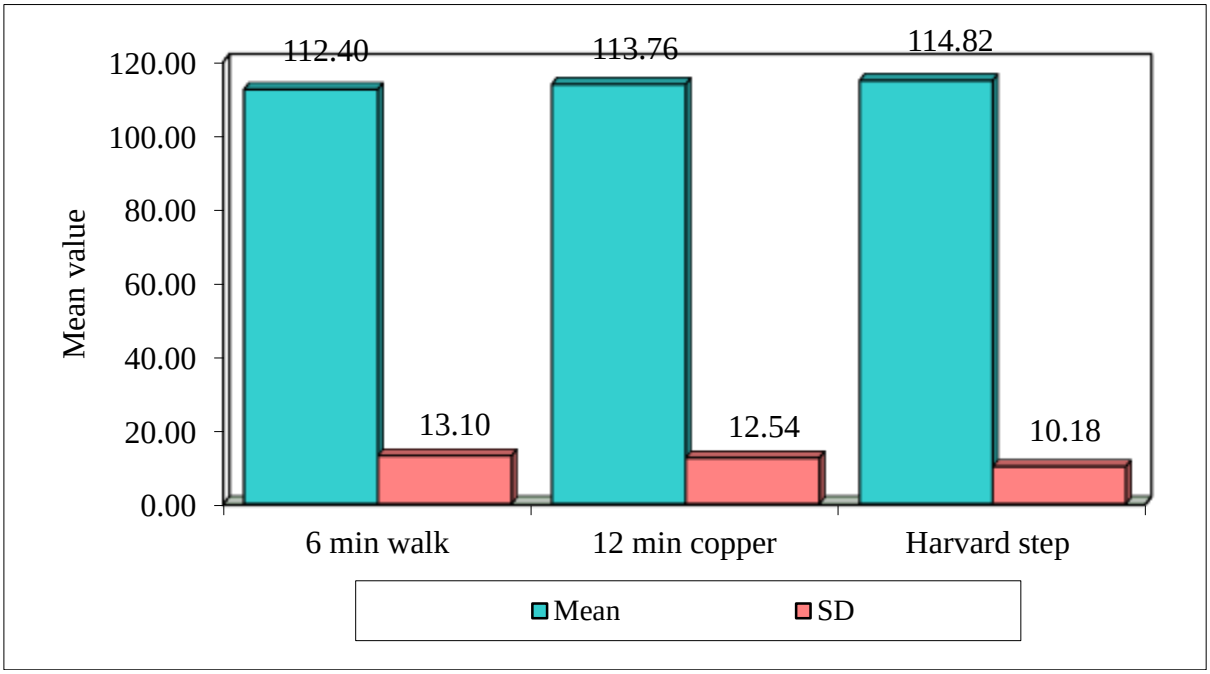
- Table: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with peak HR (bpm) scores by dependent t test

Tests	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
6 min walk	112.40	13.10					
12 min copper	113.76	12.54	-1.36	15.07	-1.21	-0.6379	0.5265
6 min walk	112.40	13.10					
Harvard step	114.82	10.18	-2.42	11.84	-2.15	-1.4452	0.1548
12 min copper	113.76	12.54					
Harvard step	114.82	10.18	-1.06	15.21	-0.93	-0.4929	0.6243

- Table: Correlation between three tests (6 min walk, 12 min copper, Harvard step) with peak HR (bpm) scores by Karl Pearson's correlation coefficient

Test	Correlation between three tests		
	r-value	r^2value	p-value
6 min walk vs 12 min copper	0.3093	0.0957	0.0288*
6 min walk vs Harvard step	0.5064	0.2565	0.0002*
12 min copper vs Harvard step	0.1165	0.0136	0.4205

- *p<0.05
- Figure: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with peak HR (bpm) scores



- Table: Correlation between two tests (6 min walk, 12 min copper) with walk distance (in meters) scores by Karl Pearson's correlation coefficient

Test	Correlation between three tests		
	r-value	r^2value	p-value
6 min walk vs 12 min copper	0.5044	0.2544	0.0002*

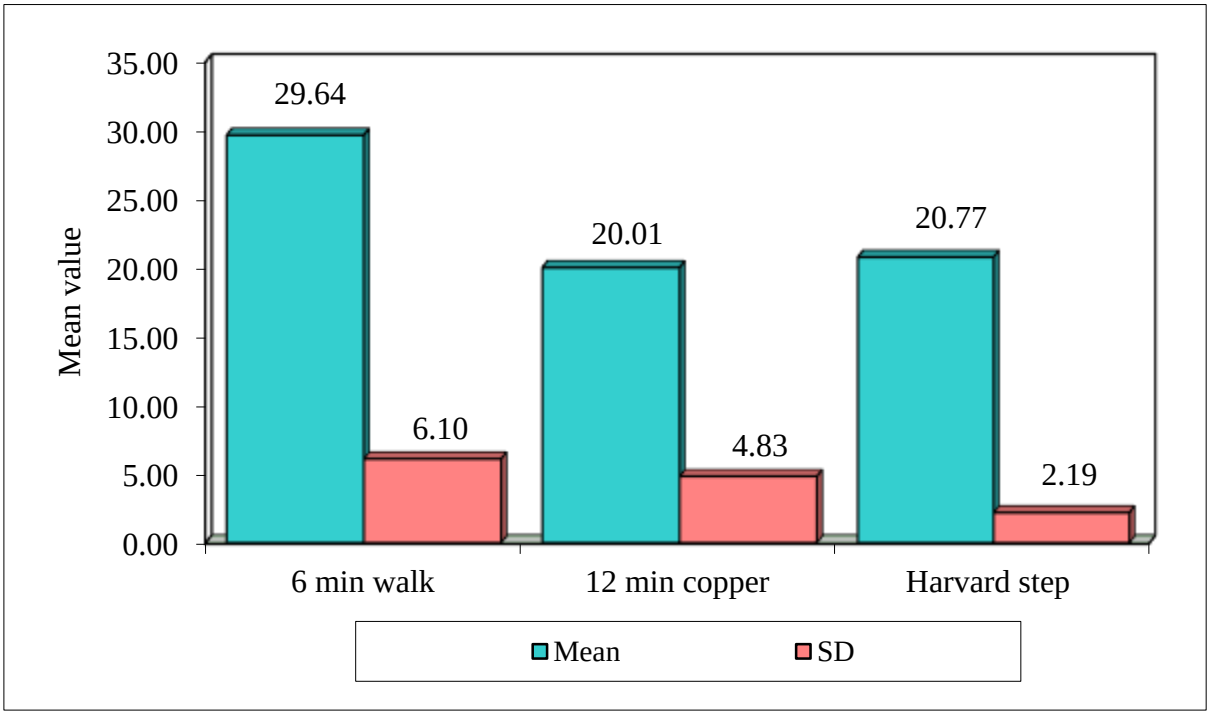
- *p<0.05
- Table: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with Vo2 max scores by dependent t test

Tests	Mean	SD	Mean Diff.	SD Diff.	% of change	Paired t	p-value
6 min walk	29.64	6.10					
12 min copper	20.01	4.83	9.63	5.55	32.49	12.2628	0.0001*
6 min walk	29.64	6.10					
Harvard step	20.77	2.19	8.87	7.34	29.93	8.5490	0.0001*
12 min copper	20.01	4.83					
Harvard step	20.77	2.19	-0.76	5.87	-3.79	-0.9135	0.3655

- *p<0.05
- Table: Correlation between three tests (6 min walk, 12 min copper, Harvard step) with Vo2 max scores by Karl Pearson's correlation coefficient

Test	Correlation between three tests		
	r-value	r^2value	p-value
6 min walk vs 12 min copper	0.5045	0.2545	0.0002*
6 min walk vs Harvard step	-0.4427	0.1960	0.0013*
12 min copper vs Harvard step	-0.2948	0.0869	0.0377*

- *p<0.05
- Figure: Comparison of three tests (6 min walk, 12 min copper, Harvard step) with Vo2 max scores



- Table: Agreement or matching between three tests (6 min walk, 12 min copper, Harvard step) in assessment of different variables by Weighted Kappa statistics

Variables	Test	Agreement	Kappa	Std. Err.	Z	Prob>Z
Resting SpO2 (%)	6 min walk vs 12 min copper	96.40%	0.8879	0.0996	8.9100	0.0001*
	6 min walk vs Harvard step	94.40%	0.8278	0.0981	8.4400	0.0001*
	12 min copper vs Harvard step	95.50%	0.8849	0.0984	8.9900	0.0001*
Lowest SpO2 (%)	6 min walk vs 12 min copper	92.89%	0.7466	0.0908	8.2300	0.0001*
	6 min walk vs Harvard step	95.56%	0.8526	0.0905	9.4200	0.0001*
	12 min copper vs Harvard step	91.56%	0.6976	0.0901	7.7400	0.0001*
Resting HR (bpm)	6 min walk vs 12 min copper	77.20%	0.2828	0.0894	3.1700	0.0008*
	6 min walk vs Harvard step	79.00%	0.3225	0.0895	3.6000	0.0002*
	12 min copper vs Harvard step	98.33%	0.9472	0.0880	10.7700	0.0001*
Peak HR (bpm)	6 min walk vs 12 min copper	78.29%	0.2442	0.0846	2.8800	0.0020*
	6 min walk vs Harvard step	80.00%	0.3330	0.0815	4.0900	0.0001*
	12 min copper vs Harvard step	73.95%	0.0624	0.0794	0.7900	0.2161
Vo2 max	6 min walk vs 12 min copper	59.42%	0.0578	0.0333	1.7400	0.0411
	6 min walk vs Harvard step	53.61%	-0.0630	0.0262	-2.4100	0.9919
	12 min copper vs Harvard step	63.42%	-0.1210	0.0784	-1.5400	0.9387

- *p<0.05

All data were entered into an Excel spreadsheet and Statistical analysis was performed using SPSS version 21 (Armonk, New York, USA) for windows, was used for interpretation and analysis of the collected data was done using statistical methods.

RESULTS

This investigation focused on individuals who had recovered from Cabg, examining the correlation between Specificity and sensitivity of 6 min walk test, Harvard step test and 12 min cooper test in patients undergone Coronary Artery Bypass Grafting surgery.

The significant results were seen in the following variables on the basis of comparison and correlation of three tests (6 min walk, 12 min copper, Harvard step) with resting SpO2 (%) scores,lowest spo2(%) ,resting HR (bpm) ,peak heart rate, vo2max by dependent t test and by Karl Pearson's correlation coefficient.

DISCUSSION

The current study discovered the correlation between Specificity and sensitivity of 6 min walk test, Harvard step test and 12 min cooper test in patients undergone Coronary Artery Bypass Grafting surgery. Interpretation of Results:Analyze the sensitivity and specificity values obtained and their implications for the diagnostic accuracy of exercise tests in coronary bypass patients.Discuss any significant correlations observed between specific exercise tests and coronary artery status, highlighting strengths and limitations.Clinical Relevance:Explore the practical implications of the study findings for clinicians managing coronary bypass patients.Consider how the sensitivity and specificity of exercise tests can influence treatment decisions and patient outcomes, emphasizing the importance of accurate diagnosis in thispopulation. Methodological Considerations:Reflect on the strengths and weaknesses of the study design and methodology, including potential sources of bias or confounding variables.Address any limitations that may have affected the reliability or generalizability of the results, offering suggestions for future research to address these limitations.Comparison with Existing Literature:Compare the current findings with previous studies in the field, highlighting any discrepancies or consistencies.Discuss how the study contributes to the existing body of knowledge on exercise testing in coronary bypass patients and advances our understanding of diagnostic strategies in this population.Conclusion: Summarize the key findings of the study and their implications for clinical practice and future research. Emphasize the importance of sensitivity and specificity in evaluating exercise tests for CAD diagnosis in coronary bypass patients and underscore the need for further investigation to optimize diagnostic accuracy and patient outcomes.

CONCLUSIONS

The conclusion of "Correlation Analysis of Exercise Tests: Sensitivity and Specificity in Coronary Bypass Patients" would likely summarize the findings of the study regarding the sensitivity and specificity of exercise tests in coronary bypass patients. It may discuss the effectiveness of these tests in accurately diagnosing coronary artery disease in this particular patient population. Additionally, the conclusion might highlight any limitations of the study, suggest areas for further research, and provide implications for clinical practice, such as the potential for refining diagnostic protocols for coronary artery disease in coronary bypass patients.

LIMITATIONS

One limitation of the study "Correlation Analysis of Exercise Tests: Sensitivity and Specificity in Coronary Bypass Patients" could be the relatively small sample size, which may limit the generalizability of the findings to a broader population of coronary bypass patients. Additionally, the study might have been conducted at a single center, potentially introducing bias or limiting the diversity of patient demographics and clinical characteristics. Furthermore, the retrospective nature of the analysis might have led to incomplete or inconsistent data collection, affecting the accuracy and reliability of the results. These limitations should be considered when interpreting the findings and designing future research studies in this area

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