

# Study to Evaluate Current Trends in Appropriate Usage of Tread Mill Exercise Testing

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## ABSTRACT

**Introduction:** Non-invasive tests are used to diagnose and prognosticate Coronary Artery Disease (CAD) patients and also in pre-operative evaluation and rehabilitation. Millions of these tests are performed worldwide in these situations. However, previous studies have shown inappropriate use of these tests.

**Aim:** The study was to evaluate the appropriate use of treadmill exercise test.

**Materials and Methods:** The present retrospective study was done in Rajiv Gandhi Super Speciality Hospital, Raichur and Institute of Medical sciences and RKB Super Speciality Clinic, Raichur, Karnataka, India. Tread Mill Tests (TMT) which were done between November 2013 and February 2016 were

included in the study. A total of 600 tests were evaluated for appropriateness. Demographic, clinical and risk factors, indications were studied.

**Results:** Overall 298 (49.66%) tests were found to be inappropriate. Younger age, female sex, pre-operative evaluation, evaluation in master health check up and insurance were predictors of inappropriate use ( $p < 0.05$ ) in this study.

**Conclusion:** The treadmill exercise testing appears to be particularly vulnerable to overuse in clinical setting due to its wide availability, affordability and awareness. The inappropriate use of the method, however, may result in additional unnecessary cost to health care system.

**Keywords:** Appropriate use, Coronary artery disease, Tread mill test

## INTRODUCTION

The annual direct and indirect cost of cardiovascular disease and stroke in the United States is an estimated 320 billion dollars. Annually more than 10 million stress tests and approximately one million diagnostic cardiac catheterizations are being performed in US alone [1].

The most frequent indications for exercise testing are to aid in establishing the diagnosis of CAD, determining functional capacity, and estimating prognosis. The indications continue to evolve, with some that are uniformly accepted and others that are more controversial [2].

Earlier studies and meta-analyses reported accuracy of TMT for the diagnosis of CAD as defined by the gold standard of cardiac catheterization [3-6]. The sensitivity of TMT for detecting CAD is only modest, approximately 70%, while specificity is good (75%-80%). Addition of myocardial imaging to standard exercise testing increases sensitivity. These tests are used to diagnose and prognosticate CAD patients and also in pre-operative evaluation and rehabilitation. Millions of these tests are performed worldwide in these situations. However, previous studies have shown inappropriate use of these tests [7-10].

In an effort to respond to the need for rational use of these tests in the delivery of high quality care, guidelines have been proposed. Appropriate use criteria publications reflects an ongoing effort to critically and systematically create, review, and categorize clinical situations where tests and procedures are utilized by physicians caring for patients with cardiovascular diseases. The process is based on current understanding of the technical capabilities of the procedures examined, evidence base, and clinical experience [11]. ACC/AHA has earlier published exercise testing guidelines update [12].

Earlier study from Brazil has reported that the vast majority of TMT referrals in the assessment of CAD to be inappropriate. In their study, 78% of TMTs were rated inappropriate [13].

Appropriate use criteria in patients undergoing exercise treadmill testing has not been reported in Indian patients earlier. The purpose of this study was to determine the rate of inappropriate cardiac exercise stress testing.

## MATERIALS AND METHODS

This study was conducted in Rajiv Gandhi Super Speciality Hospital, Raichur Institute of Medical Sciences and RKB Super Speciality Clinic, Raichur, Karnataka, India.

A retrospective study was undertaken, TMTs done between November 2013 and February 2016 were included. All were evaluated for demographic profile, clinical indications and risk profile. All TMTs were divided into three-groups. Group 1 was symptomatic with chest pain and was sub divided into known CAD (previous MI or unstable angina or revascularization), not a known CAD. Group 2 was asymptomatic group and was sub-divided into those undergoing for insurance purposes, master health check-ups and others. Group 3 was patients who were referred for pre-operative evaluation. The assessment of Cardiovascular (CV) risk was defined according to risk prediction of the WHO based on sex, age, blood pressure, presence of diabetes and smoking. Participants were then classified as low if CV risk was estimated to be <10% in 10 years, intermediate if between 10% and 20%, and high if above 20% [14]. Appropriate use criteria were adopted from ACCF/AHA/ASE/ASNC/HFSA/HRS/SCAI/SCCT/SCMR/STS 2013 multi modality appropriate use criteria for the detection and risk assessment of stable ischemic heart disease. Based on this, each test was classified as appropriate or inappropriate [11].

## STATISTICAL ANALYSIS

The primary analysis was the rate of inappropriate tread mill testing. Pre-specified sub-analysis included clinical predictors of inappropriate testing, continuous variables were compared with a t test and categorical variables were compared with Fisher's exact test. A p-value < 0.05 was considered significant.

## RESULTS

A total of 600 TMTs were done during the study period, 200 in Group 1 (symptomatic), 310 in Group 2 (asymptomatic) and 90 in Group 3 (pre-operative evaluation). More males in Group 1 and 2 and more females in Group 3 were noted. Inappropriate usage was 20% in Group 1, 60% in Group 2 and 80% in Group 3 Overall 298 (49.66%) tests were found to be inappropriate [Table/Fig-1].

Younger age, female sex, pre-operative evaluation, evaluation in master health check up and insurance were predictors of inappropriate use ( $p < 0.05$ ) in this study [Table/Fig-2]. Presence of chest pain and multiple risk factors (male sex, dyslipidemia, diabetes, hypertension, tobacco use) was more in appropriate use ( $p < 0.05$ ).

## DISCUSSION

In this study we described the prevalence of inappropriate use of TMT. It appears half of the testing was inappropriate in our study

All (600)	M:F 360:240
Age	47±13
Group 1 (200) (Symptomatic)	M:F 120:80
Group 2 (310) (Asymptomatic)	M:F 175:135
Group 3 (90) (Pre-operative)	M:F 72:18
Hypertension	60 (10%)
Diabetes	48 (8%)
Tobacco	30 (5%)
Pre-test probability	Very low 276 (46%) Low 180 (30%) Intermediate 120 (20%) High 24 (4%)
CV Risk	Low 480 (80%) Intermediate 72 (12%) High 48 (8%)

[Table/Fig-1]: Characteristics of TMTs.

Parameter	Appropriate	Inappropriate	p-value
Age (all)	58±12	40±10	<0.05
Male sex (all)	55%	45%	NS
Multiple clinical risk factors (all)	8%	3%	<0.05
Pre-operative evaluation (90)	18 (20%)	72 (80%)	<0.01
Master checkup (110)	33 (30%)	77 (70%)	<0.01
Insurance purpose (90)	27 (30%)	63 (70%)	<0.05

[Table/Fig-2]: Appropriate and inappropriate usage of TMT/exercise testing.  
NS= Not significant.

which is consistent with earlier reports. Orsini et al., have reported inappropriate testing in their 960 prescriptions. The appropriateness was only 27% for exercise stress testing which was inferior when compared with vascular echography and echocardiography. They also noted appropriateness was better when diagnostic investigations were recommended by cardiologists [15]. Also another Italian study by Lorenzoni et al., have similarly reported that less than half of the prescriptions for non-invasive diagnostic tests were appropriate, appropriately prescribed exams were more often abnormal and useful [16].

In our study younger age, female sex, pre-operative evaluation, evaluation in master health check up and for insurance purpose were predictors of inappropriate use. In younger age population pre-test probability is low or very low and hence, they are more often inappropriate. Majority of patients in pre-operative evaluation were females having non-specific ECG changes. Most of the annual master health check-ups appear unnecessary, routine stress testing every year in relatively healthy population contribute to inappropriate testing significantly. We have also studied persons

recommended for TMTs before medical or life insurance. The insurance companies rely on the premiums before recommending for TMT. Higher premiums are associated with recommendation for TMT and in this group the TMT are generally normal.

The multivariate model by Silva et al., showed that only being from the private health system was an independent predictor of inappropriate use of treadmill exercise test [13]. Neither the CV risk nor the presence of co-morbidities tested the logistic regression models remained significant after adjusting for health system.

Though it is encouraging to note that the prescriptions of cardiologists were more appropriate in earlier studies [15,16], but majority of diagnostic cardiac non invasive investigations are prescribed by treating physicians or family physicians in India. Even surgeons recommend non-invasive investigations pre-operatively to assess risk profile which in most studies appears inappropriate. The recommendation for a particular test appears to be dependent on its easy availability, cost and interpretation.

Irrational use of diagnostic complementary methods directly impacts health care spending. It was estimated that inappropriate use of treadmill testing added 3 million dollars in 2012 in Brazil's health expenditure [13].

The American Heart Association and American College of Cardiology Exercise Task Force have determined several categories of test indications drawn from a large body of published literature on exercise testing. Exercise testing should not be used to screen very low risk asymptomatic individuals because the test has limited diagnostic and prognostic value in this situation, and the resultant undesirable consequences of a false positive exercise test result might include unnecessary follow-up, additional procedures, anxiety, and exercise restriction [2].

## LIMITATION

There are limitations regarding generalization of our study. This is a single centre study with small sample size, representing local reality. There is need of multi centric large sample to represent national trends.

## CONCLUSION

Non-invasive and invasive tests are available for diagnosis and prognostication of CAD. However, each test may be underused or overused if appropriate guidelines are not followed. Non-invasive tests like TMTs are available widely and are more prone to be used beyond the recommended guidelines due to lack of awareness about appropriate use criteria. There is urgent need to create awareness among referring physicians and to follow the recommended clinical practice guidelines and appropriate use criteria.

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