

# Exercise capacity of Saudi with symptoms suggestive of cardiovascular disease in a military hospital in Western Saudi Arabia

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## ABSTRACT

**الأهداف:** تحليل نتائج اختبار تحمل ممارسة التمارين ETT بين النساء السعوديات وتقييم القدرة على ممارستها.

**الطريقة:** أجريت دراسة استرجاعية مبنية على بيانات من مستشفى القوات المسلحة بالهدا - الطائف - المملكة العربية السعودية. في الفترة ما بين فبراير 2005 وحتى يونيو 2007م. شملت الدراسة النساء اللاتي تم تحويلهن لقسم القلب لعمل اختبار تحمل ممارسة التمارين ETT.

**النتائج:** ضم البحث 176 امرأة، 51 (31.9%) لم يتوصلوا لمعدل نبض القلب المأمول. متوسط العمر كان  $48.3 \pm 9.3$  عام. لم يوجد علاقة ذات دلالة معنوية بين العمر، والسكري، وارتفاع ضغط الدم، والتاريخ العائلي لأمراض القلب (IHD)، وارتفاع الدهون بالدم، وبين الحصول على نبض القلب المأمول ( $p > 0.05$ ). مدة التمارين تأثرت بوجود مرض السكري ( $p < 0.054$ ). وارتفاع نسبة الدهون بالدم ( $p < 0.044$ ). متوسط مدة التمارين كان  $5.15 \pm 2.63$  دقيقة. حساسية الاختبار كانت 36.4% (95% CI 29.3-44.6)، وخصوصيته كانت 92.3% (95% CI 80.5-96.8). القيمة التوقعية الايجابية كانت 26.7% (95% CI 21.3-31.4)، والقيمة التوقعية السالبة كانت 95.4% (95% CI 90.9-98.3). قيمة التوقع الايجابي كانت 4.7 (95% CI 3.1-6.2) والسالبة 0.69 (95% CI 0.48-0.81).

**خاتمة:** تبين أن القدرة على ممارسة التمارين بين النساء السعوديات أقل إذا ما تم مقارنتها بالنساء في المناطق الأخرى. اختبار تحمل ممارسة التمارين يمكن أن يستخدم لاستبعاد أمراض القلب (IHD) بين النساء السعوديات، أما نتائجه الايجابية فقد ثبت من البحث أنها أقل من حيث التنبؤ بوجود أمراض القلب (IHD) بين النساء.

**Objective:** To analyze the results of exercise tolerance test (ETT) of Saudi women and assess their exercise capacity.

**Methods:** A hospital based retrospective cohort analysis was carried out on all Saudi women referred to the Cardiology Department for ETT from February 2005 to June 2007. They underwent symptom limited treadmill test according to the standard Bruce protocol with exercise electrocardiogram monitoring.

**Results:** One hundred and seventy-six women were included in the study. Fifty-one (31.9%) patients did not achieve target heart rate. The mean age  $\pm$  SD was  $48.3 \pm 9.3$  years. There was no association of age, diabetes mellitus, hypertension, positive family history of ischemic heart disease (IHD) and hyperlipidemia to achieve target heart rate ( $p > 0.05$ ). Exercise time was influenced by diabetes mellitus ( $p = 0.054$ ) and hyperlipidemia ( $p = 0.044$ ). The mean exercise time  $\pm$ SD was  $5.15 \pm 2.63$  minutes and the mean exercise capacity  $\pm$ SD was  $6.29 \pm 2.52$  metabolic equivalent. Sensitivity was 36.4% (95% CI 29.3-44.6), specificity 92.3% (95% CI 80.5-96.8), positive predictive value 26.7% (95% CI 21.3-31.4), negative predictive value 95.4% (95% CI 90.9-98.3), likelihood ratio for positive result was 4.7 (95% CI 3.1-6.2) and likelihood ratio for negative result was 0.69 (95% CI 0.48-0.81).

**Conclusion:** Exercise capacity of Saudi women is less when compared to similar studies in women from other regions. Exercise tolerance test can be used to rule out presence of IHD in Saudi women, but value of a positive test is less likely to predict the presence of IHD.

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Coronary artery disease is the leading cause of morbidity and mortality in the world. The incidence among the female population is increasing.<sup>1-3</sup> Now cardiovascular disease (CVD) is the leading cause of mortality in women. It is responsible for a third of all deaths of women worldwide and half of all deaths of women over 50 years of age in developing countries,<sup>2</sup> whereas the mortality among men has steadily declined.<sup>1</sup> Various factors were blamed for this change, including cultural, behavioral, psychosocial and socioeconomic. There is a need for in depth understanding of this difference, and it may be that the knowledge gap is responsible for this difference.<sup>2</sup> Exercise tolerance testing (ETT) is a well-established procedure with widespread clinical applications for many decades. The use of ETT is recommended by the American College of Cardiology (ACC)/American Heart Association (AHA)/American College of Physicians-American Society of Internal Medicine (ACP-ASIM) committee<sup>4</sup> for management of chronic stable angina in female patients. In many women with low test probability, a negative exercise test will be sufficient and an imaging procedure will not be required.<sup>4</sup> In addition, exercise capacity can be assessed by ETT. Low exercise capacity, failure to achieve THR and low heart rate recovery after exercise are independent predictors of death from coronary artery disease and all-cause mortality in women.<sup>5-9</sup>

The objective of the current study is to analyze the results of ETT and assess the exercise capacity as an independent and modifiable factor for all cause mortality among women.

**Methods.** This study was conducted at Cardiology Department, Al-Hada Military Hospital, Taif. A hospital based retrospective cohort analysis was carried out, using data obtained from the review of charts. The cohort included all women (N=176) referred to cardiology department for ETT from February 2005 to June 2007. Research and Ethics Committee approved the study. Non-Saudi women were excluded from the cohort (n=9). All women underwent symptom limited treadmill test according to Bruce protocol with exercise ECG monitoring. Heart rate and blood pressure were measured, and a 12 lead ECG was recorded before, at the peak and at the end of exercise. The test was discontinued for symptoms (chest pain, fatigue, dyspnea, dizziness or patient's refusal to do any more exercise), ischemic changes on ECG, decrease in blood pressure of 10 mm Hg, or achievement of target heart rate (THR). The THR was calculated (220 minus age of the person). More than 85% of the calculated heart rate was considered as THR achieved. If exercises

were stopped for any indication other than those suggestive of ischemia, before achieving the THR the test was considered inconclusive.<sup>10</sup> Exercise capacity was estimated in metabolic equivalent (MET) using the time and stage of exercise (speed and grade of treadmill). Metabolic equivalent is the ratio of a person's working metabolic rate relative to the resting metabolic rate. Metabolic equivalent is defined as one kilocalorie per kilogram per hour and is the caloric consumption of a person while at complete rest.<sup>10</sup>

Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS), version 13. Chi-square test was used to analyze the association between age, diabetes mellitus, hypertension, family history, and hyperlipidemia from one side and achieving THR from the other side. Student t-test was utilized to test the difference in mean exercise time as a continuous variable between 2 compared groups. A *p*-value of  $\leq 0.05$  was considered significant. Clinical notes were checked for other tests-coronary catheterization,<sup>18</sup> Dobutamine stress echocardiography,<sup>32</sup> thallium scintigraphy<sup>1</sup> and echocardiography (133) to confirm or rule out the ischemic heart disease (IHD). Though not ideal as a gold standard test against screening test, any test suggestive of ischemia was taken as positive for IHD. The ejection fraction (EF)  $>55\%$  in the absence of regional wall motion abnormality on echocardiography was taken as negative for IHD. Sensitivity, specificity, positive predictive value, negative predictive value, and likelihood positive and negative ratios of the screening test (ETT) were calculated with 95% confidence intervals (CI).

**Results.** During the period from February 2005 to 2007, a total 176 women reported for exercise tolerance test (ETT) for various indication (**Figure 1**) with an age range from 14-70 years. Nine non-Saudi women were excluded, and data for 167 Saudi women were analyzed. The mean age  $\pm$ SD was  $48.3 \pm 9.3$  years. The median age was 48 years. Target heart rate was studied in 160 patients. Two patients refused to carry out exercises and 5 had their ETT stopped before reaching THR due to ECG changes, their data were excluded from THR calculations. One hundred and nine (68.1%) achieved THR as compared to 51 (31.9%). Association of THR achievement was also analyzed with regards to risk factors of IHD (**Table 1**). None was found to influence the achievement of THR ( $p > 0.05$ ). The mean duration of exercise time  $\pm$  SD was  $5.15 \pm 2.63$  minutes. Second stage of Bruce protocol with mean exercise capacity  $\pm$ SD was  $6.29 \pm 2.52$  MET. The median was 6 MET (**Table 3**). Exercise capacity was  $<5$  MET in 51/167 (30.5%),

**Table 1** - Determinants of achieving target heart rate (THR).

Variable	Total	THR not achieved n=51	THR achieved n=109	$\chi^2$	P-value
<i>Age</i>				3.23	0.358
<35 years	14	2 (14.3)	12 (85.7)		
36 to 45years	46	14 (30.4)	32 (69.6)		
46 to 55 years	72	27 (37.5)	45 (62.5)		
>55years	28	8 (28.6)	20 (71.4)		
<i>Diabetes mellitus</i>				0.03	0.865
No	80	26 (32.5)	54 (67.5)		
Yes	80	25 (31.3)	55 (68.8)		
<i>Hypertension</i>				0.42	0.517
No	75	22 (29.3)	53 (70.7)		
Yes	85	29 (34.1)	56 (65.9)		
<i>Family history</i>				0.04	0.835
No	96	30 (31.3)	66 (68.7)		
Yes	64	21 (32.8)	43 (76.2)		
<i>Hyperlipidemia</i>				0.01	0.927
No	87	28 (32.2)	59 (67.8)		
Yes	73	23 (31.5)	50 (68.5)		

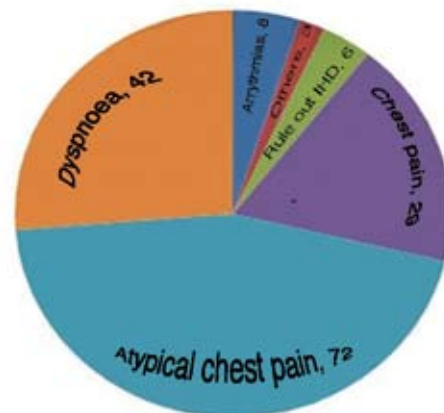
**Table 2** - Mean exercise time according to risk factors of IHD.

Risk factors	Minutes of mean exercise time $\pm$ SD	t value	P-value
<i>Diabetes mellitus</i>			
No	5.41 $\pm$ 2.87		
Yes	4.89 $\pm$ 2.36	3.68	0.054
<i>Hypertension</i>			
No	5.62 $\pm$ 2.73		
Yes	4.74 $\pm$ 2.48	0.24	0.619
<i>Family history</i>			
No	5.15 $\pm$ 2.67		
Yes	5.14 $\pm$ 2.59	0.09	0.760
<i>Hyperlipidemia</i>			
No	5.52 $\pm$ 2.84		
Yes	4.71 $\pm$ 2.30	4.11	0.044*

\*Statistically significant

**Table 3** - Results of exercise tolerance test.

Variable	%	95% confidence intervals
Metabolic equivalent		6.29 SD $\pm$ 2.52
Mean		6
Median		
Sensitivity	36.4	29.3 - 44.6
Specificity	92.3	80.5 - 96.8
Positive predictive value	26.7	21.3 - 31.4
Negative predictive value	95.4	90.9 - 98.3
Likelihood ratio for positive result	4.7	3.1 - 6.2
Likelihood ratio for negative result	0.7	0.48 - 0.81

**Figure 1** - Indications of exercise tolerance testing

between 5 and 8 MET in 95/167 (57%) and >8 MET in 21/167 (12.5%) of Saudi women. Relationship of risk factors of IHD to mean duration of exercise (exercise capacity) was analyzed using t test (Table 2). Hyperlipidemia ( $p=0.044$ ) and diabetes mellitus ( $p=0.054$ ) were found to influence the time to achieve THR, thus having an effect on exercise capacity. In this cohort of Saudi women, ETT had the sensitivity of 36.4% (95% CI 29.3-44.6) and a specificity of 92.3% (95% CI 80.5-96.8) with positive predictive value of 26.7% (95% CI 21.3-31.4) and negative predictive value of 95.4% (95% CI 90.9-98.3). Likelihood ratio (LR) for positive results LR+ 4.7 (95% CI 3.1-6.2) and the negative result is LR- 0.69(95% CI 0.48-0.81) (Table 3).

**Discussion.** We showed that ETT is a valuable test for initial assessment of IHD and assessment of exercise capacity. It is a good test to rule out IHD in Saudi women as it has a negative predictive value of 95.4% and negative likelihood ratio of 0.69 (<0.1 often suggests conclusive decrease in the likelihood of disease). However, it has the sensitivity of 36.4% in this cohort and the positive predictive value of 26.7% with positive likelihood ratio of 4.7 (2-5 suggest small increase in the likelihood of disease). This suggests that ETT may not be able to indicate that a woman with a positive test will have IHD and will need further investigations to confirm the diagnosis. Exercise tolerance testing showed a sensitivity of 36.4% and specificity 92.3% in this cohort, as compared to reported sensitivity of 68% with a specificity of 77%.<sup>1,10</sup> This difference could be explained that we did not performed coronary catheterization in all the cases, other than clinically indicated. Echocardiography was used in most of the cases along with dobutamine stress echo and thallium scan to rule out IHD. Echocardiography evidence of decreased cardiac function, EF <55% or regional wall abnormality was taken as evidence of IHD, unless proved otherwise by other tests. The important finding in this study is the low exercise capacity in this cohort. The average exercise time was 5 minutes, and most women stopped in second stage of the exercise with a mean exercise capacity of  $6.29 \pm 2.52$  MET. Approximately 31.9% failed to achieve THR and 30.5% had exercise capacity of <5 MET. Both are independent factors for IHD and all cause mortality.<sup>1,5-7</sup> Gulati et al,<sup>6</sup> calculated the relationship of exercise capacity to the risk of death in women. They suggested that MET level of <5, 5-8, and >8 had a hazard ratio of death of 3.1 (2.4-4.7), 1.9 (1.3-2.9) and 1.0 respectively. Mora et al<sup>5</sup> studied 2994 asymptomatic North American women and followed them up for average of 20 years. Four hundred and twenty-seven of these women died and 147 of these were due to cardiovascular deaths. They demonstrated low exercise capacity, low heart rate recovery, and not achieving THR were independently associated with all cause mortality and cardiovascular death. The median capacity in this study was 7.5 MET as compared to 6 MET in our study and 21% did not achieve THR as compared to 31.9% in our study. After adjusting for other risk factors, they demonstrated that women who were below the median for exercise capacity (7.5 MET) and a high recovery heart rate had 3.5 fold increased risk of cardiovascular death. Myers et al<sup>7</sup> prospectively examined >6000 symptomatic men for a mean of

6.2 years. They found that for each 1-MET increase in exercise capacity, there was a 12% reduction in all cause mortality. These comparisons clearly show that the indicators for all cause mortality and cardiovascular death are higher in Saudi women. If we translate the MET capacity of Saudi women in normal daily activity, we will realize that 30.5% are only able to carry out less than normal household activity, suggested by exercise capacity of <5 MET, and 87.5% had exercise capacity of <8 MET, the average fitness level suggested by American heart association. The American College of Sports Medicine (ACSM) and the American Heart Association have updated physical activity guidelines and greatly stressed on the physical activity in their current statement.<sup>11</sup> We also analyzed the role of different factor in achieving THR and the relationship to duration of exercise. We found that none of these factor influenced the achievement of THR whereas the mean time of exercise was influence by hyperlipidemia ( $p=0.044$ ) and to some extent by diabetes mellitus ( $p=0.054$ ). Though p value is not statistically significant in women with diabetes mellitus however, it is very close to 0.05 suggesting that diabetes mellitus may influence the mean exercise time. These findings again suggest that there are many modifiable factors in the life style of Saudi women, which appropriately can changed and can be help them to increase the quality and quantity of life.

The study has its limitation by being retrospective in nature and our inability to perform definite tests such as angiography to rule out IHD. An invasive procedure, with potential complications, would be ethically unjustifiable in ETT negative patients. Therefore, this study relied on indirect evidence of compromised cardiac functions. It also relies on data from western countries for comparison. In future these women will be followed up, to evaluate the incidence of cardiac events in Saudi women with different exercise capacities.

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