ABSTRACT

VOELKER, S. A. Relationship between the Talk Test and ventilatory threshold in cardiac patients. MS in Adult Fitness/Cardiac Rehabilitation, December 2001, 40pp. (C.Foster)

The Talk Test (TT) is a subjective method of prescribing exercise intensity. Previous studies have demonstrated that TT relates to the ventilatory threshold (VT) and can be used to prescribe intensity levels in healthy individuals. This study extends evaluation of TT to patients with stable cardiovascular disease. Each subject (N = 10) completed two maximal exercise tests. One test used gas analysis to determine VT. The second test was identical but in this one TT was administered. Outcomes at VT versus TT were compared. There was a significant difference in $V0_2$ and HR between VT and the negative stage of TT ($p < 0.05$). There was a good correlation for VO_2 at VT and all stages of TT. We conclude that when subjects were at the last positive or equivocal stage of TT that they were either at or below their VT. When subjects were at the negative stage of TT, they were above their VT and above an appropriate exercise intensity. Thus, TT appears to be a valid subjective measure of exercise intensity to guide exercise prescription in patients with clinically stable cardiovascular disease.

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RELATIONSHIP BETWEEN THE TALK TEST AND VENTILATORY THRESHOLD IN CARDIAC PATIENTS

A MANUSCRIPT STYLE THESIS PRESENTED

TO

THE GRADUATE FACULTY

UNIVERSITY OF WISCONSIN-LA CROSSE

IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE

MASTER OF SCIENCE DEGREE

BY

STACIE VOELKER

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I would first like to thank my family for all of your unconditional love and support. Mom, Dad, without you I would not be where I am today. For that I will always be grateful.

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INTRODUCTION

According to the 2000 Heart and Stroke Statistical Update published by the American Heart Association (1), one in five adults have some sort of cardiovascular disease. As these individuals enter cardiac rehabilitation programs, an individualized exercise prescription is designed using the following components: mode, intensity, duration, frequency, and progression. Perhaps the most difficult of these prescriptive elements to assess is intensity, particularly in cardiac patients, due to the absence of exercise tests or the effects of medications. Therefore, objective methods of determining intensity in cardiac rehabilitation programs such as ventilatory threshold (VT) (also known as anaerobic threshold), percentage of maximal oxygen consumption (VO_2max), and percentage of maximal heart rate are not always the most feasible ways to determine exercise training intensity. Subjective methods of determining intensity such as the Rating of Perceived Exertion (RPE) and the Talk Test may be the only practical methods of monitoring training intensity. Subjective methods are also preferred by many individuals (2,3).

Currently, the Borg RPE scale (4) is a very popular way to determine exercise intensity in rehabilitation programs. The scale goes from 0 to 10, 0 being rest and 10 being maximal exertion. The American College of Sports Medicine (ACSM) recommends that exercise be rated at 3 to 4, which is "moderate" to "somewhat hard" as the upper limit of prescribed intensity in the early stages of outpatient rehabilitation

programs (5). The RPE scale is a useful method of determining intensity only if the patient is aware of the scale and has a working knowledge of it. Importantly, a significant percentage of individuals have difficulty using the scale.

The other subjective method for determining exercise intensity that has been recommended but is not yet as well accepted is the Talk Test. Using the Talk Test, the individual exercises at an intensity at which he/she can still hold a conversation (2). Brawner and his colleagues in 1995 (2), and Czaplicki and his colleagues in 1997 (3) demonstrated that the ACSM exercise intensity guidelines of 60 to 90% of VO_2max (5) were usually met in individuals who could pass the Talk Test, meaning they could still speak comfortably while exercising. In 2000, Dehart-Beverly and her colleagues (6) conducted two treadmill tests on active college aged individuals. In one test VT was measured by gas exchange. In the second test, the Talk Test was administered using a standard paragraph, the "Rainbow Passage" (7). The results suggested that when individuals are still able to talk comfortably while exercising, they are at or below their VT. When talking while exercising is no longer comfortable, individuals are beyond their VT and possibly beyond an appropriate intensity (6). Porcari and his colleagues (8) reanalyzed the data of Dehart-Beverly and her colleagues and found that the negative stage of the Talk Test, meaning individuals could no longer speak comfortably while exercising, was beyond ACSM guidelines for percent of maximal heart rate and percent VO_2max (5). In 2000, Shafer and her colleagues (9) performed a similar study with sedentary individuals and found similar results. On this basis, the Talk Test seems to be

an acceptable method of prescribing exercise in healthy individuals (2,3,6,8,9). Since all four of the previous studies were conducted with healthy subjects, the purpose of this study was to determine whether the Talk Test could also be used to determine appropriate exercise intensity in individuals with stable cardiovascular disease. An additional goal was to determine whether the Talk Test could be used as a simple marker for exertional ischemia. Meyer and her colleagues (10) demonstrated that the ischemic threshold was usually beyond the VT in patients with coronary artery disease (CAD). If the Talk Test is a surrogate for the VT, then it may be that exercising in only the positive stage of the Talk Test would mean avoiding exertional ischemia. This is important since Hassock and Hartwig (11) have shown that the risk for exercise related complications is related to exceeding the ischemic threshold.

METHODS

Subjects

Ten patients (nine males and one female) with clinically stable ischemic heart disease volunteered and participated in the study. The means and standard deviations of descriptive physical characteristics of the subjects are presented in Table 1. All of the subjects had successfully completed a phase II cardiac rehabilitation program and were exercising regularly. Before participating in the study, a health history questionnaire was completed (see Appendix A). Each participant also provided written informed consent (see Appendix B), and filled out a physician notification form (see Appendix C) if they requested that a copy of their results be sent to their physician. The study was approved

Table 1. Means and Standard Deviations of the Descriptive Physical Characteristics

Variable	Total (n = 10)
Age (yrs)	63 +/- 3.0
Height (m)	1.74 +/- .02
Weight (kg)	92.0 +/- 4.8

by the Institutional Review Board at the University of Wisconsin-La Crosse and by the Institutional Review Board at Franciscan Skemp Healthcare. All laboratory testing took place at Franciscan Skemp Healthcare in La Crosse, WI.

Study Design

Each subject performed two maximal exercise tests with a substantial break in between them. A modified Balke treadmill test was used for all of the tests. Each subject selected a speed for a four-minute warm-up. Following the warm-up, the test began with two minutes at that speed with the treadmill belt horizontal. Every subsequent two minutes the grade was increased by 2.5%. The subject exercised until fatigue or until there were clinical indications for exercise test termination.

The first of the two exercise tests performed was with a continuous measurement of respiratory gas exchange using open circuit spirometry (Quinton Q-plex, Seattle, WA). Ventilatory threshold was determined using the V-slope method (12). At the end of every two minutes, heart rate was recorded and RPE was assessed using the Category Ratio Borg Scale (4).

The second exercise test was conducted using the same protocol but without respiratory gas analysis. This test measured the point at which the subject could no longer speak comfortably the words of a standard paragraph while exercising. This is called the Talk Test (2). During the last minute of each stage, the subject was required to read out loud "The Pledge of Allegiance," a 31-word paragraph familiar to most people in our culture. After each recitation they were asked, "Can you speak comfortably?" The possible answers were "Yes" (+), "I'm not sure" (+/-), or "No" (-). Heart rate and RPE were again recorded. Additionally, the presence or absence of electrocardiogram evidence of myocardial ischemia was noted.

Statistical Analysis

Differences in VO_2 and heart rate were compared between VT and the various stages of the Talk Test using repeated measures of analysis of variance (ANOVA). It was assumed that the VO_2 versus time relationship was the same for both tests. Since the protocol was also the same, VO_2 was matched up from the first test with the results of the Talk Test in the second test to be compared. The hypothesis was that the VO_2 and heart rate at the negative stage (-) of the Talk Test would be higher than those values at the VT. The level of significance was set at $p < 0.05$. Post hoc comparisons were made using the Tukey test.

RESULTS

The means and standard deviations for outcome variables are listed in Table 2. A one-way ANOVA was run to determine if VO_2 at VT was significantly different than the three indicators of the Talk Test and the two indicators of RPE. It was found that there

Table 2. Means and Standard Deviations for Outcome Variables

Variable	Total (n = 10)
VO_2max (L/min)	2.07 +/- 1.46
VO_2 at VT (L/min)	1.41 +/- .14
VO_2 at + (L/min)	1.33 +/- .12
VO_2 at +/- (L/min)	1.61 +/- .14
VO_2 at - (L/min)	1.85 +/- .15
VO_2 at RPE = 3 (L/min)	1.04 +/- .10
VO_2 at RPE = 4 (L/min)	1.39 +/- .16
%Predicted VO_2max	90.9 +/- 5.7
HRmax (b/min)	153.7 +/- 8.0
HR at VT (b/min)	115 +/- 6.2
%HRmax @ VT	85.1 +/- 2.2
HR at + (b/min)	108.2 +/- 16.3
HR at +/- (b/min)	119.3 +/- 19.0
HR at - (b/min)	145.8 +/- 18.9
HR at RPE = 3 (b/min)	97.0 +/- 16.9
HR at RPE = 4 (b/min)	114.4 +/- 23.5
%Predicted HRmax	86.7 +/- 5.6

+ = last positive stage of the Talk Test
+/- = equivocal stage of the Talk Test
- = first negative stage of the Talk Test

was a significant difference among the means ($p < 0.05$). A Tukey's post hoc test was used to find pairwise differences. It was found that the VO_2 at VT was significantly less than the VO_2 at the negative stage of the Talk Test ($p < 0.05$). There was not a significant difference found between VO_2 at VT and any of the other indicators ($p > 0.05$). Figures 1-7 illustrate VO_2 at VT versus the Talk Test indicators.

There was a strong correlation between VO_2 at VT and the negative stage of the Talk Test ($r = .83$). There was good correlation between VO_2 at VT and both the last positive stage of the Talk Test ($r = .71$), and the equivocal stage of the Talk Test ($r = .75$). There was only a moderate correlation between VO_2 at VT and RPE = 3 ($r = .60$) and RPE = 4 ($r = .66$).

A one-way ANOVA was run to determine significant differences in heart rate among the six exercise intensity indicators. It was found that there was a significant difference among the means ($p < 0.05$). A Tukey's post hoc test was used to determine pairwise differences. It was found that heart rate at VT was significantly lower than heart rate at the negative stage of the Talk Test ($p < 0.05$). There were no other significant differences in heart rate between VT and any of the other indicators ($p > 0.05$). Figures 8-14 illustrate heart rate (in b/min) at VT as compared to the other five exercise intensity indicators.

There was not a significant correlation between heart rate at VT and heart rate at the positive, equivocal, or negative stage of the Talk Test, or RPE at level 3 or 4 ($r = .03$, $r = .13$, $r = .16$, $r = .12$, and $r = .19$, respectively).

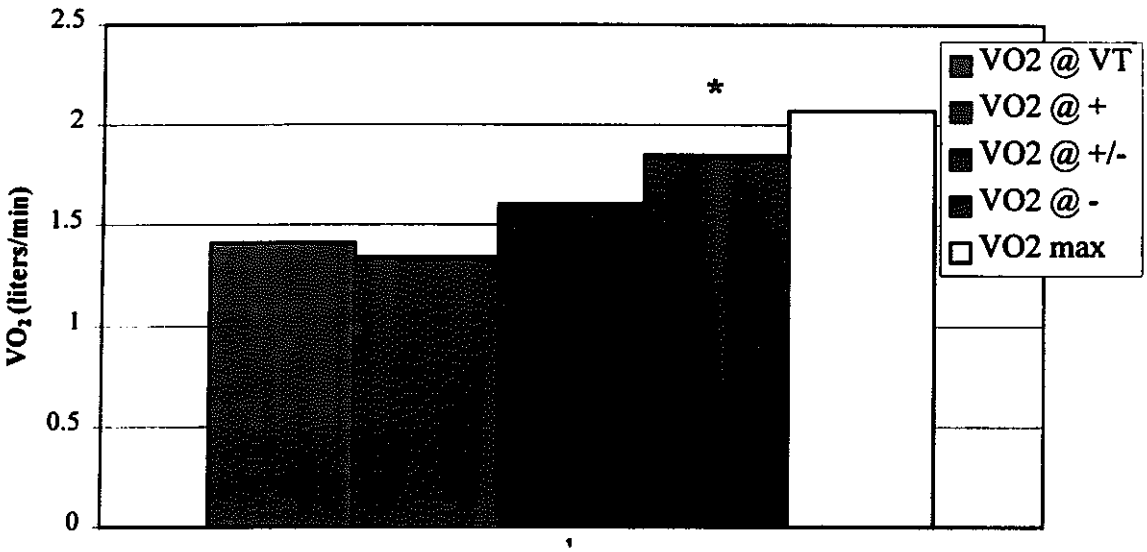

Figure 1. VO_2 at VT versus VO_2 during the Talk Test
* $p < 0.05$ versus VO_2 at VT

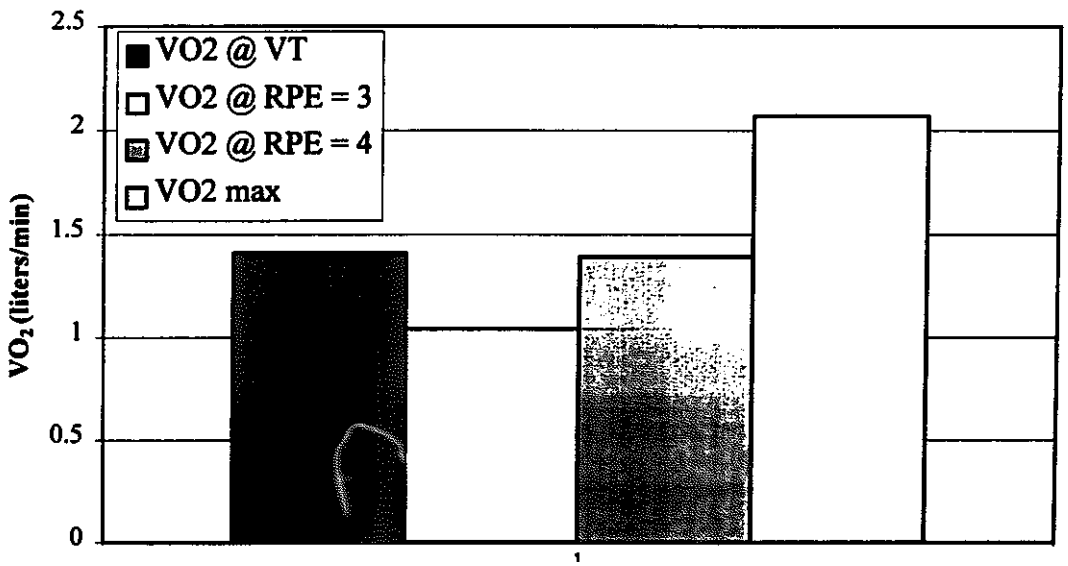

Figure 2. VO_2 at VT versus VO_2 at RPE = 3&4

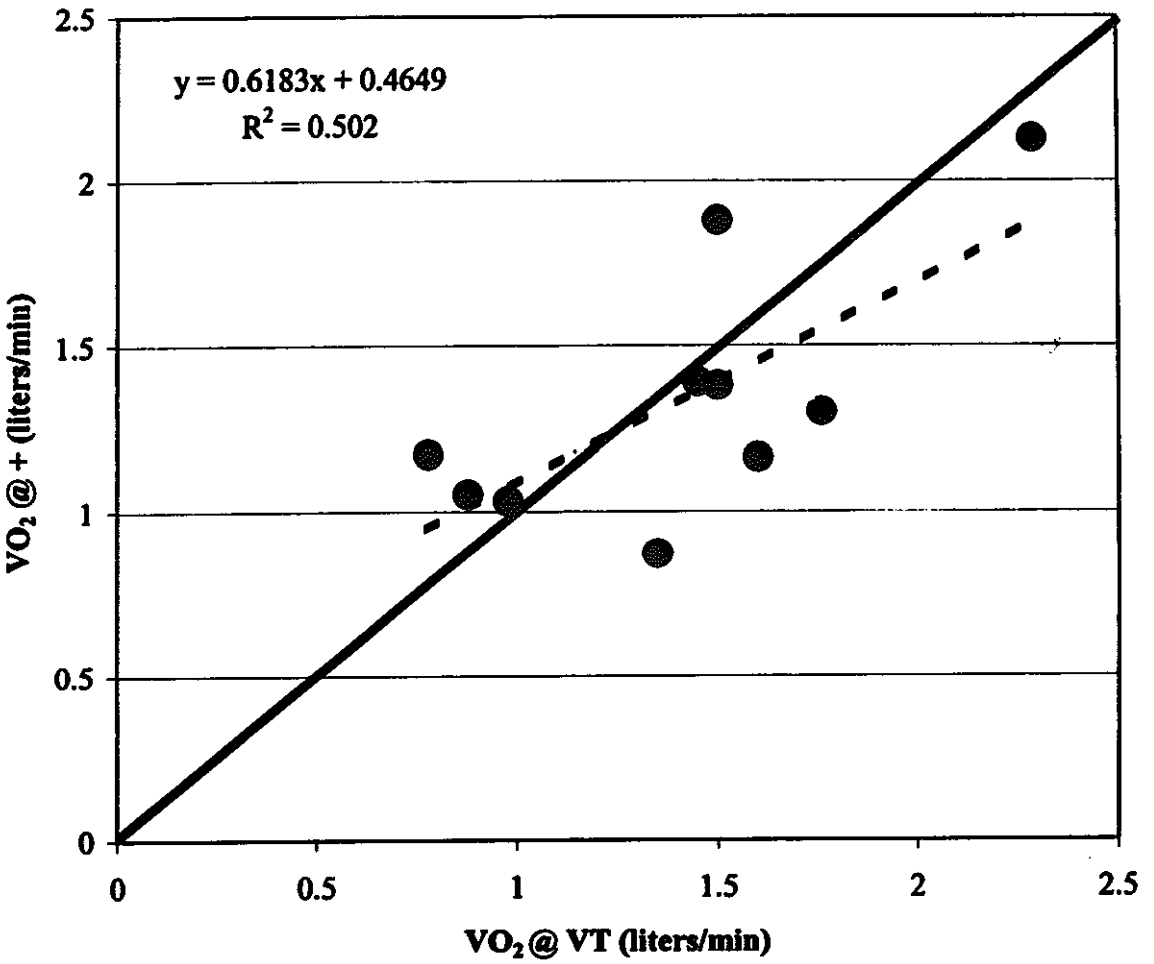

Figure 3. VO_2 at VT versus VO_2 at the last positive stage of the Talk Test

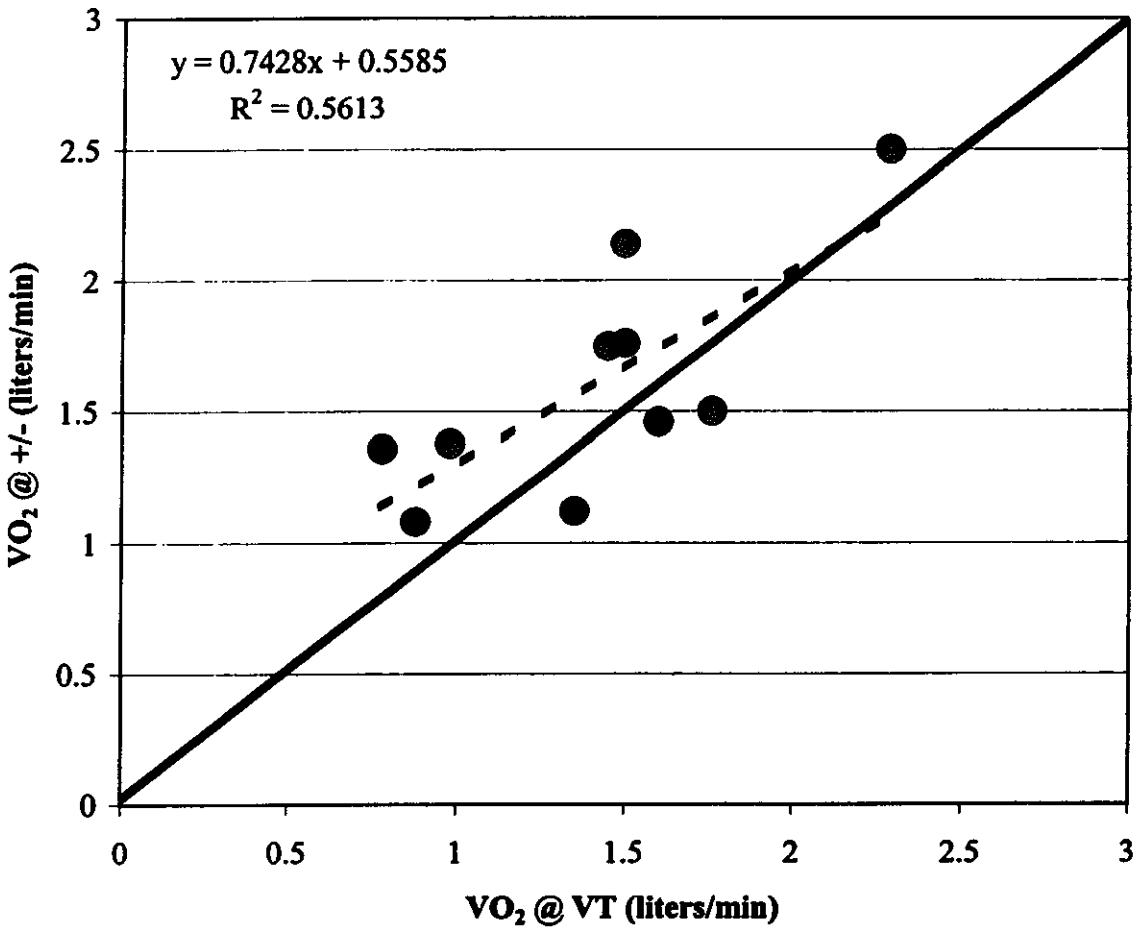

Figure 4. VO_2 at VT versus VO_2 at the equivocal stage of the Talk Test

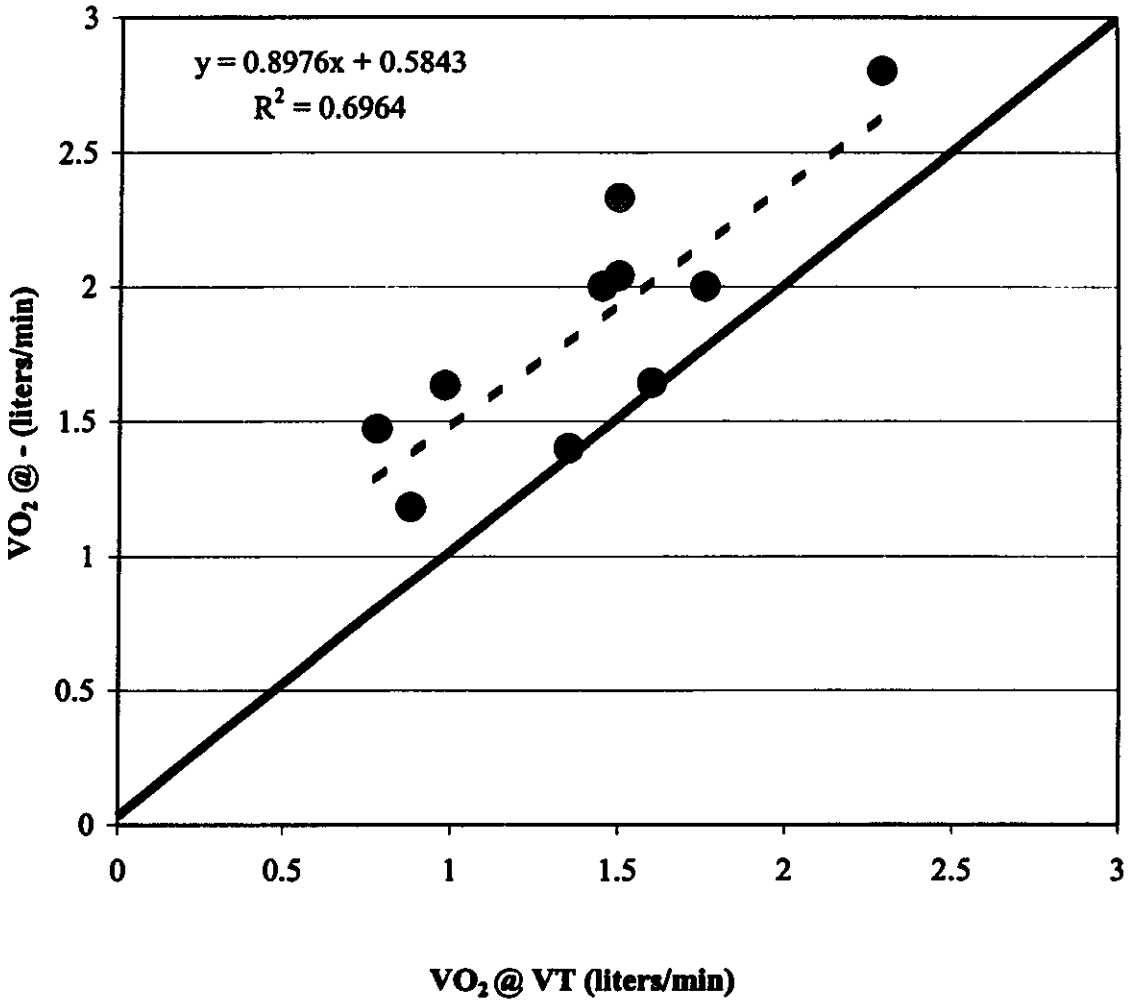

Figure 5. VO_2 at VT versus VO_2 at the negative stage of the Talk Test

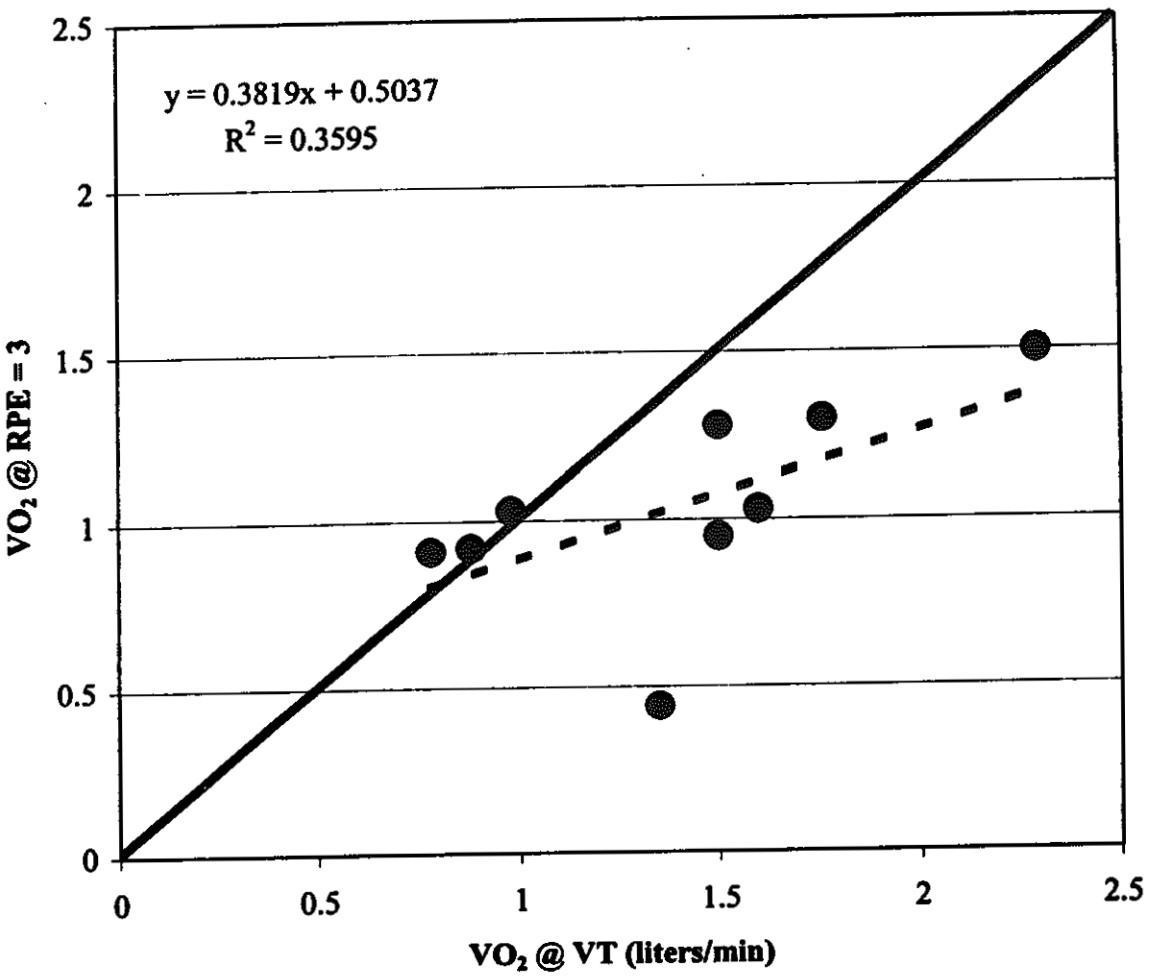

Figure 6. VO_2 at VT versus VO_2 at RPE = 3

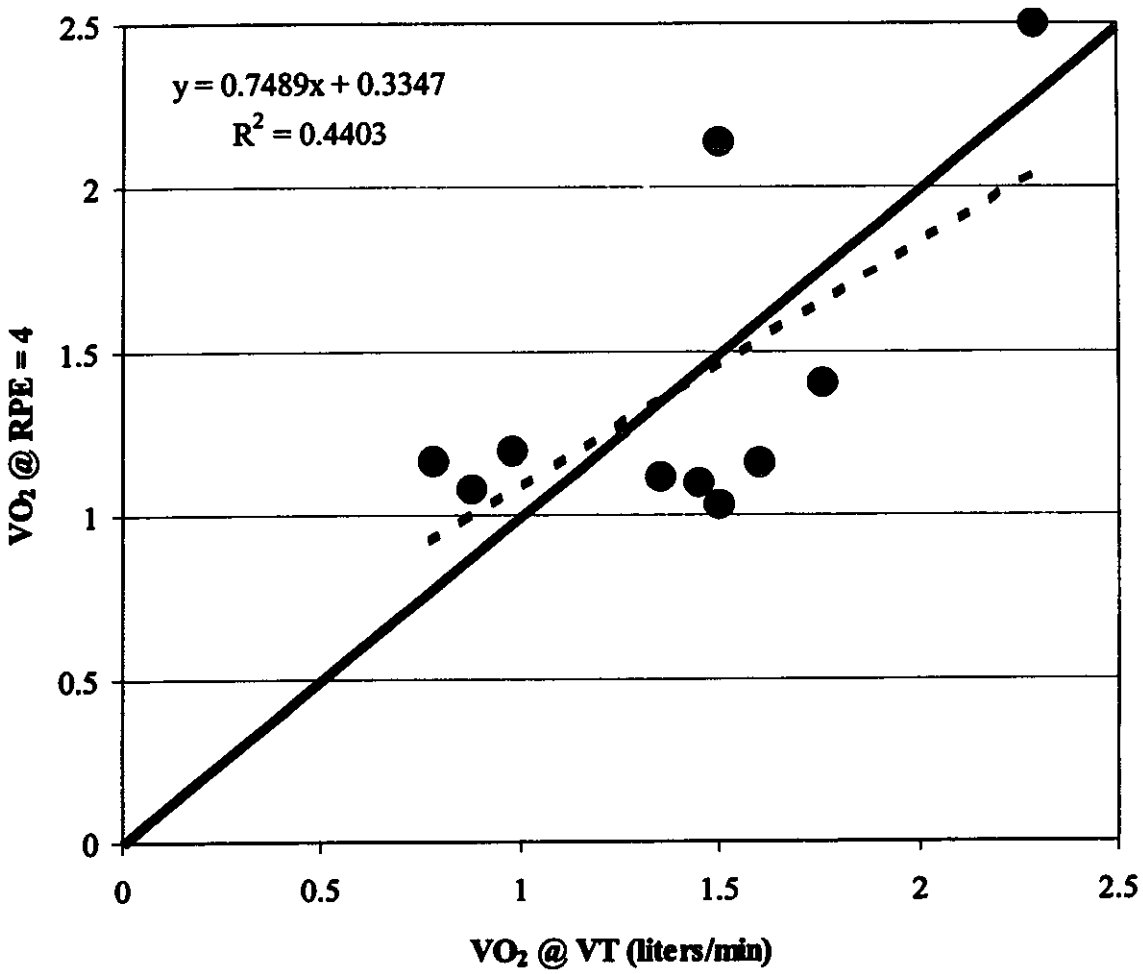

Figure 7. VO_2 at VT versus VO_2 at RPE = 4

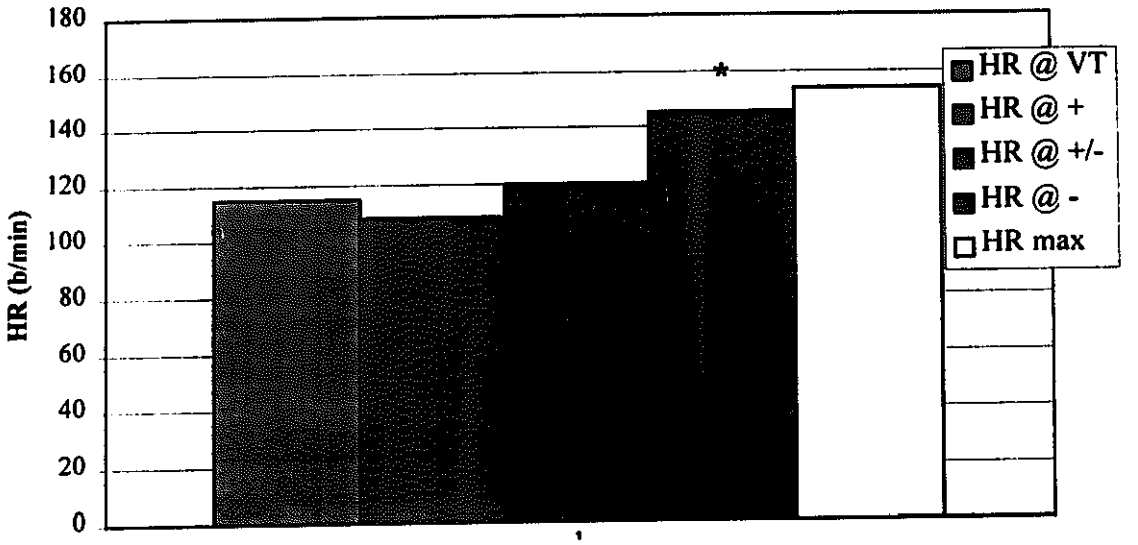

Figure 8. HR at VT versus HR during the Talk Test
* $p < 0.05$ versus HR at VT

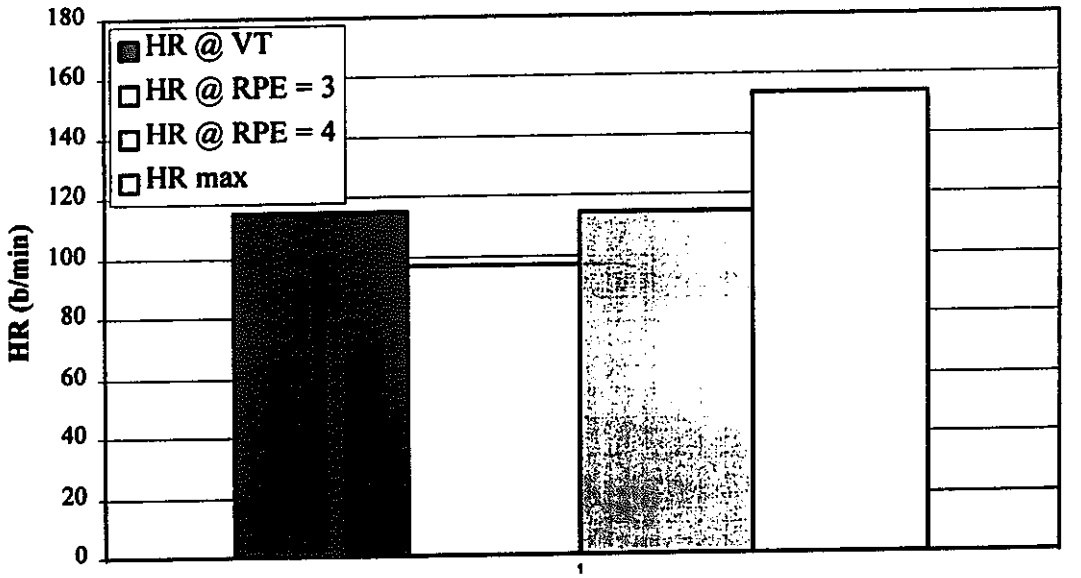

Figure 9. HR at VT versus HR at RPE = 3&4

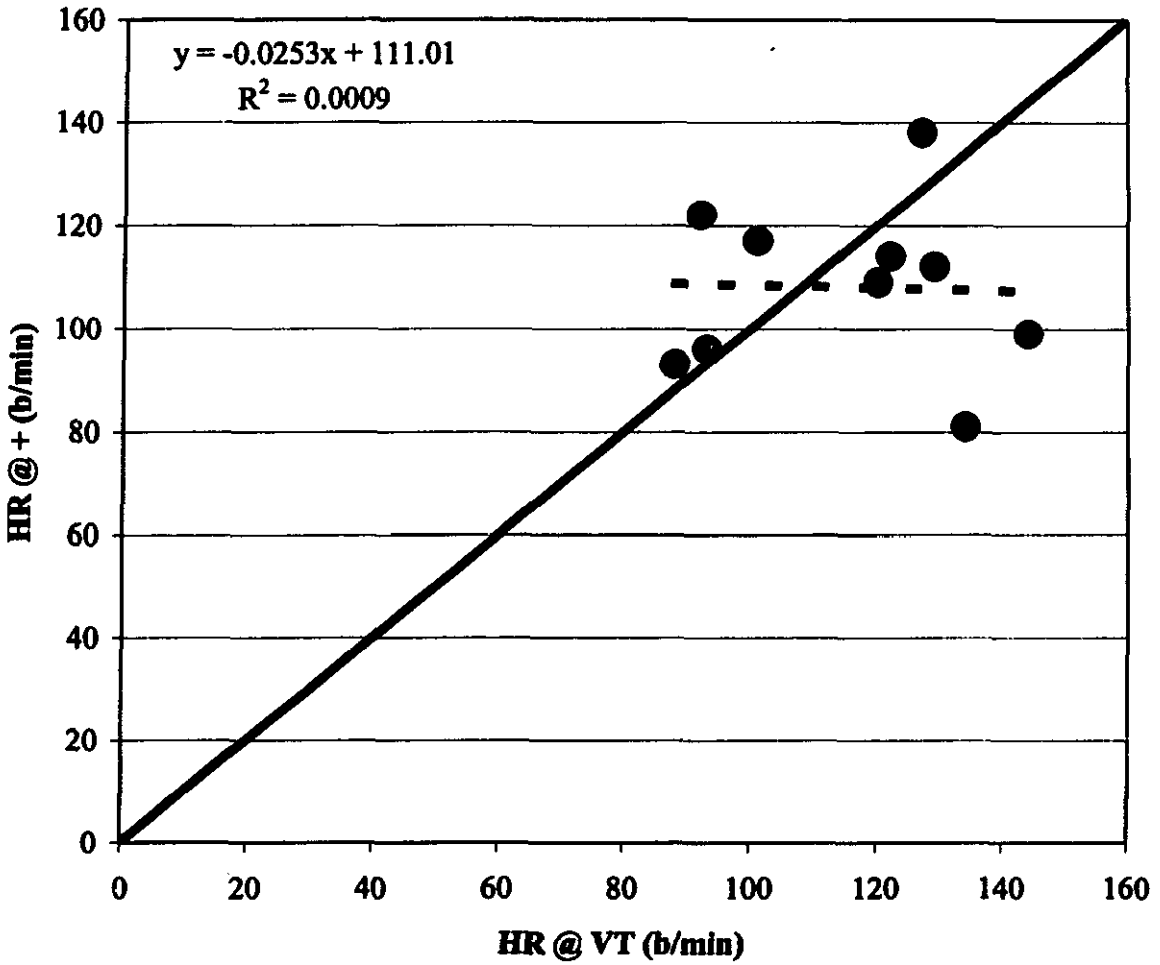

Figure 10. HR at VT versus HR at the last positive stage of the Talk Test

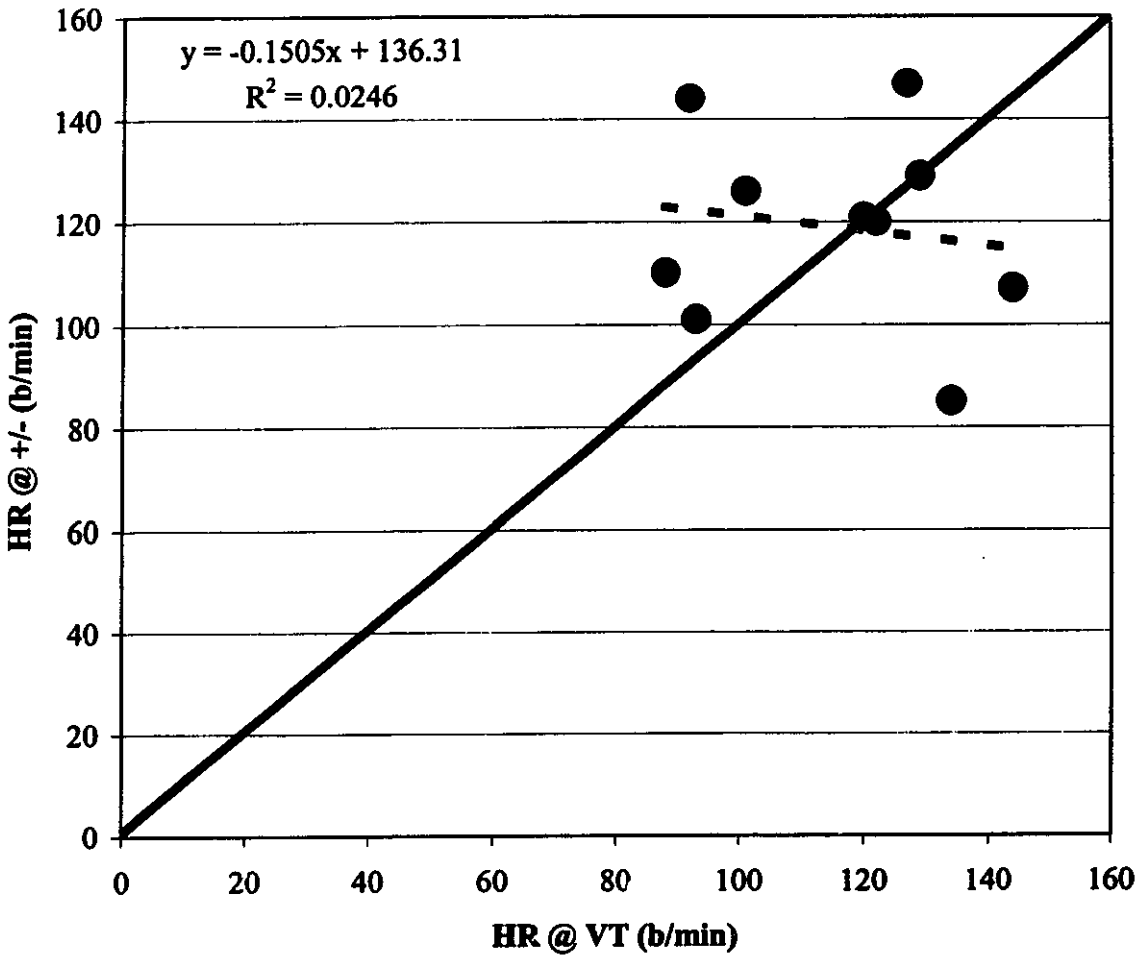

Figure 11. HR at VT versus HR at the equivocal stage of the Talk Test

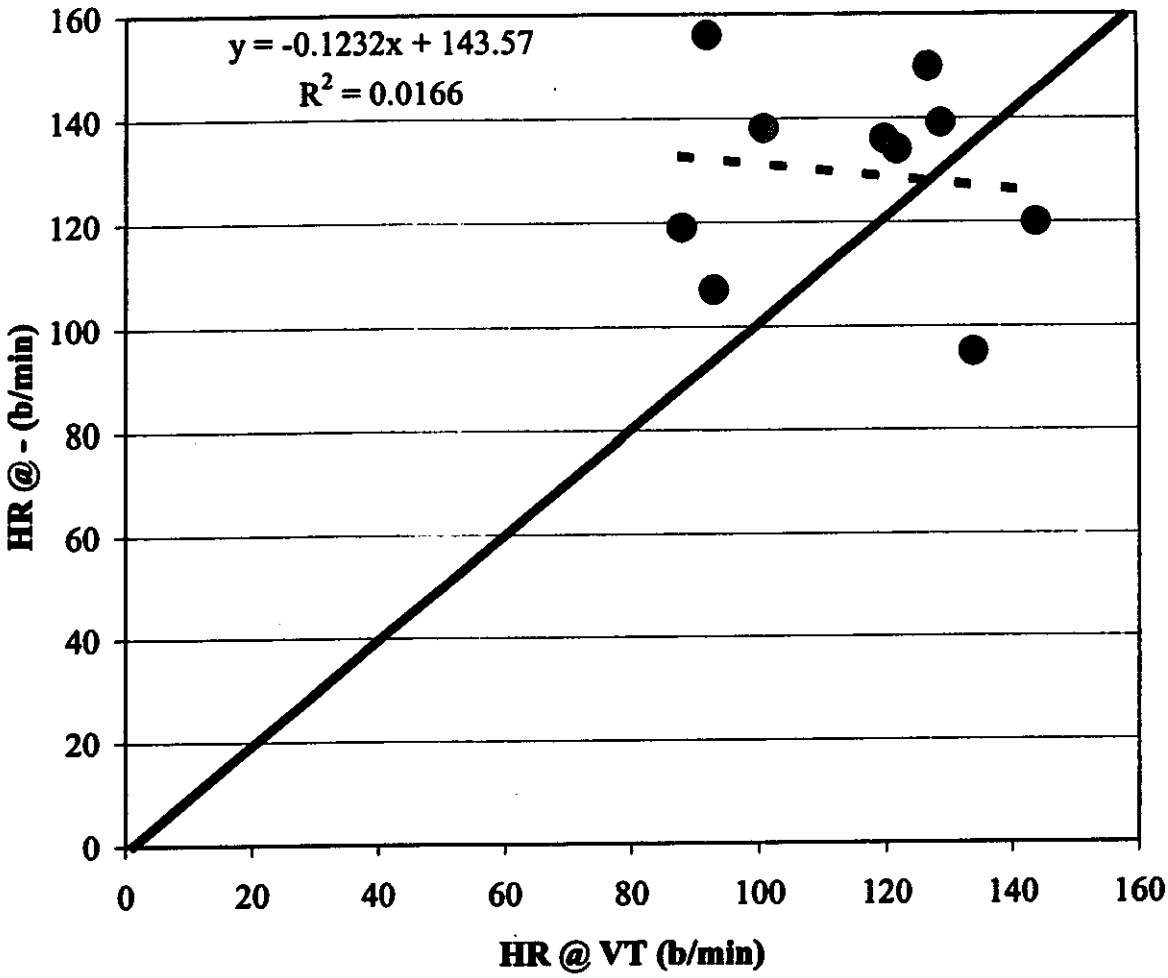

Figure 12. HR at VT versus HR at the negative stage of the Talk Test

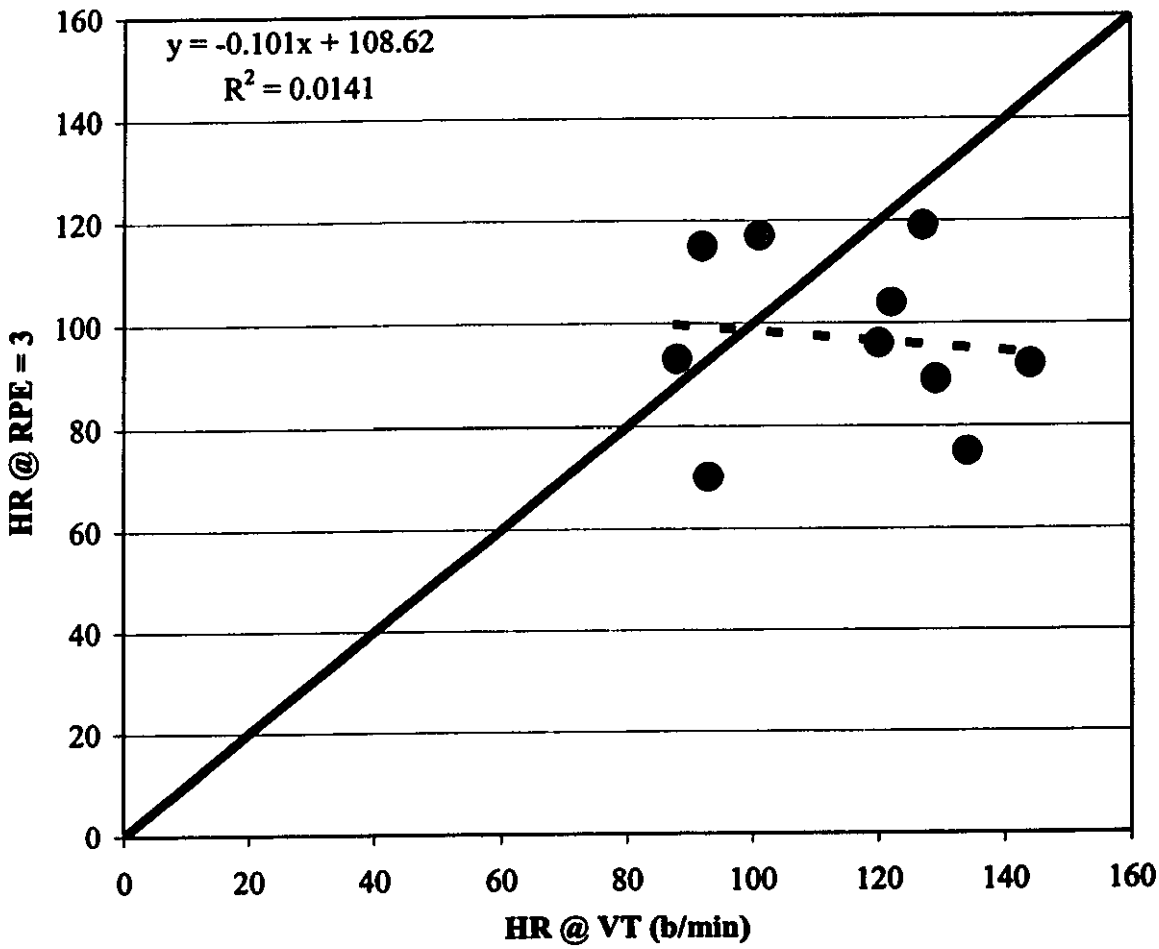

Figure 13. HR at VT versus HR at RPE = 3

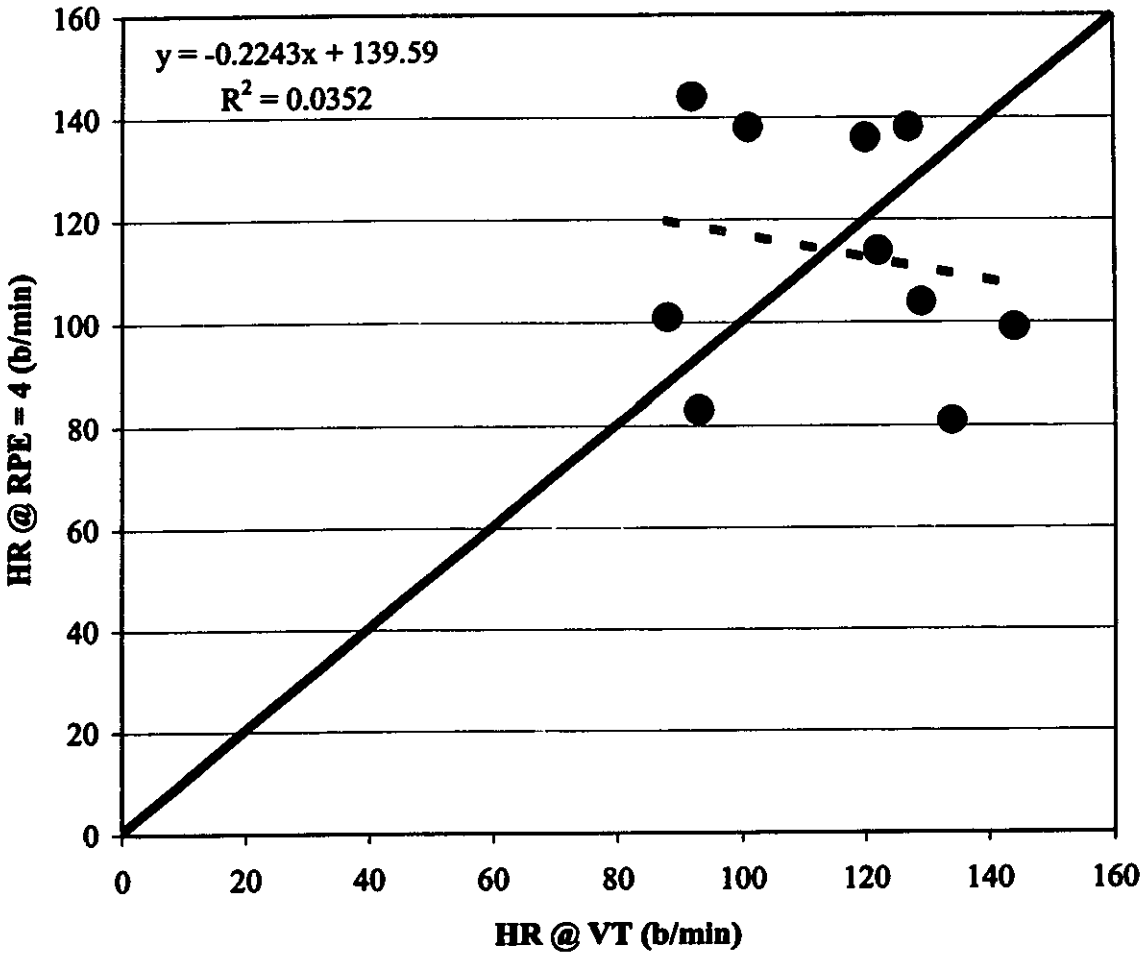

Figure 14. HR at VT versus HR at RPE = 4

DISCUSSION

The purpose of this study was to determine if the Talk Test relates to the VT in patients with stable cardiovascular disease and could be used to assess exercise training intensity in cardiac rehabilitation facilities. The results indicate that when subjects could not pass the Talk Test (could not speak comfortably while exercising) they were beyond their VT. This would indicate that the Talk Test, like RPE, is a suitable surrogate of the VT, which ACSM considers to be within guidelines for exercise prescription (5). The heart rate at the positive and equivocal stages of the Talk Test was not significantly different than the heart rate at VT. Further, the percent of maximal heart rate at the positive and equivocal stages of the Talk Test were within ACSM guidelines for exercise prescription in the cardiac population (5). The VO_2 at VT was not significantly different than the VO_2 at level 3 and 4 on the RPE scale, suggesting that the Talk Test may be used as an alternative subjective method for prescribing exercise.

Four previous studies analyzing the Talk Test (2,3,6,9) have found it to be a good estimate of exercise training intensity in healthy individuals and found it to be within ACSM guidelines (5). This present study is consistent with other findings that indicate that the last equivocal stage of the Talk Test is essentially equivalent to the VT, and when talking while exercising was no longer comfortable subjects were beyond their VT. It seems apparent that there are remarkable similarities between the findings of Dehart-Beverly and her colleagues (6), Shafer and her colleagues (9), and the results found in the present study despite the large differences in the characteristics of the subject groups.

There were some technical limitations in this study. First of all, the subjects in this study were clinically stable, meaning that our results can only apply to that population. An additional limitation with the protocol is that two-minute stages were used. However, three-minute stages elicit higher VO_2 measurements. Also, since some of the subjects had a low exercise capacity, some of them were close to their VT even during the four-minute warm up. There is also debate as to whether "The Pledge of Allegiance" is long enough to use when administering the Talk Test. Shafer and her colleagues (9) noted that there were no significant differences in physiological variables between "The Pledge of Allegiance" and "The Rainbow Passage," (7) which is a 101 word non-realistic conversation piece due to its length and the necessity for a cue card (6).

Two subjects in the study showed some ST segment changes on their electrocardiogram that started when they were either in the equivocal or negative stage of the Talk Test. Meyer and her colleagues (10) demonstrated that the ischemic threshold was usually beyond the VT in patients with CAD. Since this study agrees with others in that the Talk Test is a suitable surrogate of the VT, this may mean that exercising only in the positive stage of the Talk Test would mean avoiding exertional ischemia. More research needs to be conducted to test this hypothesis.

The findings of this study suggest that when individuals are still able to talk comfortably that they are at or below their VT. When talking is no longer comfortable during exercise, they are beyond their VT and beyond an appropriate exercise intensity. Using the Talk Test in cardiac rehabilitation settings would thus seem to be an acceptable and easy method to prescribe and guide exercise training intensity.

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APPENDIX A

HEALTH HISTORY QUESTIONNAIRE

AMERICAN HEART ASSOCIATION/ AMERICAN COLLEGE OF SPORTS MEDICINE HEALTH/FITNESS FACILITY PREPARATION SCREENING QUESTIONNAIRE

Assess your health needs by marking *all true statements.*

History
Have you had:

YES NO A heart attack
YES NO Heart surgery
YES NO Cardiac catheterization
YES NO Coronary angioplasty (PTCA)
YES NO Pacemaker/IDC/rhythm disturbance
YES NO Heart valve disease
YES NO Heart failure
YES NO Heart transplantation
YES NO Congenital heart disease

Symptoms:

YES NO You experience chest discomfort with exertion
YES NO You experience unreasonable breathlessness
YES NO You experience dizziness, fainting, blackouts
YES NO You take heart medications

Cardiovascular Risk Factors:

YES NO You are a male over 45
YES NO You are a postmenopausal female not on estrogen therapy
YES NO You smoke
YES NO DON'T KNOW Your blood pressure is over 140/90
YES NO DON'T KNOW Your cholesterol is over 200
YES NO You have a blood relative that has heart problems
YES NO You are diabetic
YES NO You are physically inactive
YES NO You are more than 20 pounds overweight

Other health issues:

YES NO You have musculoskeletal problems
YES NO You have concerns about the safety of exercise
YES NO You are pregnant
YES NO You take prescription medications

APPENDIX B

INFORMED CONSENT

Informed Consent
Relationship Between the Talk Test and Ventilatory Threshold in Cardiac Patients

I, _____(name), volunteer to participate in a research study conducted at Franciscan Skemp Healthcare in La Crosse, Wisconsin. I have been informed that the purpose of the study is to determine the relationship between two measures of exercise intensity, (the Talk Test and ventilatory threshold), in individuals with cardiovascular disease.

My participation will involve two maximal exercise tests while walking on a treadmill to fatigue. I will wear a full set of electrodes on my chest to monitor my electrocardiograph. During the first test, I will have my nose clipped and will wear a mouthpiece to collect my exhaled air so it can be analyzed. During the test, I will warm up at a selected speed for four minutes and then start the test at a selected speed. Every two minutes, the grade on the treadmill will increase by 2.5%. During the test my heart rate and Rating of Perceived Exertion (RPE) will be recorded every two minutes.

My participation will also involve a second test utilizing the same exercise protocol as the first. The only difference with this test is that every two minutes I will read "The Pledge of Allegiance" to evaluate how well I will be able to speak during increased workloads. Heart rate and RPE will be recorded every two minutes.

I have been informed the approximate amount of time that I will be devoting is one hour for each test. I have also been informed that I can stop the test at any time for any reason and that I can withdraw from the study at any time and not suffer any penalty.

I have been informed of the potential risks of participation in the study which include angina, ischemia, muscle soreness, general fatigue, abnormalities in heart rate, and in rare instances, serious heart complications (1/10,000). The tests will be terminated if complications occur. Trained personnel will be on site including a physician and researchers trained in CPR and ACLS.

The results of this study may be published. However, I have been informed that my name/identity will remain confidential. The principal investigator, Stacie Voelker, will maintain my confidentiality by keeping the data in a personal file and only allow access to her research team.

I have been informed that the benefit that I will gain from this study is a better knowledge of my own fitness level. I have also been informed that the study may benefit exercise professionals to better guide exercise intensity in cardiac rehabilitation programs. Finally, I have been informed that if I desire, a copy of my results will be made available to my physician.

I have read all of the information on this consent and have been informed of the procedures, expectations and risks associated with the study. Any questions that I had have been answered to my satisfaction. If I have further questions I may contact Stacie Voelker, (796-9252) the principal investigator or Dr. Carl Foster, (785-8786) the thesis chairperson. Questions regarding the protection of Human Subjects may be directed to

Dr. Dan Duquette (785-8124), Chair of the University of Wisconsin La Crosse-Institutional Review Board for the Protection of Human Subjects.

Signed:_____ Date:_____

Researcher:_____ Date:_____

APPENDIX C

PHYSICIAN NOTIFICATION

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I, _____(name) request that a copy of the results of the exercise tests that I will complete for the thesis, "Relationship Between the Talk Test and Ventilatory Threshold in Cardiac Patients," be made available to my physician.

Signed:_____ Date:_____

Physician name:_____

Clinic:_____

APPENDIX D

REVIEW OF LITERATURE

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Introduction

When a healthy individual enters a fitness training program or a cardiac patient enters a cardiac rehabilitation program, they are taught fundamentals of exercise based on the following components: mode, intensity, duration, frequency, and progression. Intensity is perhaps the most difficult of these to assess and prescribe.

Even though many people overlook the concept of intensity, this exercise component can be measured in many different ways. Some of the most common ways of measuring intensity include: ventilatory threshold (VT) (also known as anaerobic threshold), percentage of maximal oxygen consumption (VO_2 max), percentage of maximal heart rate, Rating of Perceived Exertion (RPE), and more recently, the Talk Test.

From the list above, the first three are objective measures of intensity. However, they are not always the most practical methods of determining intensity in cardiac patients. This is frequently due to the absence of exercise tests and also to the effects of medications. Therefore the two subjective measures, RPE and the Talk Test, which base intensity on the individuals' perceptions, may be very useful methods of monitoring training intensity in cardiac patients. Brawner and his colleagues (1) reported that 48% of sampled individuals prefer subjective methods of determining intensity rather than objective methods.

Currently, the Borg RPE scale (2) is the most popular way to determine intensity in cardiac rehabilitation programs. This is due to the abundance of research devoted to

documenting the validity and reliability of the RPE scale. On the other hand, the Talk Test is not yet as popular, perhaps due to the lack of documentation. Even with the lack of literature, the available research supports that the Talk Test can offer advantages over the more commonly used RPE scale.

Talk Test

The Talk Test is a subjective method for determining exercise intensity that allows an individual to exercise at an intensity at which he/she can still hold a conversation. Although research suggests that the Talk Test is an acceptable method of prescribing exercise and guiding intensity in healthy individuals (1,3,4,5,6), there is no documented research with the cardiac population.

Brawner and his colleagues in 1995 (1) and Czaplicki and his colleagues in 1997 (3) demonstrated that the ACSM exercise intensity guidelines of 60 to 90% of VO_2 max were usually met in individuals who could pass the Talk Test.

Dehart-Beverly and her colleagues (4) had active college aged individuals perform two exercise tests. In one test VT was measured by gas exchange. In the second test, the Talk Test was administered using a standard paragraph, the "Rainbow Passage" (7). The results suggested that when individuals are still able to talk comfortably while exercising, they are at or below their VT. When talking while exercising is no longer comfortable, individuals are beyond their VT and possibly beyond an appropriate intensity (4). Porcari and his colleagues (5) analyzed the data of Dehart-Beverly and her colleagues and found that the negative stage of the Talk Test was beyond ACSM guidelines for percent of maximal heart rate and percent VO_2max. Shafer and her colleagues (6) used

the same test procedure with sedentary individuals and found similar results. Additionally, Shafer and her colleagues noted that a shorter paragraph, "The Pledge of Allegiance," could be used with equal results (6).

All four of the studies mentioned above suggest that the Talk Test seems to be an acceptable method to prescribe exercise and guide intensity in healthy individuals (1,3,4,6). All four of the previous studies were conducted with healthy subjects; therefore, more research involving the Talk Test is needed, particularly with different populations such as those with cardiovascular disease.

Rating of Perceived Exertion

Borg's RPE scale (2) is also a subjective way of determining exercise intensity levels and is widely accepted especially in cardiac rehabilitation settings. The RPE method is used by asking an individual to assess how hard they are working based on the Borg scale. The classical scale goes from 6 to 20, but has been modified to a 10-point scale. The current scale goes from 0 to 10, with 0 being the point of rest and 10 being maximal exertion.

The American College of Sports Medicine (8) recommends that exercise be rated at 3 to 4, which is "moderate" to "somewhat hard" as the upper limit of prescribed intensity in the early stages of outpatient cardiac rehabilitation programs. There have also been many studies correlating the RPE scale with other methods of exercise intensity (9,10,11). Steed and his colleagues (9) concluded that RPE is a valid tool for prescribing exercise intensity when the intent is to use the lactate threshold and blood lactate concentration as

the intensity criterion. Purvis and Cureton (10) found that RPE can be used to prescribe intensity of exercise equal or relative to the VT.

Glass and his colleagues (11) reported that the advantage of the RPE scale as a method of assessing exercise intensity is that an individual does not have to stop during exercise and measure heart rate, but can make pace adjustments while exercising based solely upon perception of effort.

The disadvantage of using the RPE scale as a way to measure exercise intensity is that an individual has to be aware of the scale and have a working knowledge of it. Importantly, a significant percentage of individuals have difficulty using the scale.

Ventilatory Threshold

There is a lot of information published on VT. However, there are various definitions of the term. Ventilatory threshold has been used to estimate anaerobic threshold, which is defined as the oxygen uptake at which blood lactate begins to rise systematically during graded exercise (12). An advantage of this is that it is noninvasive. However, this method is questionable as to its validity. According to Powers and his colleagues (13), the systematic increase in blood lactate and nonlinear increase in expired ventilation graphed as a function of VO_2 do not always happen at the same point. This suggests a limitation in using VT to estimate anaerobic threshold. Ventilatory threshold in the present study was defined as a separate measure from anaerobic threshold and was not assumed to predict anaerobic threshold.

Ventilatory threshold in the present study was determined by using the V-slope method as described by Schneider and his colleagues (14), based upon a concept by

Beaver and his colleagues (15). Carbon dioxide elimination was plotted against oxygen uptake during incremental exercise. Next, visual interpolation was utilized to identify when the first nonlinear departure with a slope greater than 1.00 occurred. This point was determined to be the VT. In the current study, the V-slope method was used to identify VT as a measure of exercise intensity.

Meyer and her colleagues (16) determined that the VT usually precedes the onset of ischemia on an electrocardiogram. The main purpose of the present study was to determine if the Talk Test relates to VT. If it does, then we assume that the Talk Test will also precede the onset of ischemia on an electrocardiogram.

$\underline{VO_2 \text{ max}}$

Cardiorespiratory fitness is related to the ability to perform large muscle, dynamic moderate to high intensity exercise for prolonged periods. Maximal oxygen uptake (VO_2 max) is accepted as a criterion measure of cardiorespiratory fitness by the ACSM (8). Maximal oxygen uptake can be defined as the maximal amount of oxygen the body can take in, transport, and use.

Although many fitness programs focus on improving VO_2 max (17), the utility of VO_2 max as an estimate of cardiorespiratory fitness has been questioned. According to Poole and Richardson (18), VO_2 max is limited by peak cardiac output and therefore muscle oxygen delivery during maximal exercise. They concluded that measurement of VO_2 max kinetics gives information about the metabolic potential of the exercising muscles rather than the functioning of the entire cardiovascular, pulmonary, and muscular

systems. This demonstrates the problems of using VO_2 max in determining intensity levels in individuals with cardiovascular disease.

Conclusion

In conclusion, exercise intensity is an important component in exercise prescription for cardiac patients. Subjective methods are preferred and may be the only viable method of determining intensity in cardiac patients due to the absence of exercise tests and the effects of medications. A limited amount of research has been conducted regarding the Talk Test and its use with different populations. It may provide more advantages than other methods of measuring intensity in cardiac patients.

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