THE INFLUENCE OF PRE-TEST ANXIETY, PERSONALITY AND EXERCISE ON VO$_2$max ESTIMATION

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ABSTRACT

THE INFLUENCE OF PRE-TEST ANXIETY, PERSONALITY AND EXERCISE ON VO$_2$max ESTIMATION. Heather M. Hunn, Peter T. Lapuma, Daniel T. Holt. JEPonline. 2002;5(1):5-14. This research investigated the influence of exercise activities, situational factors, and personality on a submaximal cycle ergometry test (SCET). Data were collected via a questionnaire administered to 193 active duty Air Force members during their required annual SCET. Multiple regression and ANOVA were used to find the relative influence of each factor on the estimated maximal rate of oxygen uptake (VO$_2$max) determined by the SCET. For the group as a whole, self-reported test anxiety explained 24% of the variance in SCET results, while self-reported aerobic caloric expenditure explained only 10%. For runners, test anxiety explained 26%, and calories expended running explained only 5%. For cyclists, calories expended cycling explained 53% of the variance, while test anxiety had no influence on SCET results. The results indicate that for non-cyclists, high test anxiety results in an underestimation of VO$_2$max as determined by the SCET. The exercise that has the greatest influence on increasing SCET scores is cycling. Increased time or intensity spent running does not significantly enhance SCET performance.

Key Words: VO$_2$, aerobic fitness, NEO-PI, heart rate, maximal oxygen uptake
INTRODUCTION

The major components of physical fitness are cardiorespiratory endurance, muscular strength and endurance, flexibility, and body composition (1). These components provide a basis to predict the body’s ability to sustain intense exercise. Because it would be costly and time consuming to evaluate all these components, a measure of cardiorespiratory endurance, simply called aerobic fitness, is often used as an indicator of overall physical fitness. It is well documented that a good measure of aerobic fitness is the extent to which the body is able to take up and use oxygen (2,3,4). That is, aerobically fit individuals have higher cardiorespiratory and muscular endurance allowing them to deliver and offload oxygen to the skeletal muscle more efficiently as compared to individuals that are less aerobically fit.

When a person is subjected to increasing aerobic workloads, oxygen uptake will increase until a maximum quantity of oxygen uptake is reached. When the maximum oxygen uptake is reached, workload may be increased, but oxygen uptake will not increase beyond this point (4). This point is called the maximal oxygen uptake, or VO₂max. VO₂max is generally considered the best measure of aerobic fitness (2,3,4,5).

VO₂max varies due to physiological differences between people such as age, body size and gender. That is, VO₂max tends to decrease as age increases (6,7,8), and women tend to have lower a VO₂max than men. Also, oxygen uptake tends to increase in proportion to body size because more energy and therefore oxygen is required to move a larger individual (4). VO₂max is most commonly expressed as milliliters of oxygen (O₂) consumed per kilogram (kg) of body weight per minute, ml/kg/min (4). Expressing VO₂max as ml/kg/min normalizes the data for body weight and enables VO₂max measurements to be comparable among people of different body sizes.

There are three common ways to determine VO₂max for an individual. VO₂max can be measured directly with maximal tests or indirectly with non-exercise tests or with submaximal exercise tests. Maximal tests are expensive to administer and can be risky because the subject reaches their maximal heart rate near complete exhaustion. Non-exercise tests depend upon the truthful self-report of activity and cannot be used when the individuals have an interest in the results, giving them a reason to falsify the self-reported activity levels. Submaximal tests indirectly estimate VO₂max using heart rate (HR) and are most often performed on a cycle ergometer, although they can be performed on a treadmill or a track. Submaximal tests are faster, safer, and cheaper to administer than maximal tests. However, submaximal tests have been found to be less accurate than maximal tests yet more accurate than the non-exercise tests (9,10).

In a submaximal test, one or more HR measurements are taken throughout the test as workload on the individual is increased. The HR measurements, power output, and some additional factors are entered in a regression equation to determine the slope of the individual’s HR in relation to their workload. VO₂max is estimated by extrapolating the HR slope to a maximal HR which corresponds to an estimated VO₂max (10). Submaximal power outputs are defined as outputs that elicit a HR response between 45% and 70% of an individual’s estimated HR at VO₂max (10).

Because HR is used to estimate VO₂max, anything that affects HR would affect the results of a submaximal test (10). Numerous factors can alter HR such as drugs, caffeine, eating, nicotine, amount of sleep, time of day, room temperature and humidity, and anxiety (10,11). Caffeine increases, while nicotine decreases, the HR response to exercise. Therefore, caffeine would tend to underestimate VO₂max and nicotine could overestimate VO₂max (11,12).
The submaximal cycle ergometry test (SCET) is an example of a submaximal test. The SCET is used by the Air Force to evaluate the physical fitness of its members. While there is a considerable body of research that has evaluated the SCET (2,4,10,11,12), this study builds on that literature by evaluating additional factors that may influence SCET performance.

While there is general agreement that VO$_{2\text{max}}$ is a good predictor of aerobic fitness (2,3,4), the VO$_{2\text{max}}$ estimated by the SCET may vary depending on training intensity or method, situational factors such as anxiety or stress, or personality factors. Prior studies that correlate submaximal test results to maximal tests do not appear to focus on the influence of personality or anxiety factors and have not addressed perceived consequences for low VO$_{2\text{max}}$ scores.

This study examined the influence of anxiety, personality, and exercise on SCET results using active duty members of the AF who were aware of negative career consequences for failure to achieve a minimum SCET score. The AF SCET was selected because it creates a tense situation where an individual could be nervous or anxious during the test because disciplinary action can result if AF members fail to meet minimum AF fitness standards. This study was conducted during the regularly scheduled annual AF SCET to reflect typical anxiety levels felt by AF members. Because immediate anxiety often leads to an increased heart rate regardless of muscular demand, there is some concern that the AF SCET may underestimate VO$_{2\text{max}}$ in AF members with a high degree of anxiety during the test.

**METHODS**

Data were collected from Air Force officers enrolled in a graduate education program using a written questionnaire and actual SCET results. 193 military personnel assigned to the Air Force Institute of Technology (AFIT), Dayton OH, took the AF SCET and corresponding questionnaire. The questionnaire was administered after the SCET rather than before, due to concerns that the questionnaire might increase anxiety and inadvertently influence SCET performance.

There are three possible outcomes of the AF SCET. A member can receive a pass, fail, or invalid score. To pass the test, the member must have pedaled at 50 rpm and the ending HR must have been greater than 125 b/min but less than 85% of his or her age-determined maximum HR. Also, HR must reach a steady state (13). To receive a failing score, all the above must have occurred, but the member’s estimated VO$_{2\text{max}}$ score was below AF standards. An invalid test can occur for various reasons. For example, an invalid rating occurs if the HR monitor slips off an individual, or if an individual exceeds his or her maximum HR. An invalid rating means that a VO$_{2\text{max}}$ score could not be assessed, but it is not a failing score.

The data collected via the questionnaire are broken down into the following six categories. Some of the categories are further explained in the following paragraphs; (1) Demographic data – age, weight, height, gender; (2) Exercise activity during the past four weeks; (3) Perceived test anxiety of the participant during the SCET; (4) Perceived validity of the SCET; (5) Personality facet assessments (Trait Anxiety and Achievement Striving); (6) Participant’s SCET score and SCET score history.

**Exercise Activity**

Participants indicated their average weekly exercise routine during the four weeks prior to the SCET. Each participant’s average weekly activities, intensities, and durations were collected and converted to kilocalories (kcal) per week so that data could be compared between exercise activities. The conversion to kcals was accomplished using metabolic equivalents (METs). One MET is defined as the resting metabolic rate of an adult (14). Ainsworth et al. (14) published MET values for numerous physical activities to include common
methods of exercise. Energy expenditure was calculated by multiplying the MET value for a specific exercise intensity by the participant’s weight (kg) and the hours of the particular exercise (14). The calculation of kcals is shown in Equation 1. The MET conversion equation assumes the resting metabolic rate of an adult equals one kcal per kg of body weight per hour of activity. The MET value assigned to an activity is a multiple of the resting metabolic rate so the units of each MET are kcals per kg per hour.

\[
kcal = (\text{METs}) \times (\text{kg body weight}) \times (\text{hours of activity}) \tag{1}
\]

\[
1 \text{ MET} = 1 \text{kcal} / 1 \text{ kg body weight} / \text{hour of activity}
\]

For example, if an 80 kg male ran 3 hours per week at 7 mph (MET = 11.5), then the energy expended = (11.5 METs) x (80 kg) x (3 hours) = 2,760 Kcals.

**Test Anxiety and Perceived SCET Validity**

Test anxiety and perceived validity of the SCET were measured using multi-item scales for which participants indicated their agreement with each item using a six point Likert scale (i.e., 1 = strongly disagree and 6 = strongly agree). An overall score for each scale was obtained by averaging the responses of the corresponding items.

**Trait Anxiety and Achievement Striving**

Trait anxiety and achievement striving personality facets were measured using eight items each from the Revised NEO Personality Inventory (15). Trait anxiety is a measure of how anxious a person is. If someone scores high for trait anxiety, they may be a “nervous type” which may increase their anxiety response to the SCET. Someone who scores high for the achievement striving facet works hard to achieve goals and has high levels of aspiration, which may also result in increasing their anxiety response to the SCET. Participants indicated their level of agreement with each item on the questionnaire using a seven-point Likert-type scale with higher values indicating greater levels of agreement with each item (i.e., 1 = strongly disagree and 7 = strongly agree). Results for each question were averaged to form an overall score for each facet.

**Analysis**

Because it was hypothesized that other variables besides aerobic fitness contribute to SCET VO\(_2\)max assessment, multiple linear regression was used to determine the explanation of variance of an adjusted SCET VO\(_2\)max score (Â VO\(_2\)max) provided by each independent variable. Â VO\(_2\)max is the SCET estimated VO\(_2\)max score for the participant minus the AF established minimum passing score, which is age and gender specific. If ÂVO\(_2\)max=0, the individual matched the minimum AF standard. A positive Â VO\(_2\)max would indicate that the individual performed better than the AF standard, and a negative Â VO\(_2\)max would indicate that the individual performed worse than the AF standard. The Â VO\(_2\)max score is a more comparable measure of SCET performance because it places their estimated VO\(_2\)max in relation to minimum AF standards, which correct for age and gender. Variables were entered into regression analyses in differing orders, with no significant change to the results.

1. Aerobic activity kcals/week
2. Anaerobic kcals/week
3. Test anxiety score
4. Perceived validity of SCET score
5. Trait anxiety score

Figure 1: Examples of sets of independent variables entered into the multiple regression analyses.

The exercise data, expressed as average Kcals expended/week, were entered into the regression in several different ways to determine if there were certain activities that were better predictors of Â VO\(_2\)max than others.
For example, the data were grouped into aerobic and anaerobic activities to measure the relative influence of each on Å VO₂max. Also, specific exercise activities, such as running and cycling, were entered separately to determine which activities were better predictors of Å VO₂max. An example of the independent variables entered into the regression analysis is presented in Figure 1.

**RESULTS**

Of the 209 participants in the survey, 193 usable questionnaires (188 men and 16 women) were collected (i.e., complete data were provided). The age range of the men and women was 21 to 48, and 23 to 49, respectively. The mean data for select variables are provided in Table 1.

Table 2 shows the AF minimum required scores to pass the SCET. The 16 females in the study had significantly higher (p=0.032) mean Å VO₂max scores (10.9 ml/kg/min) than the males (6.8 ml/kg/min). However, the males reported expending significantly more (p=0.008) total aerobic Kcals (2,031 Kcal/wk) than the females (1,100 Kcal/wk) during the four-weeks prior to the test. The small number (n=16) of female participants prevented a detailed analysis of gender differences.

Table 3 shows descriptive statistics for all variables evaluated and their correlation with ÅVO₂max. Examination of the correlations among the variables revealed some significant correlations with ÅVO₂max. There were no significant multicollinearity relationships among the variables in any of the analyses performed.

**Anxiety and ÅVO₂max**

As shown in Table 3, there is a significant negative correlation between test anxiety and ÅVO₂max. That is, the more anxious a person was about the test, the lower the person scored on the SCET. This negative correlation was reflected in people who ran a majority (>50%) of their caloric expenditure (r=-0.51; p<0.01) and with people who cycled a majority of their caloric expenditure (r=-0.50; p<0.05). Trait anxiety, however, was not significantly correlated to ÅVO₂max. This suggests that having an anxious personality does not affect performance on the SCET, but anxiety about the SCET negatively impacts SCET performance.

**Anxiety, SCET History, and ÅVO₂max**

A correlational analysis was performed to see if there was any relationship between SCET performance history (previous failures), test anxiety, and ÅVO₂max. Past failures are significantly negatively correlated with test anxiety (r=-0.43; p<0.01) and ÅVO₂max (r=-0.49; p<0.01). Thus, participants who reported failing the SCET in the past, tended to score lower on the SCET and report high levels of anxiety. The lower SCET scores received by individuals who had failed the SCET in the past may be the result of elevated test anxiety due to past failures.

**Exercise Activities and ÅVO₂max**

Figure 2 shows the means and standard deviations of ÅVO₂max for runners, cyclists, and individuals who reported no aerobic activity. In Figure 1, individuals were grouped according to the percentage of Kcals expended in the activities. For people who participated in multiple exercise activities, an individual was
included in the activity shown only if he or she reported 50% or more of their total aerobic caloric expenditure from the activity. For example, if a participant reported 50% or more of their total aerobic kcals from running, he or she was added to the running group. Participants who reported zero aerobic activity (such as a weightlifter) were placed in the no aerobic activity group.

**Table 3. Descriptive Statistics and Correlation Table for Variables**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ÄVO₂max (mL/kg/min)</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Exercise Data</strong></td>
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<td></td>
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</tr>
<tr>
<td>2.</td>
<td>Aerobic (Kcals)</td>
<td>0.33&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Anaerobic (Kcals)</td>
<td>-0.08</td>
<td>0.12</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Situational Factors</strong></td>
<td></td>
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</tr>
<tr>
<td>4.</td>
<td>Test Anxiety</td>
<td>-0.49&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>-0.04</td>
<td>-0.031</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Perceived Validity</td>
<td>0.20&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>-0.18&lt;sup&gt;†&lt;/sup&gt;</td>
<td>-0.26&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>-0.29&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td><strong>Personality Factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6.</td>
<td>Trait Anxiety</td>
<td>0.03</td>
<td>-0.07</td>
<td>-0.15&lt;sup&gt;†&lt;/sup&gt;</td>
<td>0.31&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>-0.01</td>
<td>1.0</td>
</tr>
<tr>
<td>7.</td>
<td>Achievement Striving</td>
<td>-0.06</td>
<td>0.08</td>
<td>0.17&lt;sup&gt;‡&lt;/sup&gt;</td>
<td>0.02</td>
<td>-0.11</td>
<td>-0.05</td>
</tr>
</tbody>
</table>

*All numbers in the first row correspond with the titles in the first column; † p < 0.05; ‡ p < 0.01

Figure 2 shows that the average ÄVO₂max for runners was 4.7 ml/kg/min higher (p < 0.01) than individuals who did not report any aerobic activity. There were no significant differences in mean ÄVO₂max between any other groups in Figure 1.

**Regression and ANOVA**

Table 3 summarizes the results of the regression and ANOVA for the various subsets of the population sampled. When all participants were included in the multiple regression analysis (n=193), the variables with the most influence on ÄVO₂max were test anxiety, explaining 24% of the variance followed by total aerobic Kcals explaining only 10%.

**Runners**

For runners and cyclists, only the running or cycling kcals were input to the regression analysis to observe the influence each activity had on ÄVO₂max.

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**Figure 2. Means±SD of ÄVO₂max for several population subsets**
The running group included anyone who reported running for any portion of his or her workout expenditure (individuals who ran >0% of total aerobic Kcals; n=118). Test anxiety explained the most variance in ÅVO₂max scores (31%); Kcals burned running only explained 3%, and trait anxiety explained 4%.

For individuals who spent the majority (50%) of their aerobic Kcals running (n=74), test anxiety explained 26% of the variance in SCET performance and Kcals expended running explained only 5% of the variance. These results suggest that a differences in running kcals has only a small influence on SCET ÅVO₂max scores. However, people who ran any amount at all (running >0%) scored an average of 4.6 ml/kg/min higher than people who did not run (p<0.01). These results suggest that some time spent running does positively affect SCET results but a large difference in running expenditure does not result in a significant difference in SCET performance. The data suggests that for runners, the best predictor of SCET performance is test anxiety not Kcals spent running.

Cyclists

Another regression was performed on people who reported cycling for any portion of his or her workout expenditure (individuals who cycled >0% of total aerobic Kcals). Both stationary and outdoor cycling were included in this group of 59 individuals. Test anxiety again explained the most variance in scores (28%) followed by the amount of Kcals expended cycling (11%) and trait anxiety (10%). This group was narrowed further to individuals who cycled a majority (>50%) of their aerobic kcals (n=18). The results from this group show that Kcals expended cycling were the only predictor of ÅVO₂max, explaining 53% of the variance.

Table 3. Stepwise regression and ANOVA results with standardized Beta coefficients.

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Run &gt; 0%</th>
<th>Run 50%</th>
<th>Cycle &gt; 0%</th>
<th>Cycle 50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Size</td>
<td>193</td>
<td>118</td>
<td>74</td>
<td>59</td>
<td>18</td>
</tr>
<tr>
<td>R²</td>
<td>0.391</td>
<td>0.381</td>
<td>0.308</td>
<td>0.495</td>
<td>0.532</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.378</td>
<td>0.364</td>
<td>0.288</td>
<td>0.468</td>
<td>0.505</td>
</tr>
<tr>
<td>Variance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unexplained</td>
<td>63%</td>
<td>61%</td>
<td>69%</td>
<td>51%</td>
<td>47%</td>
</tr>
<tr>
<td>Test Anxiety</td>
<td>24%</td>
<td>31%</td>
<td>26%</td>
<td>28%</td>
<td>0%</td>
</tr>
<tr>
<td>Kcal of Activity</td>
<td>10%</td>
<td>3%</td>
<td>5%</td>
<td>11%</td>
<td>53%</td>
</tr>
<tr>
<td>Other</td>
<td>3%</td>
<td>5%</td>
<td>0%</td>
<td>10%</td>
<td>0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>β</th>
<th>β</th>
<th>β</th>
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<tr>
<td>Aerobic Activity Kcal</td>
<td>0.357</td>
<td>0.169</td>
<td>0.227</td>
<td>0.340</td>
<td>0.73</td>
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<tr>
<td>Test Anxiety</td>
<td>-0.478</td>
<td>-0.605</td>
<td>-0.504</td>
<td>-0.618</td>
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<tr>
<td>Perceived Validity</td>
<td>0.138</td>
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<tr>
<td>Trait Anxiety</td>
<td>0.167</td>
<td>0.199</td>
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<td></td>
<td>0.335</td>
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</tbody>
</table>

Achievement Striving

For individuals who spent the majority (50%) of their aerobic Kcals running (n=74), test anxiety explained 26% of the variance in SCET performance and Kcals expended running explained only 5% of the variance. These results suggest that a differences in running kcals has only a small influence on SCET ÅVO₂max scores. However, people who ran any amount at all (running >0%) scored an average of 4.6 ml/kg/min higher than people who did not run (p<0.01). These results suggest that some time spent running does positively affect SCET results but a large difference in running expenditure does not result in a significant difference in SCET performance. The data suggests that for runners, the best predictor of SCET performance is test anxiety not Kcals spent running.
The breakdown of explained variance for individuals who cycle any amount (>0%) closely resembles the group as a whole. However, individuals who cycle the majority of their total caloric expenditure, show a strong influence between cycling kcals and their SCET scores with test anxiety showing no influence. These results suggest that increased cycling will significantly improve SCET scores, particularly for people who predominantly cycle.

Figure 3 shows the relative amounts of variance in \( \dot{V}O_2\text{max} \) scores explained by test anxiety and aerobic exercise for all individuals (n=193), runners (n=74), and cyclists (n=18). The groups listed include individuals who report expending at least 50% of total aerobic kcals in the activity. For the group including all participants, the amount of variance explained by all reported aerobic activities was used. Figure 2 graphically illustrates the influence of test anxiety for non-cyclists and the strong positive influence of aerobic cycling on SCET performance.

DISCUSSION

There were two main purposes of this study. The first was to examine the relationship between different exercise activities and performance on a submaximal cycle ergometry test. The second was to examine other factors such as anxiety and personality, which may introduce bias in the estimated \( \dot{V}O_2\text{max} \).

This study suggests that running to some degree may improve SCET performance as compared to people who do not actively engage in aerobic activity. Furthermore, test anxiety explained the most variance in \( \dot{V}O_2\text{max} \) for all aerobic activities except cycling. When the majority of Kcals were expended cycling, the Kcals cycled had a large influence (53%) on SCET performance, and anxiety did not play a role in SCET performance.

The results suggest that while running does modestly improve SCET performance, the differences in running Kcals does not significantly influence SCET \( \dot{V}O_2\text{max} \). In fact, individuals who expended more than 4,000 aerobic Kcals per week had a larger mean \( \dot{V}O_2\text{max} \) by only 6.6 ml/kg/min over individuals who do not engage in aerobic exercise. An increase of 6 ml/min/kg on the SCET is very small given an aerobic expenditure of 4,000 Kcals per week (estimated by the MET conversion) which is roughly the equivalent of a 30 year-old male running 30-40 miles/week (an endurance-trained athlete). The maximally determined \( v \) of an endurance-trained male runner ranges from 65 to 80 ml/kg/min (17). The mean \( VO_2\text{max} \) for males who expended at least 4,000 kcals was only 44 ml/kg/min as determined by the SCET. For very aerobically fit, non-cyclists, \( VO_2\text{max} \) appears to be significantly underestimated by the SCET. The non-cycling underestimation is further supported by the fact that running intensity does not substantially influence SCET \( VO_2\text{max} \) estimation. For the males who report no aerobic activity, the SCET-determined \( VO_2\text{max} \) was an average of 36.6 ml/kg/min. For untrained
males, VO\(_2\)max ranges from 38 to 52 ml/kg/min (17). Thus, for the group of non-aerobic males, VO\(_2\)max was only slightly underestimated.

Test anxiety repeatedly surfaced as the most significant predictor of ÄVO\(_2\)max for non-cyclists. This may be explained by the body’s responses to immediate stress (concern over career ramifications). Specifically, an increase in HR due to something other than muscular demands would result in VO\(_2\)max underestimation. It is interesting that test anxiety had a dominant influence on SCET performance, but trait anxiety did not in most cases. Having an anxious personality does not appear to significantly influence the body’s response to test anxiety.

Although the results for the runners were heavily influenced by test anxiety (26%), the cyclists actually reported significantly higher mean test anxiety scores than the runners (3.5 for cyclists, 2.5 for runners; p<0.01). Thus, despite the fact that the cyclists were more anxious about the SCET, test anxiety did not influence results likely due to the overwhelming effect of cycling Kcals. The results suggest that when cycling is the major portion of total aerobic caloric expenditure, SCET results are more reflective of the level of cycling training.

**Limitations**

Some limitations to this study are the population studied, the relatively small groups examined, and the reliance on self-reporting. Because AFIT is a unique group composed of mostly young, male officers, results may not necessarily reflect the rest of the Air Force or the general population. The small number of cyclists also weakens the test results to some degree. Self-reported exercise over a four-week period could introduce bias from inaccurate memory recall. However, it should be noted that care was taken not to unduly influence the realism of the actual SCET. Therefore, placing people in predetermined exercise groups or tracking their workout patterns could have altered anxiety or normal preparation patterns. It would have been helpful to examine other exercise activities but larger groups would need to be examined.

**Conclusions**

For the sampled population, the validity of the SCET in predicting true VO\(_2\)max for non-cyclists is questionable due to the large influence of test anxiety. The results of this study suggest that by controlling anxiety about the test, one could significantly improve his or her score. The results also suggest that SCET performance may be improved by expending a majority of aerobic Kcals cycling.

These findings give reasons to question the validity of using the SCET to test fitness in the Air Force. If the SCET is intended to measure aerobic fitness, the amount of aerobic exercise should have been the best predictor of ÄVO\(_2\)max because true VO\(_2\)max and aerobic training are closely related. However, this was true only for individuals who cycled a majority of their aerobic Kcals. Past research has shown that the SCET is reliable, and results are correlated well with maximally-determined VO\(_2\)max. However, prior research does not appear to have administered the test to individuals who have a stake in the outcome involving career consequences for failure. AF members’ concerned for their careers will have increased anxiety during the test. This study demonstrates a link between test anxiety and SCET performance. Also, while it seems intuitive that cyclists do better on a cycling test, this test is given to all members to estimate their aerobic fitness regardless of their desired aerobic activity. A submaximal treadmill test would presumably be a more accurate test to estimate aerobic fitness for runners. A submaximal treadmill test for runners may also reduce the influence of test anxiety by providing a testing method with which runners are comfortable with.

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