

## **Efficacy of Different Durations of Aerobic Exercises on Anxiety in University Female Students.**

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### **Abstract**

The purpose of this study was to investigate the effect of different durations of aerobic exercises on anxiety level in university female students. Sixty female students from Taif University participated in this study. Their ages ranged from 18-25 years old with a mean age of 23.45 ( $\pm$  4.6) years and achieved a score of 8 to 25 in Beck Anxiety Inventory (BAI). They were randomly assigned into three equal groups with 20 participants in each; a long duration aerobic exercise group (Group A), a short duration aerobic exercise group (Group B) and a control group (Group C) who didn't participate in any exercises. Anxiety level for each participant was measured before starting the study and after 6 weeks by using BAI and Zung Self-rating Survey (SAS). The results revealed a highly significant difference of anxiety levels as measured by BAI and SAS among the three groups ( $p=0.0001$ ) at post intervention. Additionally, there was a significant decrease of anxiety levels in groups A & B (in favor of group A) at post treatment as compared to baseline assessment and a non significant improvement in the control group ( $p=0.133$  and  $p=0.23$ ) for SAS and BAI respectively. Conclusion and recommendation: Aerobic exercises have been found to decrease anxiety levels among university female students with a greater effect of long duration sessions than short duration sessions.

**Key words: Aerobic Exercises, Anxiety, University Students, Beck Anxiety Inventory, Zung Self-rating Survey.**

### **Introduction**

Anxiety is a normal human physiological mechanism designed to help the body respond to a threat. The autonomic changes that occur in anxiety are essential to avoid danger and moderate anxiety can actually improve performance. Anxiety disorders occur when this normal physiological response is associated with high level of autonomic arousal, erroneous cognitions and dysfunctional coping strategies (Kyrios et al., 2011).

Anxiety disorders are the most common psychological disorders (Olfson et al., 2000 and Anseau et al., 2004), with women being 1.7 times more likely than men to develop the disorder (Kessler et al., 2003). Anxiety disorders are associated with the most impairment across various domains of functioning, including significant impairment of relationships, care giving and job productivity (DeBoer et al., 2012).

Anxiety affects the lives of many college students, and its influence is often exacerbated during the academic year. Finding preventive or alleviating measures for anxiety might be difficult for college students, and the option of seeking professional help is not always available or realistic. State anxiety, the focus of this study, is the temporary experience of emotional arousal when encountering specific situations or demands subjectively interpreted as threatening or dangerous (**Schlicht, 1994 and Schwarzer, 1997**).

State anxiety tends to increase when individuals are placed in stressful situations. Students report experiencing academic stress at predictable times each semester with the greatest sources of academic stress resulting from taking and studying for exams, grade competition, and the large amount of content to master in a small amount of time (**Abouserie, 1994 and Misra and McKean, 2000**).

Physical exercise produces a wide variety of health benefits. People who are physically active substantially lower their risk for coronary heart disease, cardiovascular disease (**Thompson et al., 2003**), type II diabetes, overweight and obesity, osteoporosis, deterioration of functional capacity, and cancer of breast and colon. Furthermore studies have consistently noted that physical activity is associated with improved physical health, life satisfaction, cognitive functioning, and psychological well-being (**Carek et al., 2011**).

There is a general belief that physical activity and exercise have positive effects on mood and anxiety and a great number of studies describe an association of physical activity and general well-being, mood and anxiety. Intervention studies describe an anxiolytic and antidepressive activity of exercise in healthy subjects and patients (**Ströhle, 2009**). Despite the heterogeneity of research results, reviewers conclude that mental health benefits of physical activity include reduction in state and trait anxiety. Moreover, they found that physical exercise prevents the anxiety symptoms from becoming chronic (**Schlicht, 1994**).

A growing body of evidence indicates that aerobic exercise is an effective and cost-efficient treatment alternative for a variety of anxiety and mood disorders (**Salmon, 2001 and Borman-Fulks et al., 2004**). The meta-analysis by **Kugler et al., (1994)** showed that the larger effects of exercises on anxiety reduction are shown when the exercise is "aerobic" as opposed to "nonaerobic" and when the subjects have initially lower levels of fitness or higher levels of anxiety.

In a study by **Borman-fulks and storey (2008)**, significant reduction in anxiety sensitivity following six 20-minute sessions of aerobic exercise have been reported, whereas anxiety sensitivity scores among non exercisers did not significantly change. Furthermore, **Cox et al., (2004)** found that the most substantial decrease in state anxiety occurred 90 minutes following 20 minutes of aerobic exercise at 80% of maximal oxygen uptake. On the other hand, according to **Herring et al., (2010)** exercise session durations greater than 30 minutes showed larger effects than durations of 10 to 30 minutes. In addition better mental health outcomes with longer exercise session durations also have been found in studies of exercise training effects on cognitive function (**Heyn et al., 2004**).

Exercise training dose is a complex stimulus involving actual minutes of exercise in each session accumulated over all exercise sessions. A better understanding of the role of exercise stimulus variables in maximizing positive mental health outcomes could be realized through comparing different exercise training intensities and durations to better understand the minimal and optimal dose necessary to elicit mental health benefits (**Herring et al., 2010**).

Although, the evidence for positive effects of exercise and exercise training on anxiety is growing, further studies on effects of exercise and more details on optimal duration are still needed. Therefore the present study was designed to investigate the effect of different durations of aerobic exercises on anxiety in university female students.

### **Subjects, materials and methods**

#### **(I) Subjects:**

Sixty female students participated in this study. They were selected from different faculties in Taif University, their ages ranged from 18 to 25 years. The students took part in this study after providing their informed consent. All the selected students met the classification of non-exercisers (individuals having little to no regular exercise pattern).

#### **Inclusion criteria:**

1. The participants' age ranged from 18 to 25 years old.
2. Participants exhibited mild to moderate levels of anxiety (a score of 8-25) according to Beck Anxiety Inventory (BAI).
3. The participants had to be in good general health.

#### **Exclusion criteria:**

1. Subjects having health conditions that would preclude aerobic exercise (assessed using the Physical Activity Readiness Questionnaire: PAR-Q) (**Shepherd et al., 1981**).
2. Subjects having current involvement in an aerobic exercise program for three months ago (Current exercise involvement was defined as more than one aerobic exercise session per week).
3. Current involvement in psychotherapy or use of any psychotropic medication.
4. Subjects having history of chronic systemic diseases (chronic obstructive respiratory diseases such as asthma, cardiovascular disease or renal disease).
5. Any musculoskeletal disorders that hinder participation of aerobic exercise.
6. Diabetic subjects.
7. Pregnant females.

#### **(II) Materials:**

This study used the BAI (**Beck and Steer, 1990**) and Zung Self-rating Survey (SAS) (**Zung, 1971**), to measure participant's anxiety levels. The BAI is a well accepted self-report measure of anxiety in adults and adolescents for use in both clinical and research settings (**Beck and Steer, 1990**). The BAI consists of twenty-one

questions about how the subject has been feeling in the last week, expressed as common symptoms of anxiety (such as numbness and tingling, sweating not due to heat, and fear of the worst happening). Each question has the same set of four possible answer choices, which are answered by marking the appropriate one with a cross. These are: *not at all* (0 points); *mildly*: It did not bother me much (1 point); *moderately*: It was very unpleasant, but I could stand it (2 points); *severely*: I could barely stand it (3 points). The values for each item are summed yielding an overall or total score for all 21 symptoms that can range between 0 and 63 points. A total score of 0-7 is interpreted as a "Minimal" level of anxiety; 8-15 as "Mild"; 16-25 as "Moderate", and 26-63 as "Severe". The BAI has a high internal consistency ( $\alpha = 0.94$ ) and test-retest reliability ( $r = 0.67$ ) (Fydrich et al., 1992).

The SAS is a 20-item self-rating anxiety scale built to measure anxiety levels, based on scoring in 4 groups of manifestations: cognitive, autonomic, motor and central nervous system symptoms. Each subject should indicate how much each statement applies to her. Each question on the SAS is ranked with numbers 1-4 and the total score is found by adding all numbers together. Subjects who are less anxious will have lower scores while subjects who show moderate to severe anxiety will have greater scores. The total raw scores range from 20-80. The raw score needs to then be converted into an "Anxiety Index" score. The "Anxiety Index" score can then be used on this scale to determine the clinical interpretation of one's level of anxiety: 20-44 Normal Range; 45-59 Mild to Moderate Anxiety Levels; 60-74 Marked to Severe Anxiety Levels; 75-80 Extreme Anxiety Levels. The SAS shows internal consistency reliability of 0.66 to 0.80 (Zung, 1971).

A brief demographic questionnaire was completed during the screening session to obtain information on participants' age, exercise, and current use of medications. The PAR-Q also was completed by the participants to establish whether the individuals assigned to the exercise group were of optimal physical fitness to complete the activities requested from them. A written approval from the ethical committee at the College of Applied Medical Sciences, Taif University was taken before the study.

### (III) Procedures:

All the participants who met the inclusion criteria were given an informed consent to begin the study. In accordance with the recommendations of the American College of Sports Medicine (ACSM, 2000), volunteers who met the study criteria were administered the demographic questionnaire "PAR-Q" to ensure their safety and to determine if medical clearance was necessary. Each participant then received both the SAS and the BAI. After filling out the surveys, the participants were assigned randomly into three different groups; group A (long duration aerobic exercise), group B (short duration aerobic exercise), and group C (control group). Random assignment of the participants was done by the use of a computer generated randomized table of numbers created before the beginning of the study.

**Group A (long duration aerobic exercise):** Each session began with five minutes of warming-up in the form of stretching exercises and slow-paced walking on treadmill, then participants were asked to briskly walk or jog on the treadmill at a speed that produced exercise heart rates between 60% and 75% of the individual's age-adjusted predicted maximal heart rate, as recommended by the ACSM, (2000). The

lower and upper limit for each individual's aerobic heart rate range was computed using the following formula:  $(220 - \text{age}) \times (0.60 \text{ [lower-limit] or } 0.75 \text{ [upper-limit]})$ . Treadmill speed was adjusted as necessary to ensure that participants in the medium-intensity exercise remained within the lower- and upper-limits of aerobic exercise for the duration of each exercise session. Each exercise session lasted 45 minutes, and was repeated 3 times per week for 6 weeks. A brief cool down period followed treadmill sessions.

**Group B (short duration aerobic exercise):** This group completed a similar protocol except that they were trained for 20 minutes per session. Participants completed the BAI and SAS before the first exercise session, and after 6 weeks following the final exercise session.

**Group C (control group):** They did not participate in any exercises through the duration of the study. Participants received instruction to stay seated for 30 minutes while studying or reading the popular magazines. Participants completed the BAI and SAS before the beginning of the study and after 6 weeks.

#### **Data analysis:**

All data were analyzed by the SPSS software, version 15.0. Descriptive statistics of mean and standard deviation presented the participants' ages, SAS and the BAI scores. Paired sample *t*-test was used to compare pre and post treatment values of SAS and the BAI scores within the groups. *ANOVA* was used to analyze the anxiety scores among the three groups at pre and post treatment. The least significant difference (*LSD*) test was used to show the difference between group A & B, group B & C, and group A & C at pre and post treatment. A *p*-value of less than 0.05 was considered as significant.

#### **Results**

Sixty female students participated in this study with a mean age of 23.45 ( $\pm 4.6$ ) years. The results of the present study revealed a statistically significant difference between the mean values of baseline and post intervention of anxiety scores of both SAS and BAI scores in the two study groups with a highly significant improvement in group A as compared to group B. On the other hand, there was a non significant improvement of anxiety levels in the control group ( $p=0.133$  &  $p=0.23$ ) for SAS and BAI scores respectively. *ANOVA* revealed a significant difference among the three groups at post intervention for both SAS and the BAI scores. The mean values of all variables tested are shown in tables 1 and 2. *LSD* test revealed a significant difference between group A & B ( $p=0.0001$ ) and group A & C ( $p=0.0001$ ) for both SAS and BAI scores. On the contrary, the test showed a non significant difference between groups B & C ( $p=0.97$  and  $p=0.60$ ) for SAS and BAI scores respectively.

Table 1: statistical analysis of SAS scores within each group and between groups at pre and post treatment.

	Group A	Group B	Group C	F	p-value
<b>Pre treatment</b>	54.2±5.1	52.9±4.8	51.9±5.1	1.042	0.360
<b>Post treatment</b>	39.6±5.9	50.9±5.1	50.9±6.4	18.877	0.0001**
<b>t-value</b>	10.29	2.84	1.57		
<b>p-value</b>	0.0001**	0.01*	0.133		

Values are mean ± SD.

\*Significant at p<0.05.

\*\*Highly significant at p<0.001.

Table 2: statistical analysis of BAI scores within each group and between groups at pre and post treatment.

	Group A	Group B	Group C	F	p-value
<b>Pre treatment</b>	20.3±3.7	21.1±4.2	20.6±4.6	0.459	0.833
<b>Post treatment</b>	11.4±3.5	19.3±4.7	20.1±5.1	17.169	0.0001**
<b>t-value</b>	12.21	2.76	1.23		
<b>p-value</b>	0.0001**	0.012*	0.23		

Values are mean ± SD.

\*Significant at p<0.05.

\*\*Highly significant at p<0.001.

## Discussion:

This study was conducted to investigate the efficacy of different durations of aerobic exercises on anxiety in university female students. The results of the present study revealed a highly significant difference of anxiety levels as measured by BAI and SAS among the three groups at post treatment. Additionally, there was a significant decrease of anxiety levels in groups A & B (in favor of group A) at post treatment as compared to baseline assessment and a non significant improvement in the control group for both SAS and BAI.

The positive results of exercises on anxious state of the participating students in both groups A and B might be attributed to the following justifications:

First, exercises are effective on distracting the person from stressful or anxiety provoking stimuli (**Bartholomew and Linder, 1998**). This distraction mechanism gives individuals a time out from the stressful demands occurring in daily life (**Petruzzello et al., 1991**). A meta-analysis by **Long and van Stavel, (1995)** supported this opinion and reported that adults with stressful lifestyles benefitted more from aerobic exercise training as exercise distracted individuals from problems. This is because aerobic exercise training can regulate emotional and physiological reactions to threatening stimuli during and immediately after working out. Additionally, the long-term effects of exercising include increases in self-esteem, physical stamina, and positive body image. These lasting effects might promote the regular use of exercise as a mediator for anxiety, whereas brief bouts of aerobic exercise may not have an extensive influence on state anxiety.

Second, aerobic exercises might be able to decrease the feelings of state anxiety because they incorporate repetitive movements, did not involve competition with others, were predictable activities and required a steady, relaxed breathing pattern. The repetitiveness and rhythm associated with aerobic exercises lessen anxiety because these movements do not require excessive attention. The lack of competition in aerobic exercises improved mood by letting the individuals participate for enjoyment of the activity, leading to positive outcomes and less self-criticism (**Berger and Motl, 2000**).

Third, core body temperature increases with exercise and core temperature has been found in some studies to be associated with exercise-induced decreases in anxiety. The thermogenic hypothesis states that the increase in core body temperature that results from exercise may be responsible for reductions in anxiety by way of reducing muscular tension and altering neuron activity (**DeVeris, 1987**).

A numbers of studies had shown the effect of exercises on anxiety. **Landers and Petruzzello, (1994)** examined the results of 27 narrative reviews that had been conducted between 1960 and 1991 and found that in 81% of them, the authors had concluded that physical activity/fitness was related to anxiety reduction following exercise and there was little or no conflicting data presented in these reviews. For the other 19%, the authors had concluded that most of the findings were supportive of exercise being related to a reduction in anxiety, but there were some divergent results. None of these narrative reviews concluded that there was no relationship.

There are many meta-analyses examined the relationship between exercise and anxiety reduction. They found that across all studies examined, exercise was significantly related to a reduction in anxiety. These effects ranged from “small” to “moderate” in size. This reduction occurs for all types of subjects, regardless of the measures of anxiety being employed (i.e., state, trait or psychophysiological), the intensity or the duration of the exercise, the type of exercise paradigm (i.e., acute or chronic), and the scientific quality of the studies (**McDonald and Hodgdon, 1991, Petruzzello et al., 1991, Calfas and Taylor, 1994, Kugler et al., 1994, Landers and Petruzzello, 1994 and Long and Van Stavel, 1995**).

Additionally, a series of laboratory challenge studies have extended these findings by demonstrating that acute exercise confers antipanic and anxiolytic effects. For example, **Esquivel et al., (2002)** found that 12 minutes of exercise (bicycle ergometer with increasing workload) prior to a single vital capacity inhalation of 35% CO<sub>2</sub>/65% O<sub>2</sub> was associated with significantly decreased fear reactivity demonstrated by fewer panic symptoms, compared with minimal exercise (cycling on the ergometer with continuous low workload) in 20 healthy adults .

Similarly, **Ströhle et al., (2005)** randomized 15 healthy participants to either 30 minutes of treadmill exercise at 70% of maximum oxygen consumption or 30 min of quiet rest prior to a biological challenge using an injection of 50 µg of cholecystokinin tetrapeptide (CCK4) and found moderate to large between-group differences with respect to CCK4-induced panic attacks, panic symptoms and anxiety. **Smits et al., (2009)** documented that healthy participants who engaged in 20 minutes of moderate-intensity treadmill exercise (i.e., 70% of maximum heart rate; n = 46) reported less anxiety reactivity prior to a single vital capacity inhalation of 35% CO<sub>2</sub>/65% O<sub>2</sub> (n = 46) relative to participants who rested prior to challenge.

**Broocks et al., (1990)** demonstrated that the anxiolytic effect of exercise is correlated with a regulation of postsynaptic serotonin receptors. **Ströhle et al., (2005)** examined the effects of exercise on atrial natriuretic peptide (ANP) and response to

panic provocation. They found that exercise (30 min of 70% of maximum heart rate on a treadmill) significantly increased plasma ANP and reduced anxious responding to CCK4. Importantly, the magnitude of the reduction in anxiety was directly associated with the increase in plasma ANP. Furthermore, **Boecker et al., (2008)** were the first to demonstrate increases in central endogenous opioid binding following prolonged vigorous exercise among trained athletes. The authors of this study also found that opioid binding in the fronto-limbic brain regions was associated with self-reported euphoria, suggesting that opioidergic effects of exercise may indeed mediate anxiolysis following prolonged physical exertion.

Few studies have examined the dose–response relationship of exercise and anxiety reduction. Therefore, little is known about the effects of exercise program length, session duration, session frequency and exercise intensity on anxiety. It appears that the length of the exercise intervention may have a linear relationship to the magnitude of anxiolytic effects (**Petruzzello, 1994**).

In a meta-analysis, **Wipfli et al., (2008)** found that exercise frequency of three to four times per week elicited larger anxiolytic effects than less or more frequent regimens. While **Ekkekakis and Petruzzello (1999)** suggested that exercise session duration may also affect the magnitude of anxiety reductions, with activity sessions lasting 21–30 minutes potentially providing the most anxiety reduction. Additionally, **Herring et al., (2010)** reported that exercise session durations greater than 30 minutes showed larger effects than durations of 10 to 30 minutes.

There were several limitations to this study. First, the small number of participants might limit the generalization of the study results. Second, the subjects who participated in this study were all females aged between 18 and 25 years old. Further studies are recommended to target older ages to enable comparison of the results across different age groups including males and females. Third, the data was self-reported so we could not exclude recall bias. In addition, subjects in this study were recruited from only one university, Taif University, Saudi Arabia and it is unlikely that this could be representative of all Saudi university students. Thus generalization of the results to other undergraduate student populations may be limited. The lack of follow-up for the participants in the three groups might be considered another limitation of the study. Therefore, further study is recommended to overcome these limitations.

#### **Conclusion and recommendations**

Anxiety disorders are some of the most common neurological disorders. Aerobic exercise with different durations has been shown to decrease anxiety level among university female students. Aerobic exercise sessions with longer duration (45 minutes) showed greater effect than aerobic exercise sessions with short durations (20 minutes).

Further studies on the clinical effects of exercise, interaction with conventional psychological treatment approaches and more details on the optimal type, intensity, and frequency of the exercise program are still needed to investigate their effects on improving anxiety symptoms. Moreover, future research is needed to address whether longer participation in the aerobic exercise training (eight weeks or more) will provide additional benefits, and whether these benefits are maintained for longer follow-up periods. Developing plans, providing facilities and encouraging people to participate in regular exercise are recommended for achieving physical and mental health among students and all the people of the society.



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