

## EVALUATION OF NICOTINE EFFECTS ON MUSCLE PERFORMANCE UNDER WINGATE ANAEROBIC TEST CONDITION

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### Abstract

Nicotine is a naturally occurring addictive alkaloid and in some cases, is a fatal drug. The long-term noxious effects of nicotine have been reported by means of publications to stop the use of nicotine in the form of tobacco. In this study the use of nicotinic substances was tested during Wingate Anaerobic Tests (WAnT) on collegiate football athletes. These tests had three possible results: ergogenic, ergolytic or no effect. The subjects were 12 University of Ataturk University football players between the ages of 19 - 23. They did a series of two tests on a Monarch cycle ergometer for 30 seconds at a time on two separate days. One day post-nicotine gum consumption, the another day post-placebo gum consumption. The data received was considered significant with a p-value  $\leq 0.05$ . This experiment showed nicotine's effect on: peak anaerobic power ( $P = 0.34$ ), anaerobic capacity ( $P = 0.92$ ) and anaerobic fatigue percentage ( $P = 0.33$ ) in the human body during a WAnT. So, the data received from this experiment were concluded not to be statistically significant.

**Key Words: Nicotine, Wingate test, Anaerobic, Muscle Performance**

### 1. INTRODUCTION

Nicotine is a colorless and strong liquid alkaloid that has found in all tobacco plants. It is used in drugs such as: smokeless tobacco, cigarettes and cigars (Metz et al., 2004). There is a lot of researches for suggesting that tobacco has many harmful long-term effects. Several studies have shown that caffeine and creatine have improved muscular performance in the human body during exercise, whereas little has been published regarding nicotine's effect on the human body during exercise conditions (Racette, 2003; Spriet, 1995). There is no published work about the effect of nicotine on the human body during a supra-maximal exercise test such as the Wingate Anaerobic Test (WAnT). The effects of nicotine in the body vary under resting and exercising conditions. Studies by Symons and Stebbins (1996) showed that nicotine infusions during resting states caused hypertension, decreased cardiac output, increased blood pressure and decreased heart rate. The study by Narkiewicz et al. (1998) showed that smoking caused to increase norepinephrine and increased blood pressure. Van Van Duser and Raven (1992) suggested that smokeless tobacco had strong sympathetic nervous system stimulation as well. Their findings concluded smokeless tobacco decreased endurance performance by means of an increase in heart rate and plasma lactate concentrations. Landers et al. (1992) showed that ergogenic effects in regards to vigilance, rapid information processing, state dependent learning and retention of paired associates. Escher et al. (1998) attempted to demonstrate the significance between smokeless tobacco, reaction time and strength in athletes. The results showed that tobacco did not have any effect on reaction time, but had a significant effect on decreasing strength. The experimenters were unsure if the effect was a substance in the smokeless tobacco producing an ergolytic effect, or if tobacco withdrawal stimulates an ergogenic effect. Muscular performance is calculated anaerobically by peak power, mean power and percent fatigue. The WAnT is a supramaximal exercise for 30 seconds against a pre-determined force load usually 7.5% of body weight in kilograms. Gullstrand and Larsson (1999) reported eight investigations showing a mean reliability of  $r=0.94\pm 3SD$ . This is in agreement with studies by Bar-Or (1987). Therefore, the WAnT is proven to be a reliable test. The WAnT also parallels football because they both last short durations of time. Severson et al. (2005) declared that during the mid-1980's and the early 1990's the use of smokeless tobacco among professional baseball players was about double the percentage of the entire population. Lombardo (1986) stated that one-third of Texas varsity football and baseball players used nicotinic substances in the form of smokeless tobacco. This study made the following assumptions: 1. The nicotine levels in the nicotine chewing gum were high enough to affect the EPSP's in a human body. 2. The conditions of the experiment were parallel between the two test days. 3. The test subjects were honest and followed the protocol before the experiment. 4. The WAnT was a valid and reliable anaerobic test. By regarding to this matter that football is a game of explosive activity and muscular strength. A normal play usually lasts only a few seconds. These short durations of play stress the importance of anaerobic activity, or fast twitch muscle performance. A WAnT is a good test for football athletes because it consists of all explosive actions and fast twitch muscular activity and by attention to all researches that was inconclusive based on the variety of results showing ergogenic, ergolytic and no significant statistical difference, the study purpose is illustration of the nicotine effects on anaerobic exercise during a WAnT.

## 2. MATERIALS AND METHODS:

Twelve football players of Ataturk University were tested by using of a WAnT on two separate days (N=12). All test subjects were male and they were from Turkey. One day consisted of administering nicotine gum and the other day a placebo was administered. Each subject was given a one week period of recovery between tests. This was a single-blind experiment (test-retest). Therefore, only the researchers knew which gum was administered for each day. The statistical analysis was performed using a paired student's *t*-test. Testing was performed on Monark bicycle ergometers (Monark 834E). The procedures required a subject, a timer and two counters for each test. Each test subject wore a t-shirt, athletic shorts, and athletic shoes. The subject randomly was administered a piece of chewing gum by the researcher. The subject chewed the piece of gum for 30 minutes to allow optimal peak time for the possibility of 4 mg nicotine to enter the bloodstream. This is in agreement with clinical studies performed by Van Duser and Raven (1992). During the time of chewing the gum the test subject had his weight taken and subsequently the brake force set up on the Monark cycle ergometer. The seat height was adjusted allowing a slight bend in the knee when the pedals were at the bottom of the revolution. Then the subject had a two minute warm-up cycling with no resistance at a moderate pace. The force was then applied by dropping the weight holder. The timer began counting with a stop watch for 30 seconds and called out time intervals every five seconds. As the timer counted the subject was encouraged to keep pedaling as hard as he could by the researcher, timers and counters for the duration of the experiment. One counter counted pedal revolutions during the first, third and fifth time intervals. The other counter counted pedal revolutions during the second, fourth and sixth time intervals. After the 30 seconds were up the resistance was removed from the Monark cycle ergometer and the subject cooled down until he was comfortable with stopping. The data was used to calculate peak muscle power, average muscle power and rate of fatigue. One week later, the subject reproduced this experiment by using of the other piece of nicotine or placebo gum that was not administered during the first test.

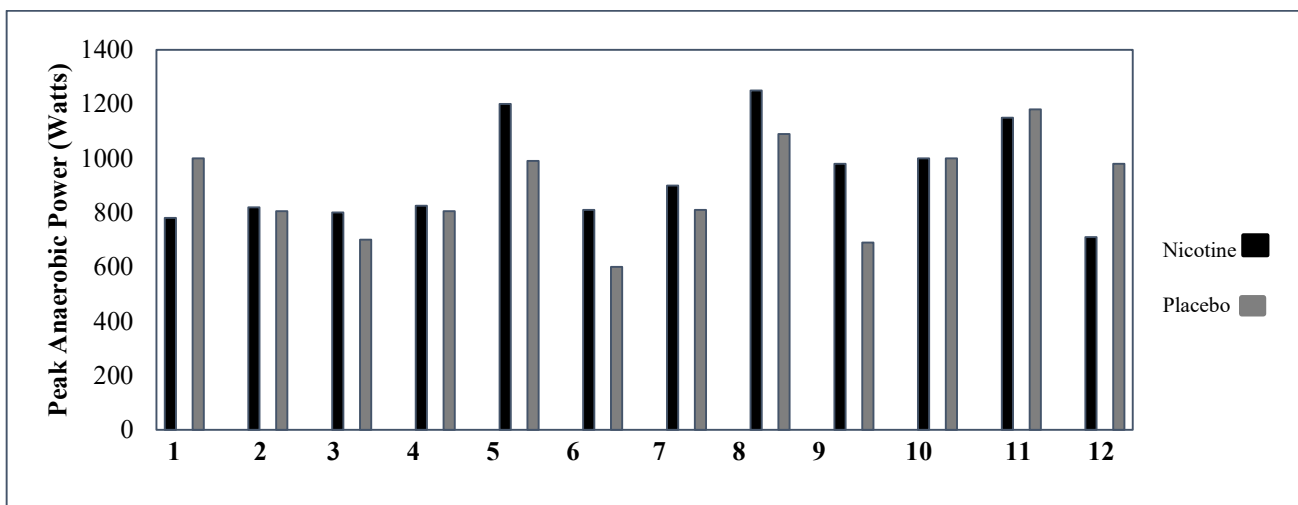
## 3. RESULTS:

The purpose of this study was to determine if nicotine had a positive, negative, or no effect on muscle performance in the human body during a WAnT. The literature review showed that previous researches were inconclusive. The results of this study showed the effects on non-tobacco using collegiate football players during a WAnT. The ages, height, weight and brake weight are shown in Table 1. Brake weight was the prescribed force used as resistance for the WAnT calculated by 7.5% multiplied by the body weight (kg) of the test subjects and rounded to the nearest 0.5 kg.

**Table 1: Demographics of the participants.**

Test Subjects (N=12)	Mean	SD	Range
Age	20.8	1.36	19-23
Height (in)	71.23	2.5	66-75.5
Weight (kg)	92.5	12.4	74.5-105.5
Brake Weight (kg)	7.1	0.91	6-9

Table 1 reports the demographics of the 12 test participants. There were little differences in the ages and brake weights of the subjects, but there were significant differences in the heights and weights of the subjects.

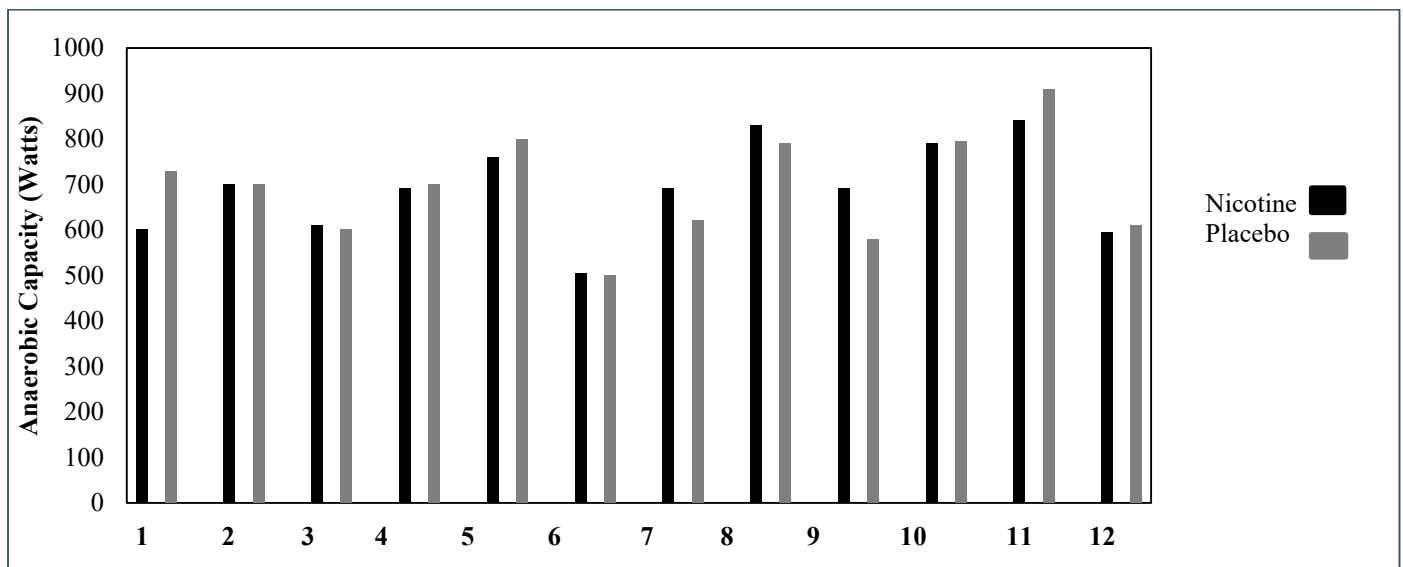


**Figure 1: Results for peak anaerobic power.**

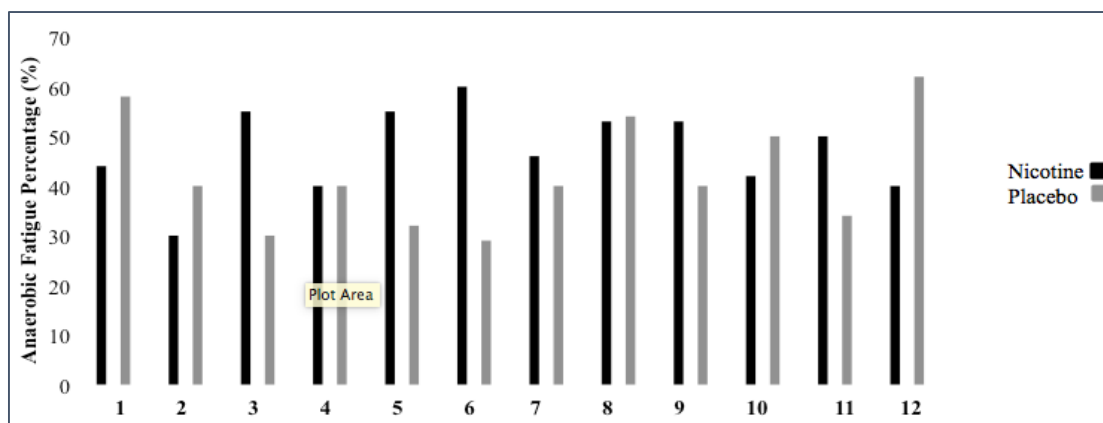
Figure 1 shows that the data collected from all twelve subjects on peak anaerobic muscle power comparing the effects of nicotine versus a placebo. Fifty percent of the Subjects (6 of 12) showed an increase in peak anaerobic power during the nicotine trial. Twenty-five percent of the subjects (3 of 12) had no difference in peak anaerobic power output. Lastly, 25% of the subjects (3 of 12) showed a decrease in muscle power during the nicotine gum experiment in comparison with the placebo gum. Table 2 reports a wide variety of peak anaerobic power values obtained from a paired student's *t* – test. The values showed that the mean scores were higher by 47 Watts in the nicotine gum trials. Standard deviation values were also more prominent in the nicotine gum with a greater difference of 14 Watts. The p-value was greater than 0.05 ( $P = 0.34$ ). Therefore, one cannot claim this as statistically significant data.

**Table 2: Comparison of peak anaerobic power values for nicotine and placebo trials.**

Nicotine Gum				Placebo Gum			
Mean	935			Mean	891		
95% CI	825.3 - 1050			95% CI	787.9 - 995.1		
SD	178			SD	163		
Median	881			Median	885		
t-score		1	DF	11	P-value	0.35	



**Figure 2: Results for anaerobic capacity.**



**Figure 3: Graph results for percentage of anaerobic fatigue.**

Figure 2 indicates that the data collected from all twelve subjects on anaerobic capacity or mean anaerobic muscle power output. The effects again show the values of nicotine in comparison with a placebo. Fifty percent of the subjects (6 of 12) showed an increase in anaerobic capacity during the nicotine trial. In contrast, 50% of the football players (6 of 12) showed a decrease in anaerobic capacity during the nicotine trial. Figure 3 shows the data collected from all twelve subjects on anaerobic fatigue. This comparison between nicotine gum and placebo gum was based on the percentage of decline in performance from the highest to lowest five second intervals throughout the 30 second experiment. A lower percentage rate for the experiment indicated a better effect of maintaining performance; a higher percentage rate indicated decrease in muscle performance. Fifty percent of the subjects (6 of 12) showed a greater percentage loss in the nicotine gum trial. Forty-two percent of the subjects (5 of 12) showed a lower percentage from nicotine gum. Finally, eight percent of the subjects (1 of 12) showed no difference from both trials of anaerobic fatigue. As seen in Table 3, the values for anaerobic capacity were similar. The mean scores were almost identical with nicotine scores edging placebo scores by a difference of 2 Watts. The nicotine standard deviation scores were 11 Watts smaller than the placebo. Because the resulting p-value of 0.92 was far from the 0.05 level of significance, this data was not statistically significant.

**Table 3: Comparison of anaerobic capacity values for nicotine and placebo trials.**

Nicotine Gum			Placebo Gum			
Mean	694		Mean	695		
95% CI	627 – 766.7		95% CI	618 – 772		
SD	111		SD	122		
Median	680		Median	687		
t-score		0.1	DF	11	P-value	0.93

**Table 4: Comparison of percentage of anaerobic fatigue in nicotine and placebo trials.**

Nicotine Gum			Placebo Gum			
Mean	46%		Mean	44%		
95% CI	43% – 54%		95% CI	36% – 51%		
SD	9%		SD	12%		
Median	49%		Median	42%		
t-score		1.01	DF	11	P-value	0.34

As seen in Table 4, the values are comparable. The subjects had a larger drop off in anaerobic fatigue from highest peak interval to lowest end interval when the percent score was greater. Consequently, mean scores were higher in nicotine gum by a difference of 4%. Nicotine gum had a lower standard deviation by 2%. The resulting p – value was 0.33.

**4. DISCUSSION:**

Landers et al. (1992) described that athletes also believe that smokeless tobacco enhances performance by preventing dry mouths, improving concentration, improving reaction time and providing an arousal effect. These study results are in contrast with research done by Escher et. al. (1998) who believed that smokeless tobacco decreased muscular strength. In the future it is recommended to further investigate the effects of nicotine and muscular performance. Recommendations for future research on nicotine and muscle performance include: 1. Increasing the sample size. This will ensure a larger validity of the experiment. 2.Using cycle ergometers with computerized systems that automatically count pedal rate and determine the results to prevent human error. 3. Using a variety of subjects from different sports, races and genders. 4. Comparing the effects of nicotine users and non-users. 5. Improve validity and other factors that may influence an effect using nicotine.

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