

# The effect of creatine monohydrate supplement on stroke volume during high intensity aerobic exercise in non active adults

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

## Abstract

**Purpose:** Creatine is the most popular supplement to improve body composition and anaerobic performance. There are some other properties of creatine with regard to fitness and aerobic performance. The purpose of current study is to determination of creatine supplement intervention on stroke volume.

**Material:** 38 inactive adult postgraduate students had been divided (n=20) into two groups where the treatment in weight was  $76.34 \pm 11.73$  and height was  $174.89 \pm 5.82$  while placebo group in weight was  $81.83 \pm 13.10$  and height was  $176.29 \pm 5.2$ .

**Results:** The result of this research shows that there is no significant effect on the stroke volume during high intensity aerobic exercise. The results of the data in present study also show that there is no effective intervention by the creatine monohydrate supplement on the stroke volume during exercise. However it is showed that there is an increase of stroke volume from the pre to post test in treatment group while the placebo group does not have any increase and the group's stroke volume has decreased from the pre test to the post test.

**Conclusions:** Stroke volume normally reduce during final step high intensity exercise. By the way the current research figured that decreasing of stroke volume at final steps of incremental exercise will be with slow latency at resulted by creatine monohydrate supplements.

**Keywords:** creatine, stroke volume, cardiac output,  $VO_2$  max, hemoglobin.

## Introduction

Aerobic performance is essential factors at both high level of sport performance and health area [1, 2]. Creatine monohydrate has been known as a supplement to improve some aspects of human performance in high level competitions [3]. Previous studies have showed that creatine monohydrate may improve anaerobic performance by increasing creatine concentration of the cytosol and improve the anaerobic phosphor creatine energy system [4, 5] as well. There are several functions of the creatine monohydrate supplement for examples as hormonal alteration, protein turnover, lipid member stabilization, molecular modification and metabolic adaptation [6-8].

Stroke volume is an important factor for human performance and also cardiovascular fitness [1]. The amount of blood pumped by the heart is closely related with aerobic and long term duration performance [9, 10]. Both Stroke volume and cardiac output increase during exercise [11]. There is no any research with regard to the creatine effect on the stroke volume or cardiac output. It appears that the creatine supplement improves cardiac muscle contraction by increasing the ATP transportation form mitochondria and also by increasing the GLUT-4 concentration on the cells membrane [12].

The effect of exercise and endurance aerobic exercise on the cardiac function and stroke volume has been investigated in several researches [13]. On the other hand, to improve cardiovascular function and specifically stroke volume with supplements as well as herbal and non herbal supplements in-combined with or without exercise is a new area of research [14]. Some supplements as well as

omega-3 have shown improved cardiac output and other cardiovascular functions [15]. There are a few researches regarding the effect of creatine supplementation on the stroke volume. Results of a research by Wildman showed that there is no any significant effect of the seven days creatine loading (25gr/daily) on the cardiac output and stroke volume. However this research is conducted for just a few days due to resting situation [16].

The current research hypothesized that creatine monohydrate may improve stroke volume during incremental exercise. A research, examined effect of the creatine supplement on the cardiac pump function on the rat's subject. The result of this investigation showed effective intervention by the creatine supplement on the maintenance of cardiac pump function during long term administration of energy deficiency [17].

The objective of the current study is to determine the creatine monohydrate intervention on stroke volume during high intensity aerobic exercise.

## Material and methods

### Participants.

38 healthy male volunteer students participated in the present study. All the subjects were within the age of 25-35 years old and were postgraduate students in University Purta Malaysia. A single blind experimental research was used for the present study. Initially, subjects were divided into two groups; the placebo group and treatment group. 38 inactive adult postgraduate students were divided (n=20) in two groups where the treatment in weight was  $76.34 \pm 11.73$  and height was  $174.89 \pm 5.82$  while placebo group in weight was  $81.83 \pm 13.10$  and height was  $176.29 \pm 5.2$ .

Randomized block sampling were applied according to the baseline data in fitness score for group managements. The treatment group (n=20) and placebo group (n=18) were under experimental condition for five weeks. All subjects were without renal impairment, heart disease and medical limitation from exercising. Subjects did not participated in any physical activity program during the past recent six months and they did not also participated in any other supplementation programs. The location of the present study was at the Sport Academy laboratory in University Putra Malaysia.

#### *Research Design.*

Gas analyzer with cycle ergometer were used to determine oxygen pulse. The impedance electric was used to determine the body composition factors.

Experimental research conditions were the same at the pre and post test. All measurements took place between 9:00 am and 10:00 pm at the laboratory room temperature of 20° C.

The commercial creatine monohydrate supplement (produced by GNC from USA) was used in the present study. There were two phases to supplementation by creatine monohydrate. The first step was called loading and the second step was called maintenance. At the loading step, subjects used 20gr daily creatine (4 times per day and 5gr per time). This step will continue for five days.

The second step of the creatine supplementation was called the maintenance step. In this step, subjects used 5gr daily creatine for four weeks. At the end of second step, subjects had to inter in wash-out phase. The wash-out period allows the body to recover from the artificially high creatine levels observed during supplementation that the body would not ordinarily encounter in everyday life. The placebo-control group used dextrose as the placebo in the same steps.

The standard diet controlling methods are used to control the daily diet effect on the human subjects. Three days of the dietary intake were recorded at first and later three days were recorded after five weeks of experimental protocols. Both of the pre and post test were included during the weekends and weekdays. Total calories intake, carbohydrate, fat and protein percentages were recorded in a record sheet. Food Procedure ESHA software program was used to analyze the recorded information (Food Procedure, ESHA, Research, Salem, OR).

#### *Stroke Volume*

Cardiac output (Q) is the volume of blood being pumped by the heart in a minute. The average of the cardiac output is recorded for 5L.min<sup>-1</sup> for male subjects and 4.5L.min<sup>-1</sup> for female subjects in previous studies. Stroke volume means the volume of blood which is pumped in per bit by the heart. There are invasion and non-invasion methods to determine the cardiac output or Stroke volume. Estimating the stroke volume with the hemoglobin concentration is a new method which may estimate the stroke volume during high intensity aerobic exercise on the cycle ergometer. Subjects went under an incremental test on an electromagnetically braked cycle-

ergometer to determine the stroke volume. This test consisted of a warm-up period of three minutes pedaling with 20 watt followed by a linear increasing workload of 50W every three minutes. The starting stage was 50 w with pedaling frequency of 60 rpm up to exhaustion which was taken at the point when a subject was no longer able to maintain the pedaling rate. The workout which was achieved during the latest minute of exercise was taken as the maximum work load (Wmax).

Hemoglobin concentration was recorded at the beginning (on the rest time) and immediately after the end of the pedaling (one minute after the finishing time). Oxygen plus was determined by dividing VO<sub>2</sub>max which was recorded by the gas analyzer on a maximum heart rate which was recorded during the test [18]. The stroke volume in this experimental research was estimated via the following equation:

$$SV_{est} = OP/a-v O2D_{est}$$

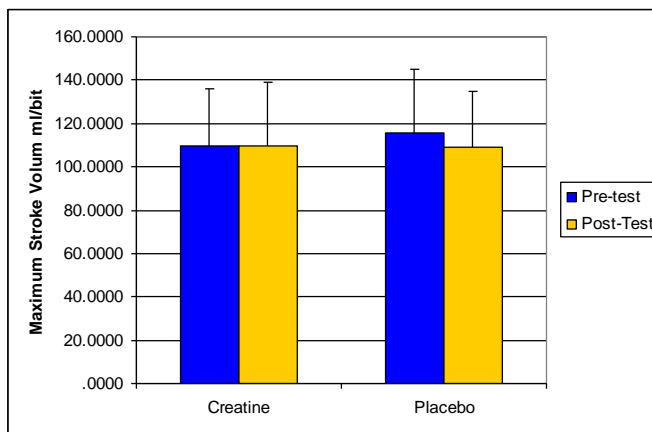
The portable hemoglobin analyzer based on the finger's blood was used to determine the hemoglobin concentration.

#### *Statistical Analysis.*

Descriptive statistical method was used to determine the mean and standard deviation (SD). Statistical analysis software PASW version 18 (anew version of SPSS) was used to analyze the process. ANOVA repeated measure was applied to analyze the variance. Helmert test was used to determine the timing effect. The age of the subjects was applied as the covariance. The probability value of < 0.05 was considered statistically significant. The Microsoft Excel software was used to graph the drawings. Other than that, Paired Samples T Test and Independent Samples T Test were used to examine the hypothesis of the present study.

### **Results**

The results of the data show that there is no any significant difference between the treatment and placebo of the creatine monohydrate used. A multivariate repeated measures ANOVA was used to evaluate the effects of creatine in maximum stroke volume (SV). No significant effect is found for creatine timing effect on the maximum stroke volume between the groups (SV: F(1,32)=2.37, p=0.13) (Fig. 1). This data shows that there is no significant difference of maximum stroke volume between treatment group and placebo group (SV: F(1, 32)=0.995, p=0.325). has bee Covariance Analysis shows that the age intervention, as the covariance in this research has no significant intervention between subjects (Age F(1,32)=3.65, P=0.065). The descriptive data is presented as in Table 1. The result of the data shows that there is no effective intervention with the creatine monohydrate on supplement on inactive adult students. The result of the Paired-Samples T Test has shown that there is no significant effect with the creatine supplement in the Pre to Post test (P=0.4040). In addition, it is also showed that there is no significant effect at the stroke volume in



**Figure 1.** Creatine intervention on the Maximum Stroke Volume after five weeks supplementation is presented in this graph.

**Table 1.** Physiologic responses at comparing maximum stroke volume at treatment and placebo groups.

Study Groups	Pre-test (Mean ± SD)	Post test (Mean ± SD)
Treatment (Creatine)	109.70 ± 26.10	109.89 ± 29.22
Placebo	115.76 ± 29.51	108.90 ± 26.14
Total	112.82 ± 27.67	109.39 ± 27.27

changing SV from the pre to post test in both treatment and control groups ( $P= 0.267$ ).

### Discussion

Stroke volume and cardiac output are the important factors of cardiovascular fitness [1] which affect the physical performance as well specifically for long term duration and aerobic performance. Previous researches have investigated the effect of several supplements on the stroke volume. However there is not enough research regarding creatine supplement on the cardiac function and stroke volume on the human subject. The present study has the same results with the research by Wildman [16] which is conducted in loading period (seven days). The effect of the creatine monohydrate supplement on cardiac output and stroke volume on the young male subjects, show no significant results. This data shows that there is no any improvement on the cardiac muscle and cardiac function after seven days of loading phase. According to the findings, the present research basically shows that creatine has a positive effect on the cardiac muscle by improving the GLUT-4 concentration and increasing the ATP transportation from mitochondria to the cytosol.

The result of the data in the present study has shown that there is no effective intervention with the creatine monohydrate supplement on the stroke volume during exercise. However it can be seen that there is an increase

on the stroke volume from the pre to post test in treatment group while the placebo group does not have any increase and the group's stroke volume has decreased from the pre test to the post test. The maintenance of the stroke volume during exercise is an important factor to be in high level of performance at aerobic exercise. There are more researches needed to determine the maintenance of stroke volume during exercise.

### Conclusion

This research may not have a significant result but has very important results. The main aspect of the stroke volume during maximum exercise intensity is the maintenance of the stroke volume from the rest time [19, 20], because with an increase of the heart rate during high intensity exercise, the stroke volume will normally decrease. In this research, it is showed that the stroke volume does not decrease at high intensity exercise while the placebo group on the other hand, do increase. This is an important finding in the present study.

### Conflict of interest.

The author states that there is no conflict of interest.

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