

Effects of a Single Dose of Caffeine on Resting Cardiovascular System of Normal Young Black African Adults

Lamina Sikiru and Musa Danladi I. (Prof)

Abstract

The objective of this study was to determine the effect of 5mg/kg body weight dose of caffeine on cardiovascular system of normal young adult males of Black African Origin. Twenty normal young adult male volunteers participated. A repeated measures 2 randomized Crosse over (counter balanced) double blind design was used in data collection. One hour post caffeine ingestion of varied doses (5mg/kg body weight) and placebo dose cardiovascular (SBP, DBP & HR) parameters were assessed. Repeated measures t-test was used to assess the level of significance in all variables of interest. The result showed no significant effect of varied doses (5mg/Kg) of caffeine over placebo in all cardiovascular parameters assessed at $P < 0.05$. It was concluded that instant soluble coffee (Caffeine) dose up to approximately 3199mg (300mg caffeine) seems not to stress the cardiovascular system of normal young black African adults.

Keywords: Caffeine, Coffee, Cardiovascular, black Africa

Introduction:

Caffeine (1, 3, 7-trimethylxanthine is a methyl derivative of xanthine. It is basically a Purine compound containing two condensed heterocyclic rings and it is a naturally occurring chemical found in leaves, seeds and fruits

of over 60 species of plants. Specially, much caffeine is found in tea, coffee (Coffee Arabica), Cola nuts (Cola Acuminata) and cocoa (theobroma Cacao), (Esig & Haymes,1992; VanHandel,1983; Wilcox,1990).

The controversy surrounding the use of caffeine as a food beverage by laymen or its use as an ergogenic aid by local, national and international athletes has drawn the attention of many scientists to research into the effect of this wonderful drug (Wilcox,1990; Clark, 1997; Spriet,1995; Anhrendt, 2001). Caffeine stimulates the heart, increasing the rate and contractile to the heart at rest, causing peripheral vasodilatation (Brooks, Fahey & White, 1996). The effects of Caffeine on the cardiovascular system are mediated through stimulation of the central nervous system (CNS) or direct action on the heart and blood vessels. This actually increases the systemic blood pressure, such that chronic use of caffeine has been linked with coronary heart disease risk (Robertson, et al., 1981). However, following caffeine ingestion, bradycardia is also possible because xanthine stimulates the Medullary vagal nucle, this in turn decreases the heart rate (VanHandel, 1983)

The use of caffeine is not without danger, the diuretic and cardiac stimulatory properties can combine to increase the risk of arrhythmias such as ventricular ectopic beats and paroxysmal arterial tachycardia. This is particularly alarming for older, less conditioned individual (Brooks, Fahey & White, 1996). Many studies (Costil, Dalskj, & Fink, 1978; Tarnopolsky, et al., 1989; Gamba, 2001) reported no significant effect of caffeine on the cardiovascular system. Several other studies (Robertson,etal., 1981; VanHandel, et al., Graham, et al. 2000) have also reported significant effect of Caffeine on cardiovascular system. However, most of the studies investigating the effects of caffeine on health have been conducted using white or other mixed black subjects.

The propose of the present study was therefore to investigate the effects of 5mg/kg dose of caffeine on the cardiovascular system of normal young adults of black African (Nigerian) origin

Methodology

Subjects: The subjects for the study included 20 male students volunteers of Bayero University, kano-Nigeria. Subjects were non regular users of caffeine, non smokers, non cardiac patients and apparently healthy. Their age ranged from 18 to 25 years. Health information was obtained from the self reported health history and life style questionnaire developed and validated by the British Columbia Ministry of Health (1978). Subjects were fully informed about the experimental procedures, risk and protocol after which they were informed, their consent in accordance with the American College Sports Medical [ACSM],1991) guidelines regarding the use of human subjects (15) and ethical approval by the Faculty of Education, Bayero University Ethical Committee. Subjects were advised to avoid caffeinated food and beverages; also to avoid any vigorous physical activities 24 hours to the test days.

Design of the study:

In this study, repeated measure design in which each subject served as his own control (a post test placebo-controlled design) was used to determine the effect of varied doses of caffeine and placebo on the variables of interest. The ingestion of caffeine and placebo was in a double blind, two randomized cross over order (a

counter balanced test).The cross over ingestion of caffeine was separated by seven days interval to avoid carry over effect (Brooks, Fahey, & White,1996; Graham, et al.,2000).

Procedures

Anthropometric measurement:

Subjects' physical (height & weight) characteristics were measured using standardized anthropometric protocols (. Rose, & Marfell-Jones, 1991; International Society for the Advancement of kinanthropometry ([ISAK], 2001).

Physiological measurement:

Subjects' systolic blood pressure (SBP), Diastolic blood pressure (DBP), Heart rate (HR) were monitored from the right arms as described by Walker et al (1992) using automated BP monitor. The measurement was done in the morning between 8 am and 10 am each test day. The equipment was used to take the Blood pressure and HR at rest and one hour after caffeine ingestion. This procedure was repeated and the average of the two readings was recorded.

Caffeine and placebo measurement:

The quantity of coffee to give, and the amount of caffeine needed (5mg /Kg body weight) were calculated by multiplying the amount of coffee by 10.68 (1mg of caffeine = 10.68 mg of coffee). Capra Nescafe Coffee commonly found in Nigeria contain about 0.09366mg caffeine per mg of coffee (Eteng, et al., 1999). Since pure caffeine is not readily available, pure coffee was used instead.

Subjects ingest 5mg/kg caffeine (measured using electronic weighing machine) dissolved in 200 ml warm water (Gamba, 2001); and sweetened with artificial sweetener (Engels, & Haymes, 1992). For placebo, 0.1 ml liquid food Colour (coffee colour) was also dissolved in 200 ml warm

water sweetened with artificial sweetener. The purpose of coffee colour placebo was to blind the subjects of ingested substance.

Test procedure:

On arrival to the exercise Physiology Laboratory of the department of Physical and Health Education, Bayero University, Kano Nigeria, subjects rested for about 10 minutes in a sitting position, subjects BP and HR were monitored. Subjects ingested caffeine doses and placebo dose in random order, following ingestion, quietly rested in sitting position. One hour post caffeine ingestion SBP, DBP and HR were measured as earlier described. This procedure was repeated on the second, third and fourth test days in a 2 randomized cross over (counterbalance) order in a double blind manner.

Data analysis:

Following data collection, the measured variables were statistically analyzed. Mean and standard deviation for all variables were determined. The resting, post caffeine dose (5mg/kg) and placebo dose SBP DBP & HR was analyzed using repeated measures t-test. All statistical analysis was performed on a IBM compatible microcomputer using the statistical package for the Social Science SPSS, Chicago IL, USA. The probability level for the above test was at 0.05 to indicate significance.

Results

Twenty subjects participated in the study; all were males of African (Nigeria) origin. Their physical characteristics

are depicted in table 1. Table 2 showed no significant effect of caffeine doses over placebo on cardiovascular parameters investigated.

Discussion

This study was designed to assess the effects of varied dose of caffeine on cardiovascular parameters. Result of the study indicated no significant effect of caffeine dose (5mg/kg) over placebo on the cardiovascular system (SBP, DBP & HR) at $P < 0.05$. This result is inconsistent with the report of Robertson et al. (1981) and VanHandel et al. (1977). While other studies (Gamba, 2001; Pitcher, 1984) corroborated the result of the present study. Robertson et al (1981) reported a significant increase in SBP and DBP after oral administration of 250 mg of Caffeine which is closely similar to the 5 mg kg⁻¹ (299.5 mg) caffeine in the present study. Despite the fact that both studies utilized a lower doses compared to the present study yet reported a significant effect of caffeine. Pitcher (1984) in review of relevant literature concluded that there is not direct relationship between caffeine intake and elevated blood pressure. In a randomized placebo control study, Waring, Goudsmith, Marwick, Webb, & Maxwell,(2003); examined the effect of 300mg caffeine on blood pressure of 20 healthy adults. They reported no effect of caffeine on peripheral blood pressure while caffeine increased the central blood pressure.

The non significant effect of caffeine on the cardiovascular system in the preset study and as opposed to others (Robertson, et al.,1981;VanHandel, et al.,19778) earlier mentioned might not be unconnected to the fact that there exist differences in interracial caffeine pharmacodynamics and pharmacokinetics (metabolism and tolerance) (Clark, 1997; Gamba, 2000). The effect of the type

of caffeine used could not be ruled out. Better coffee are lower in acid, higher in caffeine and have a longer lasting effect and that ground coffees are generally preferable to canned or instant coffee (Marquis, 1979). Several coffees also contain several other substances that may exert cardiovascular effects such as estrogen, nicotinic and phenols (Burke, & Biejen, 2000); whose effect could not be ruled out. The effect of the type of placebo used also worth consideration, most previous studies use decaffeinated coffee as placebo, decaffeinated coffee vary considerably in the chemical used or process in reducing their caffeine content, these chemicals and processes may affect Caffeine metabolism and tolerance (Burke, & Biejen, 2000). Also failure to distinguish between pure coffee and caffeine is another important factor worth given attention.

Conclusion

Based on the result of the present study, it was concluded that instant soluble coffee by Nestle Carpral of approximately less than 3199mg(300mg or 5mg/Kg caffeine) has no effect on resting cardiovascular (SBP, DBP & HR) system of normal young adult males of black African (Nigerian) origin.

References

- American College of Sports Medicine (1991) Policy statement regarding the use of human subjects and informed consent. *Medicine and Science in Sports and Exercise* 16,467.
- Anhrendt, D.M (2001) Erogenic aid. Counseling the athlete. *American Family Physician*. 63 (5) 913-22
- British Columbia Ministry Health (1978). Canadian standardized test of fitness operations manual (3rd ed.) Ottawa; Author.
- Brooks, G.A, Fahey T.D & White T, P (1996). Exercise physiology, human Bioenergetics and its application (2nd Ed) Mountain View, May Field Publishing Company.
- Burke, V & Biejen, L.J (2000) Coffee, caffeine and blood pressure. *Cardiovascular Rounds and Review*. 4,187-197
- Clark, W (1997) Caffeine a users guides. *The Physician and Sports Medicine*, 25(11). 11
- Costil, D.L; Dalskj G.P, and Fink, W.J. (1978) Effects of caffeine ingestion on metabolic and exercise performance. *Medicine and Science in Sports and Exercise*. 10: 155-158.
- Engels, H.J and Haymes, E.M (1992) Effect of caffeine ingestion

on metabolic responses to prolonged waking in sedentary males. *International Journal of Sports Nutrition*, 2, 386-396

Esig, H.J; Haymes, E.M (1992) Effects of caffeine ingestion on metabolic responses to prolonged walking in sedentary males. *International Journal of Sports Nutrition*.2, 386 - 396

Eteng, M.R et al. (1999) Nigeria Nescafe coffee. *Plant Food for Human Nutrition*. 54(4)337-344

Gamba. A.A (2001) Effect of caffeine ingestion on the P.P and R.R intervals of adult males. *Journal of Health Physical Education Sports and Leisure Studies*, 2 (2) 17-24

Graham, T.E et al. (2000) Caffeine ingestion does not alter carbohydrate or fat metabolism in human skeletal muscle during exercise. *The Journal of Physiology*, 529(3) 837-847.

International Society for the Advancement of kinanthropometry (2001) *International standards for anthropometric assessment*. Potchefstroom, South Africa: Author

Marquis, T (1979). *Effect of caffeine on performance*. Unpublished Manuscript, University of Florida

Pitcher, M. (1984). Does coffee raise blood pressure? *American Journal of Cardiology*. 53 (7) 918 - 22

Effects of a Single Dose of Caffeine on....

- Robertson, D. et al. (1981) Tolerance of the humoral and homodynamic effects of caffeine in man. *Journal of Clinical Investigation*. 64, 1111-1117
- Rose, W.D & Marfell-Jones, M.J (1991). Physiological testing of the high performance athletes . In J.D MacDugall; H.A Wenger & H.J Green(eds). *Kinanthropometry*. Champaign,IL. Human Kinetics Books(pp 223 – 308)
- Spriet, L. L (1995) Caffeine and performance. *International Journal of Sport Nutrition*, 5 (suppl.) S 84-99
- Tarnopolsky M.A et al (1989) physiological responses to caffeine during endurance running in habitual caffeine users. *Medicine and Science in Sports and Exercise*, 24, 418 – 424 .
- VanHandel, P (1983). Caffeine .In: M.H Williams (ed) *Ergogenic aids in sports*. Champaign. Human kinetics Publishers (pp 128-163).
- VanHandel, P.J et al (1977). Physiological responses to cola ingestion. *Research Quarterly*. 48, 436 - 444
- Walker, A.J et al. (1992) Cardiovascular and plasma catecholamine responses to exercise in blacks and white. *Hypertension*, 20(4)542-548
- Waring, W.S, Goudsmith, J, Marwick, J, Webb, D.A, & Maxwell, R.J (2003) Acute caffeine intake influence central more than peripheral blood pressure in young adults. *American Journal of Hypertension*. 16(11) 919 – 924.
- Wilcox, A R (1990) caffeine and endurance performance *Sports Nutrition*, 3 (26)

Table 1: Physical characteristics of subjects (N=20)

Variables	Mean	SD	Range
Age (years)	22.3	4.0	18.0-25.0
Height (cm)	169.3	5.4	160.0-180.0
Weight (kg)	59.3	5.5	52.0-73.0
Body mass index (kg/m ²)	22.0	2.6	20.3-24.5
Resting SBP (mm Hg)	127.0	5.4	120.0-130.0
Resting DBP (mm Hg)	78.0	4.2	72.0 - 80.0
Resting HR (b/m)	70.0	4.8	68.0 – 78.0

Table 2: Exercise performance responses to varied doses of caffeine (t-test)

Variables	Mean	SD	t-value
SBP(mmHg)	135.0	2.7	.788**
DBP(mmHg)	77.5	4.8	.620**
HR(beat/min)	75.0	4.6	.964**

t ** Not significant