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Faculty of Graduate Studies

Effect of "Energy drinks" consumption on hemodynamic and electrocardiographic parameters among healthy young nurses in Palestinian private hospitals in Nablus city

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This thesis was defended successfully on:6/10/2021 and approved by:

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Declaration

I certify that this thesis submitted for the degree of master, is the result of my own research, except where otherwise acknowledged, and that this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Student Name: Ameen Enaya

Signature: 

Date: 30 /11/2021

Dedication

I dedicate this work to the Almighty Allah for preserving my life, ensure my security in West Bank during the COVID-19 pandemic, and Gave me good Health and strength to be able to do this work .

To my parents for their endless prayers and my family for their encouragement .

To my lovely friends Mr. Ali E. abo ammash, Mr. Akram Shahroor, and Mr. Ali Ghanem for their patience and support .

To my friends for support and encouragement .

To all martyrs and injuries in Palestine .

To every person help me to finish this work.

Acknowledgments

This section can contain an infinite amount of appreciation to my family, friends, and colleagues who helped make the thesis process possible, however, I will keep it simple. The utmost love and appreciation to my father and mother, who sacrificed their two years of care to make this degree possible. Much appreciation to my family and fiancé for their support. Dr. Jamal Qaddumi, my advisor, I extend my special thanks and gratitude to you for your help, encouragement, support and ideas. and statistical knowledge. To the cardiologist Dr. Hammam for his interest in the current study and assistance in supervision during the data collection. thank you all!

Effect of "Energy drinks" consumption on hemodynamic and electrocardiographic parameters among healthy young nurses in Palestinian private hospitals in Nablus city

Abstract

Background: Energy drinks are one of the most popular drinks in the world. which consider non-alcoholic drinks that boost the body's energy level.

Aim: The current study aimed to determine the effect of energy drinks consumption on electrocardiographic and hemodynamic parameters in young healthy nurses.

Method and result: A cohort prospective crossover quantitative study involved 84 healthy young nurses working in private hospitals in Nablus city, divided into two groups, group A interventional and group B control, each group contain (42). The participant rest for 5 min then ECG, HR, BP, and QTc were measured and document as a baseline, then the participant consumes 2 can of XL over 30 min, then the same measurement was taken after 30 min, 1 hour, 2 hours, 4 hours and at 7 days. Mann-Whitney U test was used to detect the effect of Energy drinks consumption on SBP at 30 minutes (U = 546.5, p = .003), 1h (U = 415, p <.001), 2h (U = 448.5, p < .001), 4h (U = 440, p < .001), and 7 day (U = 534.5, p = .002). And the effect on the DBP at 30 minutes (U = 637.5, p = .028), 1h (U = 611, p =.015), 2h (U = 611, p =.015), 4h (U = 566.5, p =.005), and 7 day (U = 541, p = .002). And the effect on the HR at 30 minutes (U = 548.5, p = .003), 1h (U = 361, p <.001), 2h (U = 497.5, p =.001), 4h (U = 390.5, p <.001), and 7 day (U = 515.5, p = .001). And on the ECG at 1h (*U* = 798, *p* =.042), and at 2h (*U* = 777, *p* =.022). And the effect on QTc at 1h (*U* = 665, *p* =.052), and at 2h (*U* = 656, *p* =.043).

Conclusion: The energy drinks consumption led to significantly elevate SBP, DBP, HR, QTc, and changes in the ECG.

Key words: Energy drinks, Systolic blood pressure, diastolic blood pressure, heart rate, ECG and QTc.

List of abbreviations

ECG: Electrocardiograph

SBP: Systolic blood pressure

DBP: Diastolic blood pressure

HR: Heart rate

TMA: Trimethylamine

TMAO: Trimethylamine N-oxide

DM: Diabetic mellitus

HTN: Hypertension

IHD: Ischemic heart disease

SAH: Specialized Arab Hospital

AAUP: Arab American University

SPSS: Statistical Package for the Social Sciences

QTc: Corrected QT Interval

ANOVA: one-way analysis of variance

AHA: American Heart Association

U. S: United States

FDA: Food and Drug Association

N-oxide: amine oxide

BMJ: British Medical journal

US: fluid ounce

Chapter One

Introduction

Chapter One

Introduction

1.1 Background

Energy drinks begins in 1987 with Red Bull, these drinks are non-alcoholic drinks used for boosting energy levels. Now the Energy drinks are one of main worldwide drinks because it's inexpensive and accessible for everyone.

According to scientists at the FDA (2108), Between 2004 and 2014, 34 deaths related to energy drinks were reported to the US Food and Drug Administration, in addition to serious adverse events including cardiac arrest, myocardial infarction, atrial fibrillation, and seizure. Evidence reports of energy drink-related cardiovascular side effects have added to the criticism surrounding these drinks.

Energy drinks are a compound of (Caffeine, sugar, Taurine, B vitamins, Inositol, Ginseng, Ginko Biloba, L-Carnitine, L-Theanine, and BCAAs), the major unit of energy drinks is caffeine. Energy drink contains Caffeine from 40-250 mg per 8 fluid ounces, (1 US fluid ounce =29.5735296 ml) (U. S FDA, 2018). This large amount of caffeine induces ventricular arrhythmias (Handanagic et al., 2019). In addition to the effect of energy drinks consumption on blood pressure and heart rate (Wassef et al., 2017). Moreover, Shah et al. (2019) reported in research that energy drinks consumption significantly prolongs QTc in the ECG.

According to Voskoboinik (2018) study result, the consumption of caffeine affects sympathetic activation, intracellular calcium trafficking, and adenosine receptors. Moreover, caffeine act as an antioxidant. These actions of caffeine increase the blood pressure, heart rate and play the main role in arrhythmogenesis.

Then the L-carnitine plays role in increase the platelet aggregation in the body. L-carnitine is braked down by gut bacteria in our body produced a trimethylamine (TMA) compound. The liver converts this compound from TMA to trimethylene N-oxide (TMAO). TMAO played a vital role in platelet Feature Modulation and increases platelet hyperactivity and thrombosis in the body, this significant risk factors for the occurrence of complications, such as stroke and heart attack, for cardiometabolic disease (Weifei Zhu et al. 2017).

1.2 Problem statement

Energy drinks are licensed and available worldwide but are still have a lot of question marks about safety. notice an increase in the number of young ages who visit the emergency room and this is a coinciding increase in energy drinks–associated emergency department visits in Palestine. We still ignore this issue as a community and health care providers, especially in Palestine. Palestinian cutler still has a lack of information about the hazard of energy drinks consumption.

Increasing heart rate and risk for tachyarrhythmia are some serious symptoms that come with energy drinks. It may affect if consumed in large amounts to the cardiovascular system. It also happens because you still have cardiovascular issues even when drinking a little volume.

Also, there is a difference in the results in some studies QTc changes related to energy drinks consumption.

unfortunately, in our country don't have full censorship of this product, and this led to an increase in emergency visits from a different age due to energy drink's side effects. This study was done to show the effect of energy drinks consumption on electrocardiographs and hemodynamics parameters among Palestinian people. also, to see if there is a difference between the Palestinian culture result and other cultures.

1.3 Significance of the Study

Palestinian culture still has an unclear vision about the harms that may occur due to energy drinks consumption. So, this study was the first study about the effect of energy drinks consumption on the cardiovascular system and ECG among Palestinian people, to increase awareness about the side effects of these drinks.

The objective achieved by measuring the ECG, Blood pressure, and heart rate used an interventional study among healthy young age nurses in private hospitals in Nablus city in Palestine after drinking a specific amount of energy drinks in multiperiod, with taking into consideration the harms that can be during this study.

1.4 Research Aim

The purpose of this study is to assess the effect of energy drinks consumption on blood pressure, heart rate, and ECG, as well as QTc prolongation.

1.5 Research Objectives

This study aimed to detect:

1- The effect of energy drinks consumption on an electrocardiograph (ECG) among healthy young nurses in private hospitals in Nablus.

2- The effect of energy drinks consumption on systolic blood pressure among healthy young nurses in private hospitals in Nablus.

3- The effect of energy drinks consumption on diastolic blood pressure among healthy young nurses in private hospitals in Nablus.

4- The effect of energy drinks consumption on heart rate among healthy young nurses in private hospitals in Nablus.

5- The effect of energy drinks consumption on QTc among healthy young nurses in private hospitals in Nablus.

1.6 hypotheses:

H0: There are no relationship between energy drinks consumption and electrocardiograph (ECG) among healthy young nurses in private hospitals in Nablus.

H1: There is a relationship between energy drinks consumption and electrocardiograph (ECG) among healthy young nurses in private hospitals in Nablus.

H0: There is no relationship between energy drinks consumption and systolic blood pressure among healthy young nurses in private hospitals in Nablus.

H1: There is a relationship between energy drinks consumption and systolic blood pressure among healthy young nurses in private hospitals in Nablus.

H0: There is no relationship between energy drinks consumption and diastolic blood pressure among healthy young nurses in private hospitals in Nablus.

H1: There is a relationship between energy drinks consumption and diastolic blood pressure among healthy young nurses in private hospitals in Nablus

H0: There is no relationship between energy drinks consumption and heart rate among healthy young nurses in private hospitals in Nablus.

H1: There is a relationship between energy drinks consumption and heart rate among healthy young nurses in private hospitals in Nablus.

H0: There is no relationship between energy drinks consumption and QTc among healthy young nurses in private hospitals in Nablus.

H1: There is a relationship between energy drinks consumption and QTc among healthy young nurses in private hospitals in Nablus.

1.7 Conceptual definition:

Energy drinks are any drinks that consist of a stimulant ingredient that is promoted as a commodity that will boost mental and physical efficiency and productivity (Rogers et al., 2019).

Blood pressure is defined by the National Institutes of Health as the force of blood pushing against the artery walls. Furthermore, the NIH defines heart rate as the number of times the heart beats in a given period, usually one minute (U.S. National Library of Medicine,2021).

Blood pressure varies according to the muscular efficiency of the heart, blood volume and viscosity, the individual's age and health, and the state of the vascular wall.

ECG It is a voltage versus time graph, reflect the electrical activity of the heart using electrodes placed on the skin. These electrodes detect the small electrical changes that are a consequence of cardiac muscle depolarization followed by repolarization during each cardiac cycle (Lilly & Leonard, 2016).

According to the American Heart Association (AHA), the **electrocardiogram (ECG)** is a test that analyzes the electrical activity of the heartbeat. And **arrhythmia** is described by the National Institutes of Health as a disturbance in the rate or rhythm of your heartbeat. It indicates that your heart is beating too quickly, too slowly, or in an irregular pattern (U.S. National Library of Medicine, 2021).

ECG is frequently used in conjunction with other tests to help diagnose and monitor cardiac problems.

QT interval is representing the period from onset of depolarization to completion of repolarization of the ventricular myocardium, while the **Corrected QT (QTc)** is the time it takes for the heart to go from isovolumetric contraction to isovolumetric relaxation during ventricular systole (BMJ, 2016).

It can be used to look into signs of a cardiac issue, such as chest discomfort, palpitations (rapid heartbeats), dizziness, and shortness of breath.

1.8 Operational definition:

Blood pressure:

participant sit quietly for five minutes before the test begins, sit in a chair/bed with feet on the floor and arm supported so the elbow at about heart level, the inflatable part of the cuff completely covers at least 80% of the upper arm, and the cuff placed on bare skin, then measurement taken by automated blood pressure monitor.

Blood pressure is measured in units of millimeters of mercury (mmHg), The readings are always given in pairs, with the upper (**systolic**) value first, followed by the lower (**diastolic**) value.

Heart Rate:

The heart rate was measured by the number of contractions (beats) of the heart per minute (bpm), the measure was taken by connecting the participant to a cardiac monitor.

QT interval:

Is measured from the first deflection of the Q wave until the end of the T wave (the point that ECG start is straight), after the interval is defined, the number of small squares is counted then multiply by 0.04.

QTc:

Acceptable ranges of QT vary with heart rate, so it must be corrected to the QTc by dividing by the square root of the RR interval.

QTc in this study measured by a **Bazett's** Correction formula, $QTc = QT/(\sqrt{RR})$ (BMJ, 2016).

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Introduction

This chapter provides a summary of available research on the Energy drinks mechanism effect on the body, hemodynamics and cardiovascular system.

Due to the scarcity of research on this issue in the Middle East, particularly in Palestine, the researcher chose to widen the scope of the literature study to include additional nations. By extending the literature study to other nations, the researcher was able to collect the most recent and up-to-date data on the subject.

The goal of the literature study was to learn what is currently known regarding energy drinks' adverse effects.

Review the studies, that explained the mechanism effect of energy drinks and ingredients on the human body, in addition to the studies result about energy drinks consumption effect on the hemodynamic and cardiovascular system.

In the current study, the researchers used PubMed, AHA journals, USFDA as a data bases and references by using key word: Energy drinks, Caffeine, Hemodynamic, Blood Pressure, Heart Rate, ECG, QTc.

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2.2 Effect of energy drinks ingredient on the human body

In 2017, Mangi et al. conduct a study that review kinds of literature that talked about Energy drinks and the risk of cardiovascular disease mention that Energy drinks can increase the risk for myocardial infarction and cardiac arrest .

In 2018, Voskoboinik mention in a study discuss the cardiovascular effect of caffeinated beverages, that they work as a methylxanthine alkaloid and central nervous system stimulant. It also affects sympathetic activation, intracellular calcium trafficking, adenosine receptors, and is an antioxidant, in addition to increases the heart rate by sympathomimetic effects, an increase in intracellular calcium has a risk to induce atrial arrhythmia by enhancing the automaticity of atrial pacemaker cells and after depolarization-induced triggered activity.

The L-carnitine is related to the development of cardiovascular diseases; because of L-carnitine's role in increase platelet aggregation in the body. L-carnitine is braked down by gut bacteria in our body produced a trimethylamine (TMA) compound, the liver converts this compound from TMA to trimethylene N-oxide (TMAO). TMAO played a vital role in platelet Feature Modulation and increases platelet hyperactivity and thrombosis in the body, these are significant risk factors for the occurrence of complications, such as stroke, heart attack, and cardiometabolic disease (Weifei Zhu, et al., 2017).

Whereas an energy drink is associated with Platelet aggregation and endothelial Dysfunction (Worthley et al., 2010) .

On the other hand, caffeine and Taurine is act as cooperative to increase the risk for heart attack. Another study in 2011 study report that caffeine is responsible for a

decrease in myocardial blood perfusion related to physical exercise in a participant with coronary artery syndrome. However, the sympathetic/parasympathetic equilibrium left ventricular repolarization and diastolic activity may probably be affected by caffeine consumption (Silvio Buscemi et al., 2011).

In 2015 a comprehensive and systematic review of case studies linked to energy drinks and their adverse health Effect has found that a lot of adverse effects on the neurological and cardiovascular systems. Often seizures but also neuro psychotic anxiety, violent behavior, and suicidal ideation are the neurological symptoms. That mostly is a caffeine and taurine effect, they are known, psychoactive agents. Heart-associated effects involved arrhythmias, coronary vasospasm, dissection of aortic aneurysm, cardiac arrest, QT prolongation, acute cardiomyopathies, accurate hypertension, reversible posture coronary thrombosis, and ST-elevation myocardial infarction (STEMI). they found the attribute cardiovascular adverse effects to energy drinks Ingredients such as Caffeine and taurine, which have shown that platelet aggregation is increasing, the endothelial function can be altered and can cause vasospasm and hypertension (Ali et al., 2015).

These problems must be addressed and noted because it is very important to save lives and reduce the number of heart attack patients as much as possible. However, in this study, we will focus our attention on the effect on hemodynamics and ECG changes

2.3 The effect of Energy drink on ECG and hemodynamics

In a previous study, relatively sixteen participants (eight male and eight female) were involved by caffeine energy shots or a coffee-free energy shot and

substantially elevated peripheral and central blood pressure in the caffeine group (Karatzis et al., 2005).

Another study involved fifteen healthy adults. After 47 hours of abstention from caffeine, their blood pressures were taken and the measurement of baseline BP, HR, and electrical cardiograph (ECG) was measured. A 500 mL energy drink was ordered, and the assessment was repeated 30 minutes, 1 h, 2 h, 3h, and 4 h afterward, and then the final day was followed by the drinking of 500 mL of energy per day for the next 5 days and measurements were taken again. No major ECG modifications were observed‹

but the measurements of HR and SBP were elevated by 5-7 beats/min and 10mmHg. After five days of drinking, the coronary effect was higher than the first day (Steinke et al., 2009).

Also, in 2014 study involves fourteen volunteers who completed the three-session study. 1st session they got a 2oz 5-hr energy shot,2nd session they got 2oz Ocean Spray Diet Cranberry Juice as the placebo, 3rd session was no drink. In the energy drinks condition, the readings of diastolic BP compared with non-drink and placebo were much higher. It was also interestingly much greater at 240 and 360 min when compared to 60 min. In the blood pressure measurement between placebo and no drink, there is no substantial difference (* 1 ounce [oz] is equal to 28.34952 grams [g]). (Cecile, et al., 2014)

In 2017, double-blind control crossover study was done in 18 young volunteers, they divide them to two groups and give them energy drink or caffeinated control drink, blood pressure and ECG was measured 5 times over 24 hours in the 6th

day of drinks, the modified QT interval and systolic blood pressure were substantially greater when high volume energy drink intake comparison to caffeine alone (Fletcher et al., 2017).

Another study in 2017 examined 24 Long QT syndrome patients by cross-over study using energy drink vs control drink and they found that energy drinks sometimes leading to serious problems such as increased blood pressure and prolongation of the QT interval in a lengthening of the repolarization period and the potential for an ectopic beat to occur during a vulnerable period (Gary et al., 2017).

A paper published in 2019 through the AHA assumes that many of these energy-boosting properties have been reported to cause QT prolongation (Winniford, 2019).

In contrast, a 2013 study published on the influence of energy drinks on QT and P-Wave included 20 healthy volunteers. According to this study, the consumption of energy drinks had no effect on the QT or P-Wave (Arinc et al., 2013).

upon to extensively researching literature, we find out that no one has discussed this topic within the Palestinian culture. This study is the first research in Palestine that would investigate the effect of energy drinks on Hemodynamic and Electrocardiographic Parameters among healthy young Nurses in private hospitals in Nablus. Also, due to the inconsistency of results about the changes in electrocardiograph, we will explore the existence of changes in QTc or not.

This research provides an image of the Effect of energy drinks consumption on an electrocardiograph (ECG), heart rate, and blood pressure QTc in multi-period among healthy young Nurses in private Nablus hospitals in Palestine.

Chapter Three

Methodology

Chapter Three

Methodology

3.1 Introduction about the methodology

This chapter presents an overview of the research methodology that will be used for this study and it includes research design, study sample, setting of the study, duration of the study, source of data, inclusion and exclusion criteria, sample size, sample, and sampling process, pilot study, validity, reliability, data collection, variables, Ethical consideration, Analysis plan.

3.2 Research design

A prospective crossover quasi experimental study design was used to test the hypothesis. Data were obtained from the young healthy nurses who working in private Palestinian hospitals in Nablus city.

3.3 Setting of the study:

The measurement was taken in Specialized Arabi Hospital (SAH) in the medical CCU department under close monitoring with cardiologist supervision.

3.4 Population:

A research population is defined as a group of subjects or departments who share specific characteristics and meet the inclusion criteria, and from whom data can be

collected (Burns & Grove 2005; Polit& Beck 2014; Rebar & Macnee 2011; Schneider & Fisher 2013).

In this study, the target population was all adult healthy nurses working in private hospitals in Nablus city in Palestine, the total population in these hospitals is (810) at the time of sample collection.

3.5.1 Sample and Sampling:

The research purposes, steps, and possible complication that may happen was explained to the nursing team in departments of the selected hospitals, then the participant who was interested in this study and included in the study criteria were chosen. Then numbers from 1-84(depending on sample size) were given to the participants randomly. The selection of the participant group was made by a computer-generated code to divide them into two groups. Each group contains half number of total participants. The experimental group was coded by (A) and the control group by (B). Then the participant informed to avoid ingestion of caffeine and energy drinks for 48 hours before each study day.

3.5.2 Sample size:

The sample size depended on the response rate of nurses working in the private hospitals in Nablus city.

Based on alpha 0.05, power 0.80 and medium effect size the estimated sample size by G-power 3 was 84 (42 for each group)

3.5.3 Including criteria:

1- Age between 20 – 40 years old (based on the definition of young adult age in previous studies [Sachin et al., 2019]).

2-Male and Female.

3- Nurses working in private hospitals in Nablus.

3.5.4 Excluding criteria:

1- Chronic diseases.

2- Brachial blood pressure >140/90 mm Hg in last readings

3- Alcohol or drug abuser

4-Who complain recently about ECG changes

5- Pregnant or breastfeeding women

6- Nurses with a baseline of QTc >450 ms

8- Who were taking any chronic prescription or over-the-counter medications

3.6 Instrument and data collection plan:

Burns and Grove (2011) define data collection as the identification of the subject and the precise, systemic collecting of data related to the research aim or the specific objectives, or research questions.

Section 1 (social demographic data) which include:

A- Gender

B- Age

C- Educational level

D- Years of experience

E- Consumption of Energy drinks (yes or No) + frequency

Section 2: Hemodynamic and ECG measurement

	Baseline	**30min**	**1 hour**	**2 hours**	**4 hours**	**Day 7**
Blood Pressure (mmhg)	/	/	/	/	/	/
Heart Rate (bpm)						
E C G changes						
QTc (mm/sec)						

A protocol based on a previous study (Leah Steinke et al., 2009) and modified to achieve our study objectives were used in the current study.

1- The participant was informed about the risk of this intervention that includes:

   A- palpitation

   B- seizure

   C- Nausea or vomiting

   D- Headache

   E- Abdominal pain

2- Consent Form singed.

3- Demographic data in section one documented.

4- All of the participant rested for a 5 min, then the ECG, HR, BP, QTc value as a baseline were taken.
5- Participants in group A received two bottles of Energy drinks (XL) but group B not received anything. The energy drinks were consumed within 60 minutes but no faster than 1 bottle in 30 minutes.
6- All of the participants have the same characteristics and circumstances during measurements and the same devices were used to measure, all the measurements were taken in the same place by the same researcher (except the female's ECG were done by female nurses from the CCU department), all of data collection was under the vision of the same cardiologist.
7- measurements were measured after 30min – 1hour – 2hours and 4hours for each group and filled in the table in section 2.
8- Then, the participant drinks 2 cans (500ml) of XL for 5days. Then 2 days will be without an energy drink consumption as a wash-out period. Day 1 protocol will be repeated on day 7.

A Philips monitor (866062 A04 C15 C50 H10) and a Philips ECG device at a speed of 25 mm/sec were used to take our measurement.

The XL was chosen in the current study because it’s the most popular energy drink in Palestine. In addition to involving a larger amount of caffeine than other energy drinks in Palestine.

3.7 Pilot study:

A pilot study was conducted for 5 nurses as experimental and 5 nurses as control and the data collection process have done among them. This test was done before starting

the whole data collection as a pre-test to point out weaknesses in steps, predicted response rate, determined the real time needed to fill the questionnaire for every participant, and identified areas of vagueness and, test the validity, and suitability of the questionnaire. The questionnaires were evaluated by 2 cardiologists and assess the validity of the questionnaire, comments, and modifications applied as needed. These 10 participants were involved to study sample.

3.8 Validity:

After constructing the questionnaire, it was reviewed by experts to judge face and content validity to get feedback and comments then a pilot study was done.

3.9 Analysis plan

In this study, statistical analysis of the collected data was conducted using the statistical package for the social science (SPSS) version 23. SPSS is a software package that will be used for conducting statistical analysis, manipulating data, and generating tables and graphs by using descriptive and inferential statistics such as frequency tables, relative frequencies, graphically illustrated. Means, standard deviations, Mann-Whitney U test, median, ANOVA, Effect size, Post-hoc with Wilcoxon single rank test, Bonferroni correction and Friedman's test will be used to summarize data. So, the Surveys result was entered directly into the database and then data cleaning was conducted. This enabled the identification existence of potentially statistically significant correlations between the relevant variables.

3.10 Duration of the study

Ethical approval for this study was obtained on 6th Jan 2021. Protocol approval period: 6th Jan 2021 to 6th Jan 2022. Data were collected in the month of (March to

June 2021) as indicated in the proposal. Data was analyzed in (July 2021). The final thesis was submitted for examination in (31, Aug 2021).

3.11 Ethical consideration

This study was approved by the American Arab University (AAUP), the Specialized Arabi Hospital (SAH). All participants were provided written informed consent consistent with university requirements for clinical studies involving human subjects.

All the responses will be confidential and no identifying information such as name, email address, or IP address is required. All information will be kept confidential, the surveys will not contain information that will personally identify the participant. The results of this study will be used for scholarly purposes only.

Chapter four

Results

Chapter four

Results

4.1 Introduction:

This study aims to detect if the energy drinks consumption affects hemodynamics (SBP, DBP, & HR) and electrocardiograph (ECG [arrhythmia & QTc]) among the healthy young nurses in Palestinian private hospital in Nablus. Moreover, to evaluate the Effect of energy drinks consumption on blood pressure among the healthy young nurses in Palestinian private hospital in Nablus. And finally, estimate the Effect of energy drinks consumption on heart rate among the healthy young nurses in Palestinian private hospital in Nablus.

4.2 Demographic characteristics of the study participants:

Given the demographic characteristics of the study participants, the majority were males (70.2%), and this applied to both groups (intervention= 69% & control= 71.4%).

As for the age of the participants, the majority (95.2%) of them were in the age group between 20-30 years which seems the same for the both groups (intervention= 97.6% & control= 92.8%).

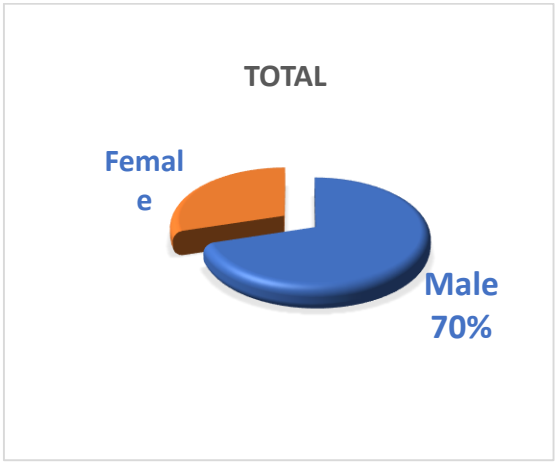
More than half of the participants were holders of a bachelor's degree and had work experience between 1-5 years (90.4%).

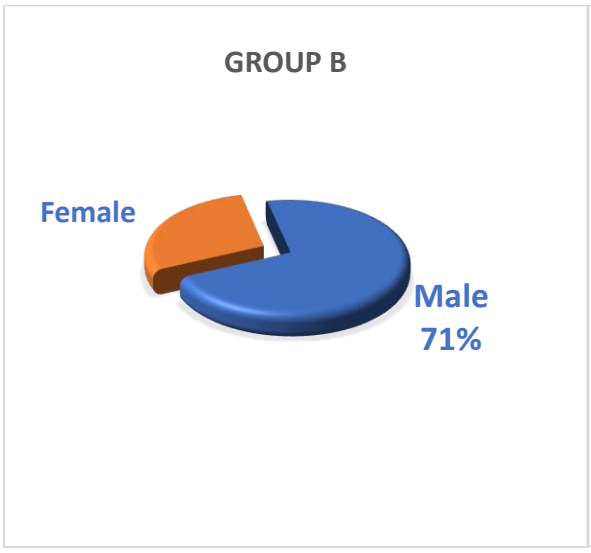
Table 1: Demographics characteristics of healthy young nurses in private hospitals in Nablus.

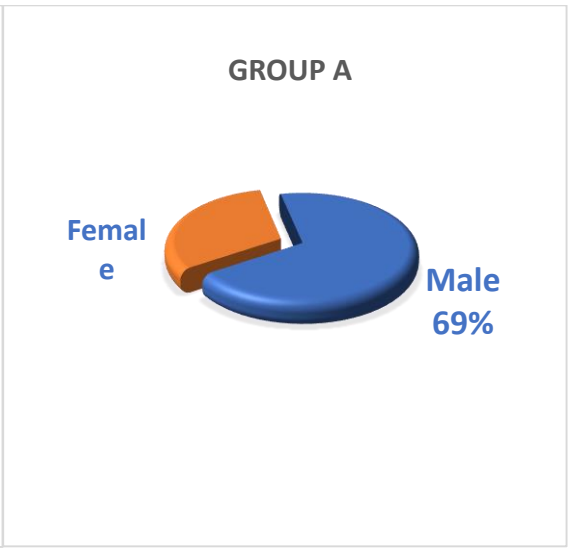
			Group		X^2	**Sig.**
		Total	**Intervention**	**Control**		
Gender	Female	25(29.8%)	13(31.0%)	12(28.6%)	.057	.811
	Male	59(70.2%)	29(69.0%)	30(71.4%)		
Age (years)	20-25	42(50.0%)	22(52.4%)	20(47.6%)	1.09	.578
	26-30	38(45.2%)	19(45.2%)	19(45.2%)		
	31-35	4(4.8%)	1(2.4%)	3(7.1%)		
Educational level	Diploma	22(26.2%)	9(21.4%)	13(31.0%)	2.90	.234
	Bachelors	55(65.5%)	31(73.8%)	24(57.1%)		
	Master	7(8.3%)	2(4.8%)	5(11.9%)		
Experience (years)	1-3	48(57.1%)	22(52.4%)	26(61.9%)	4.90	.179
	4-5	28(33.3%)	18(42.9%)	10(23.8%)		
	6-10	7(8.3%)	2(4.8%)	5(11.9%)		
	>10	1(1.2%)	0(0.0%)	1(2.4%)		

Significantly from each other at the .05 level.

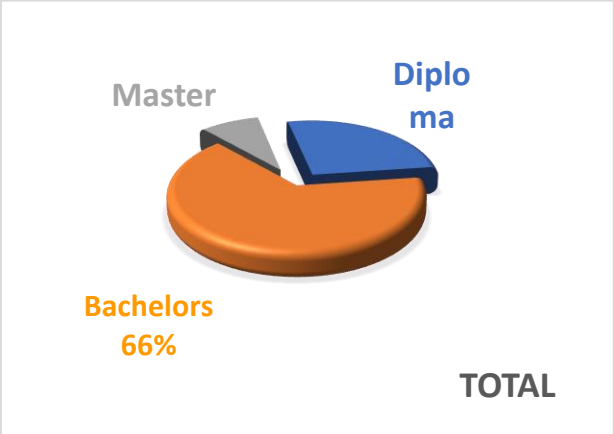
Gender

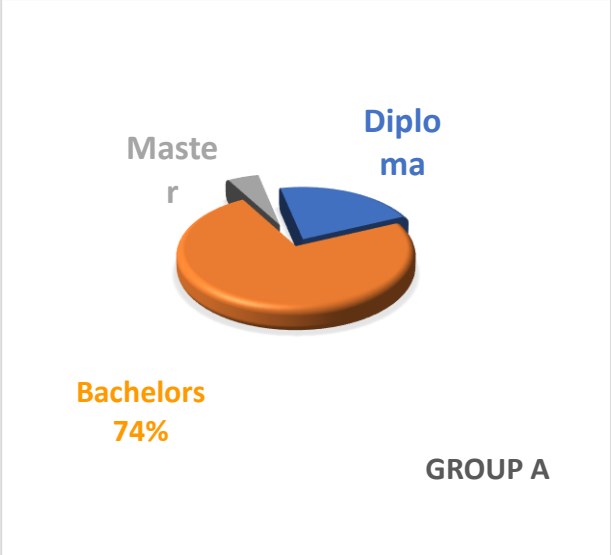

TOTAL
Femal
e
Male
70%

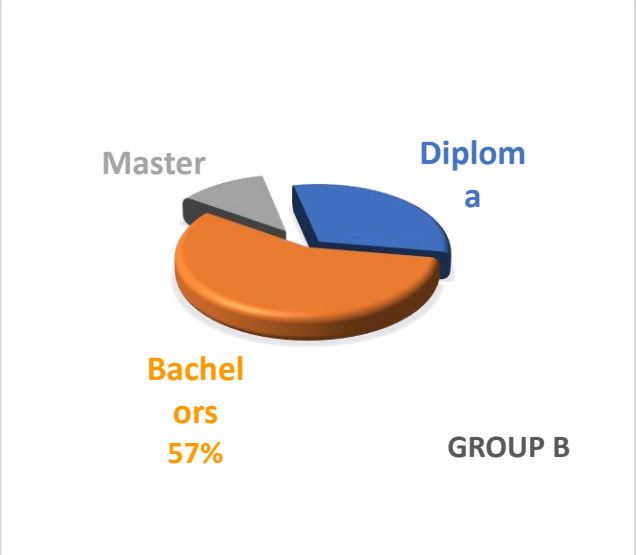

GROUP B
Female
Male
71%


GROUP A
Femal
e
Male
69%

Education level







Experience (years)

As for the consumption of energy drinks and the number of daily cans consumed by the healthy young nurses in private hospitals in Nablus before starting the study, the first figure and table 2 shows that the participants in the two groups had an average consumption of energy cans within the limits of one and a half per day, knowing that the percentage of consumers of energy drinks was higher among the participants in the interventional group compared to with the control group (81.0% vs 52.4% respectively).

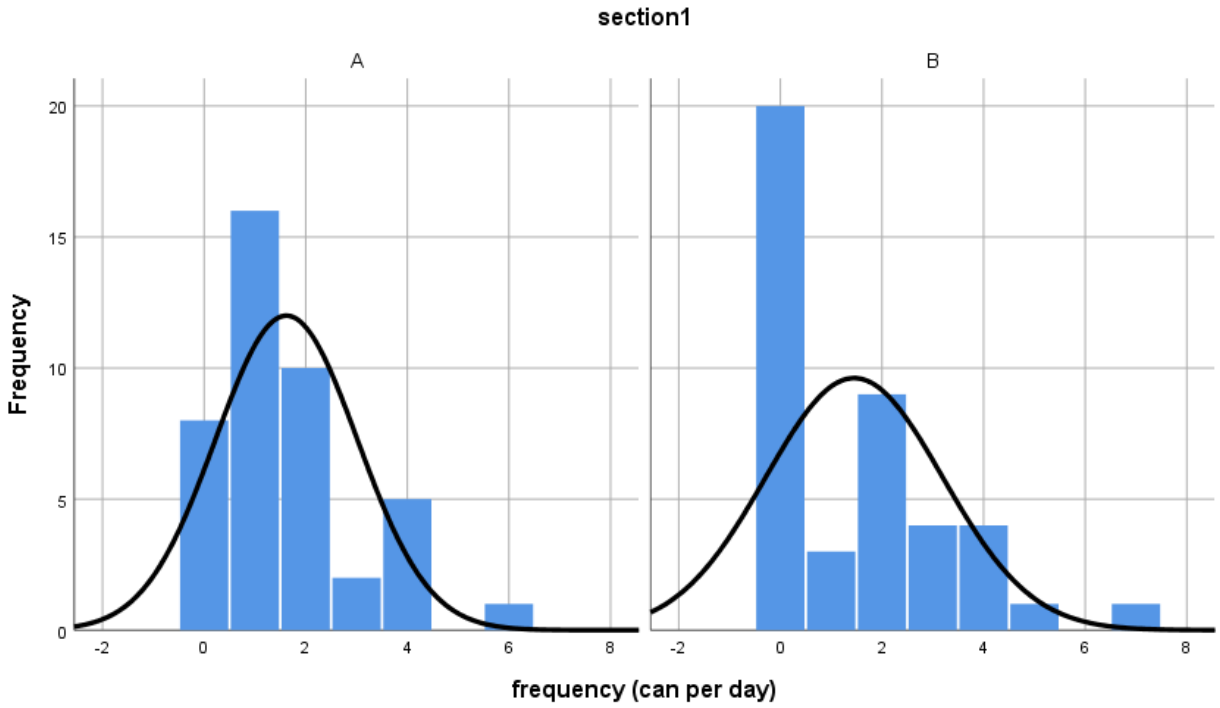


Figure 1:

4.3 Table 2: Consumption of energy drinks and the number of daily cans consumed

			Section			
		Total	**A**	**B**		
Energy drink consumption	No	28(33.3%)	8(19.0%)	20(47.6%)	7.714	.005
	Yes	56(66.7%)	34(81.0%)	22(52.4%)		

	Group	**N**	**Mean (SD)**	**Median**	**MW**	**Sig.**
Frequency (can / day)	Intervention	42	1.62 (1.39)	1.0	766.0	0.28
	Control	42	1.45 (1.74)	1.0		

By looking at Table 3, we find that the systolic blood pressure of the participants in the interventional group was higher than the systolic blood pressure of the control group during the study period. Furthermore, the result of the Mann-Whitney U test supports the proposition that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are have different systolic blood pressure.

From this data, it can be concluded that systolic blood pressure in the consumers of energy drink of young nurses' group was statistically significantly higher than the non-consumers of energy drink of young nurses' group at baseline ($U = 597.5$, $p = .011$), 30 minutes ($U = 546.5$, $p = .003$), 1h ($U = 415$, $p < .001$), 2h ($U = 448.5$, $p < .001$), 4h ($U = 440$, $p < .001$), and 7 day ($U = 534.5$, $p = .002$). Therefore, we can be confident in rejecting the null hypothesis that holds that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are drawn from the same underlying population. Although the energy drink was statistically significant, but it had low correlation and it can just explain 8 % to 21 % of the change of the variance in systolic BP between the two groups (Intervention vs. Control).

4.4 Table 3: Comparison between intervention and control groups regarding their systolic BP

Systolic BP	Group	N	Median	Mean Rank	M-W U	Sig.	η2
Baseline	Intervention	42	124.50	49.27	597.5	0.011	.08
	Control	42	121.00	35.73			
30 min	Intervention	42	125.00	50.49	546.5	0.003	.11
	Control	42	119.00	34.51			
1 Hour	Intervention	42	126.00	53.62	415	<0.001	.21
	Control	42	121.00	31.38			
2 hours	Intervention	42	126.00	52.82	448.5	<0.001	.18
	Control	42	122.50	32.18			
4 hours	Intervention	42	125.00	53.02	440	<0.001	.19
	Control	42	120.00	31.98			
Day 7	Intervention	42	125.00	50.77	534.5	0.002	.21
	Control	42	121.00	34.23			

M-W U: Mann-Whitney U

By looking at Table 4, we find that the Diastolic blood pressure of the participants in the interventional group was higher than the Diastolic blood pressure of the control group during the study period. Furthermore, the result of the Mann-Whitney U test supports the proposition that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are have different Diastolic blood pressure.

From this data, it can be concluded that Diastolic blood pressure in the consumers of energy drink of young nurses' group was statistically significantly higher than the non-consumers of energy drink of young nurses' group at baseline (U = 619.5, p = .019), 30 minutes (U = 637.5, p = .028), 1h (U = 611, p =.015), 2h (U = 611, p =.015), 4h (U = 566.5, p =.005), and 7 day (U = 541, p = .002). Therefore, we can be confident in rejecting the null hypothesis that holds that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are drawn from the same underlying population. Although the energy drink was statistically significant, but it had low correlation and it can just explain 6 % to 11 % of the change of the variance in systolic BP between the two groups (Intervention vs. Control).

4.5 Table 4: Comparison between intervention and control groups regarding their Diastolic BP

Diastolic BP	**Group**	**N**	**Median**	**Mean Rank**	**M-W U**	**Sig.**	**η2**
Baseline	Intervention	42	73	48.75	619.5	0.019	.07
	Control	42	68	36.25			
30 min	Intervention	42	73.5	48.32	637.5	0.028	.06
	Control	42	68.5	36.68			
1 Hour	Intervention	42	75	48.95	611	0.015	.07
	Control	42	71	36.05			
2 hours	Intervention	42	73.5	48.95	611	0.015	.07
	Control	42	70	36.05			
4 Hour	Intervention	42	72	50.01	566.5	0.005	.10

	Control	42	68	34.99			
day 7	Intervention	42	71.5	50.62	541	0.002	.11
	Control	42	70	34.38			

M-W U: Mann-Whitney U

By looking at Table 5, we find that the heart rate of the participants in the interventional group was higher than the heart rate of the control group during the study period except at baseline (median= 71bpm vs. 71bpm respectively). Furthermore, the result of the Mann-Whitney U test supports the proposition that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are have different heart rate.

From this data, it can be concluded that heart rate in the consumers of energy drink of young nurses' group was statistically significantly higher than the non-consumers of energy drink of young nurses' group at baseline (U = 708.5, p = .118), 30 minutes (U = 548.5, p = .003), 1h (U = 361, p <.001), 2h (U = 497.5, p =.001), 4h (U = 390.5, p <.001), and 7 day (U = 515.5, p = .001). Therefore, we can be confident in rejecting the null hypothesis that holds that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are drawn from the same underlying population. Although the energy drink was statistically significant, but it had low to medium correlation and it can just explain 3 % to 26 % of the change of the variance in heart rate between the two groups (Intervention vs. Control).

4.6 Table 5: Comparison between intervention and control groups regarding their heart rate

Heart rate	Group	N	Median	Mean Rank	M-W U	Sig.	η2
Baseline	Intervention	42	71.00	46.63	708.5	0.118	.03
	Control	42	71.00	38.37			
30 min	Intervention	42	79.00	50.44	548.5	0.003	.11
	Control	42	72.00	34.56			
1 Hour	Intervention	42	80.50	54.90	361	<0.001	.26
	Control	42	72.00	30.10			
2 hours	Intervention	42	80.50	51.65	497.5	0.001	.14
	Control	42	72.50	33.35			
4 Hour	Intervention	42	80.00	54.20	390.5	<0.001	.23
	Control	42	72.00	30.80			
day 7	Intervention	42	77.00	51.23	515.5	0.001	.13
	Control	42	71.50	33.77			

M-W U: Mann-Whitney U

By looking at Table 6, we find that the ECG of the participants in the interventional group was differing than the ECG of the control group during the 1st hour and 2nd hour during the study period. Furthermore, the result of the Mann-Whitney U test supports the proposition that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are have different ECG at the 1st and 2nd hour after consuming energy drink.

From this data, it can be concluded that ECG in the consumers of energy drink of young nurses' group was statistically significantly comparing with the non-consumers of energy drink of young nurses' group at 1h (U = 798, p =.042), and at 2h (U = 777, p =.022). Therefore, we can be confident in rejecting the null hypothesis that holds that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are drawn from the same underlying population during 1st and 2nd hour. Although the energy drink was statistically significant, but it had very low correlation and it can just explain 0 % to 6 % of the change of the variance in ECG between the two groups (Intervention vs. Control).

4.7 Table 6: Comparison between intervention and control groups regarding their ECG

ECG	Group	N	Median	Mean Rank	M-W U	Sig.	η2
Baseline	Intervention	42	1	42.5	882	1	.00
	Control	42	1	42.5			
30 min	Intervention	42	1	43.0	861	0.317	.01
	Control	42	1	42.0			
1 Hour	Intervention	42	1	44.5	798	0.042	.05
	Control	42	1	40.5			
2 hours	Intervention	42	1	45.0	777	0.022	.06
	Control	42	1	40.0			
4 Hour	Intervention	42	1	43.5	840	0.155	.02
	Control	42	1	41.5			

day 7	Intervention	42	1	42.5	882	1	.00
	Control	42	1	42.5			

M-W U: Mann-Whitney U

By looking at Table 7, we find that the QTc of the participants in the interventional group was differing than the QTc of the control group during the 1st hour and 2nd hour during the study period. Furthermore, the result of the Mann-Whitney U test supports the proposition that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are have different QTc at the 1st and 2nd hour after consuming energy drink.

From this data, it can be concluded that QTc in the consumers of energy drink of young nurses' group was statistically significantly comparing with the non-consumers of energy drink of young nurses' group at 1h (U = 665, p =.052), and at 2h (U = 656, p =.043). Therefore, we can be confident in rejecting the null hypothesis that holds that the consumers of energy drink of young nurses and non-consumers of energy drink of young nurses are drawn from the same underlying population during 1st and 2nd hour. Although the energy drink was statistically significant, but it had very low correlation and it can just explain 0 % to 5 % of the change of the variance in QTc between the two groups (Intervention vs. Control).

4.8 Table 7: Comparison between intervention and control groups regarding their QTc (ms)

QTc (ms)	**Group**	**N**	**Median**	**Mean Rank**	**M-W U**	**Sig.**	**η2**
Baseline	Intervention	42	367.50	43.46	841.5	0.717	.00
	Control	42	361.00	41.54			

30 min	Intervention	42	380.00	44.46	799.5	0.46	.01
	Control	42	372.00	40.54			
1 Hour	Intervention	42	393.00	47.67	665	0.052	.05
	Control	42	375.00	37.33			
2 hours	Intervention	42	388.00	47.88	656	0.043	.05
	Control	42	379.00	37.12			
4 Hour	Intervention	42	391.00	46.93	696	0.096	.03
	Control	42	364.00	38.07			
day 7	Intervention	42	377.50	44.96	778.5	0.354	.01
	Control	42	367.00	40.04			

M-W U: Mann-Whitney U

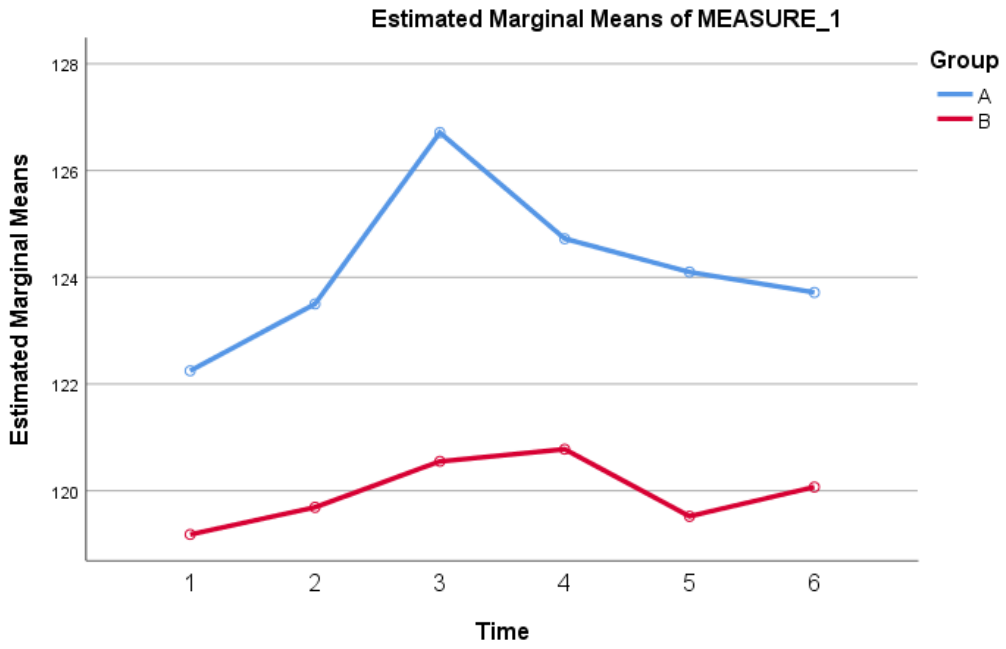
The sphericity assumption seems to be met. The results of the one-way repeated-measures ANOVA showed that there was a significant main effect of energy drink consumptions on the average systolic blood pressure of the young nurses' participants (F [1, 76] = 11.61, p = .001, ηp^2 =.133). Nor time neither demographic characteristics had statistically significant effect on young nurse's systolic blood pressure.

Bonferroni post hoc tests showed that systolic blood pressure significantly higher among young nurses who consume energy drink (mean = 124.1; SE = 0.83) compared to those non consumer’s energy drink young nurses (mean = 119.9; SE = 0.83; p=.001). This evidence supports the hypothesis that the energy drink affects participants’ systolic blood pressure. Specifically, these findings suggest that energy drink had a high effect size (ηp2 =.133) on increase young nurses' participants’ systolic blood pressure.

4.9 Table 8: Repeated measure ANOVA for systolic BP among the two group during the 6 points.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η2
Intercept	111588.6	1	111588.6	691.3	.000	.901
Gender	151.7	1	151.7	.940	.335	.012
Age (years)	.713	1	.713	.004	.947	.000
Educational level	1.94	1	1.94	.012	.913	.000
Experience (years)	.825	1	.825	.005	.943	.000
Energy drink consumption	357.0	1	357.0	2.21	.141	.028
Frequency (can / day)	422.6	1	422.6	2.61	.110	.033
Group	1874.4	1	1874.4	11.6	.001	.133
Error	12267.1	76	161.4			

Computed using alpha = .05



Covariates appearing in the model are evaluated at the following values: Gender = 1.70, Age = 1.55, Educational level = 1.82, Experience = 2.49, Energy drink consumption = 1.67, frequency (can per day) = 1.54

Comparison of the repeated measures among consumer energy drink nurses was performed using Friedman's test showing a statistically significant increase in SBP, $\chi2(5) = 42.0$, $p < 0.001$. Post-hoc analysis with Wilcoxon signed-rank test was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.008$. The mean SBP (±SD) was 122.5 (6.8) at baseline, 123.9 (9.03) at 30 m, 127.0 (7.43) at 1h, 125.4 (7.16) at 2h, 124.6 (6.46) at 4 h, and 123.9(6.03) at 7 day. A significant increase was seen between all times and baseline ($Z = -3.118$, $p = 0.002$, $Z = -4.608$, $p < 0.001$, $Z = -3.060$, $p = 0.002$, $Z = -3.031$, $p = 0.002$, $Z = -2.692$, $p = 0.007$).

On the other hand, comparison of the repeated measures among non-consumer energy drink nurses was performed using Friedman's test did not elicit a statistically significant change in SBP, $\chi2(5) = 7.46$, $p = 0.18$. Indeed, median SBP was nearly the same during the period of the study among control (non-consumer energy drink) nurses.

4.10 Table 9: Comparison of the SBP repeated measures among consumer energy drink nurses using Friedman's test for each group

Group	SBP	N	Mean	SD	Min	Max	Median		Sig.
Intervention	**Baseline**	42	122.5	6.83	103	137	124.5	X^2 **= 42.0**	**<0.001**
	30 min	42	123.9	9.03	90	140	125.0		
	1 Hour	42	127.0	7.43	112	147	126.0		
	2 hours	42	125.4	7.16	104	139	126.0		
	4 hours	42	124.6	6.46	102	137	125.0		
	Day 7	42	123.9	6.03	107	135	125.0		
Control	**Baseline**	42	118.8	6.95	103	135	121.0	**X2 = 7.46**	**0.18**
	30 min	42	119.2	6.97	101	132	119.0		
	1 Hour	42	120.1	6.29	107	130	121.0		
	2 hours	42	120.0	6.70	104	131	122.5		
	4 hours	42	118.98	6.07	104	130	120.0		
	Day 7	42	119.81	5.30	108	129	121.0		

The sphericity assumption seems to be met. The results of the one-way repeated-measures ANOVA showed that there was a significant main effect of energy drink consumptions on the average diastolic blood pressure of the young nurse's participants (F [1, 76] = 9.18, p = .003, ηp2 =.108). Nor time neither demographic characteristics had statistically significant effect on young nurse's diastolic blood pressure.

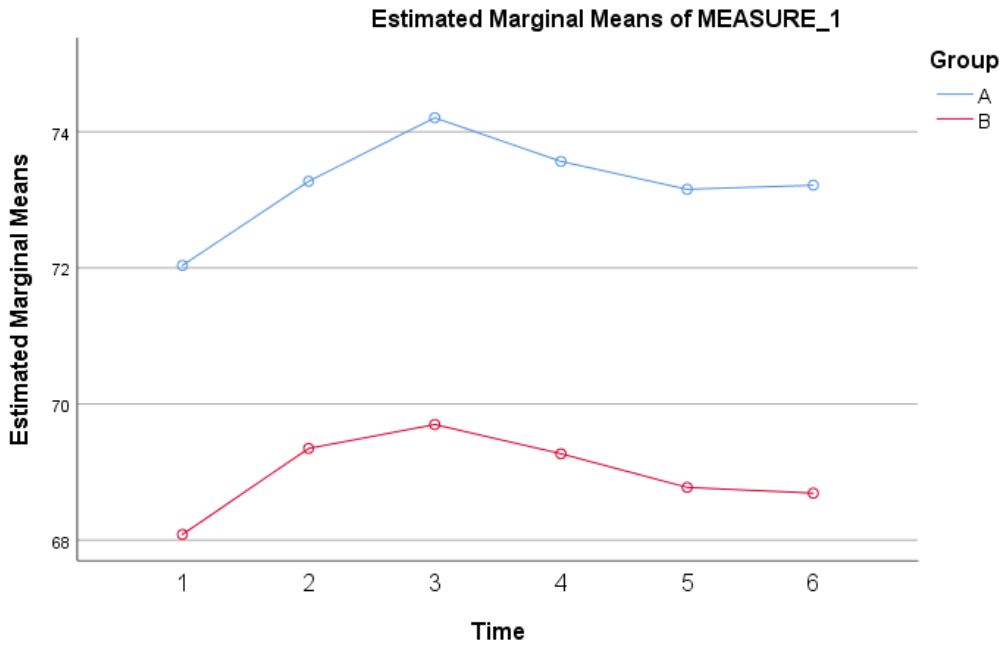
Bonferroni post hoc tests showed that diastolic blood pressure significantly higher among young nurses who consume energy drink (mean = 73.2; SE = 0.95) compared to those non consumers energy drink young nurses (mean = 68.9; SE = 0.95; p=.003). This

evidence supports the hypothesis that the energy drink affects participants' diastolic blood pressure. Specifically, these findings suggest that energy drink had a medium to high effect size (η_p^2 =.108) on increase young nurses' participants' diastolic blood pressure.

4.11 Table 10: Repeated measure ANOVA for diastolic BP among the two group during the 6 points.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η_p^2
Intercept	37848.5	1	37848.5	179.9	.000	.703
Gender	634.8	1	634.8	3.01	.086	.038
Age (years)	38.7	1	38.7	.184	.669	.002
Educational level	5.43	1	5.439	.026	.873	.000
Experience (years)	3.25	1	3.255	.015	.901	.000
Energy drink consumption	.031	1	.031	.000	.990	.000
Frequency (can / day)	14.2	1	14.216	.068	.796	.001
Group	1933.0	1	1933.0	9.18	.003	.108
Error	15989.1	76	210.3			

a Computed using alpha = .05



Covariates appearing in the model are evaluated at the following values: Gender = 1.70, Age = 1.55, Educational level = 1.82, Experience = 2.49, Energy drink consumption = 1.67, frequency (can per day) = 1.54

Comparison of the repeated measures among consumer energy drink nurses was performed using Friedman's test showing a statistically significant increase in DBP, $\chi 2(5) = 12.03$, $p = 0.034$. Post-hoc analysis with Wilcoxon signed-rank test was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.008$. The mean DBP (±SD) was 72.29 (6.8) at baseline, 73.07 (6.5) at 30 m, 74.07 (6.0) at 1h, 73.45 (6.3) at 2h, 72.98 (7.0) at 4 h, and 73.21 (6.6) at 7 day. Although there were changes in DBP in different time point but these changes did not elicit a significant change between all DBP measurement times' points and baseline ($p > 0.008$).

On the other hand, comparison of the repeated measures among non-consumer energy drink nurses was performed using Friedman's test did not elicit a statistically significant change in SBP, $\chi 2(5) = 10.08$, $p = 0.055$. Indeed, median DBP was nearly the same during the period of the study among control (non-consumer energy drink) nurses.

4.12 Table 11: Comparison of the DBP repeated measures among consumer energy drink nurses using Friedman's test for each group

Group	DBP	N	Mean	Std. D	Min	Max	**X2**	**Sig.**
Intervention	Baseline	42	72.29	7.127	61	85	12.03	0.034
	30 min	42	73.07	6.546	62	85		
	1 hour	42	74.07	6.070	64	84		
	2 hours	42	73.45	6.379	60	87		
	4 Hour	42	72.98	7.003	49	89		
	day 7	42	73.21	6.635	51	85		
Control	Baseline	42	67.83	7.957	47	81	10.82	0.055
	30 min	42	69.55	6.575	57	81		
	1 Hour	42	69.83	7.112	53	82		
	2 hours	42	69.38	7.268	53	84		
	4 Hour	42	68.95	7.945	51	82		

The sphericity assumption seems to be met. The results of the one-way repeated-measures ANOVA showed that there was a significant main effect of energy drink consumptions on the average heart rate of the young nurses' participants ($F [1, 76] = 28.1$, $p < .001$, $\eta p2 = .27$). the demographic characteristics had no statistically significant effect on young nurses' heart rate. While the time had a statistically significant (p=0.004) effect on young nurses' heart rate

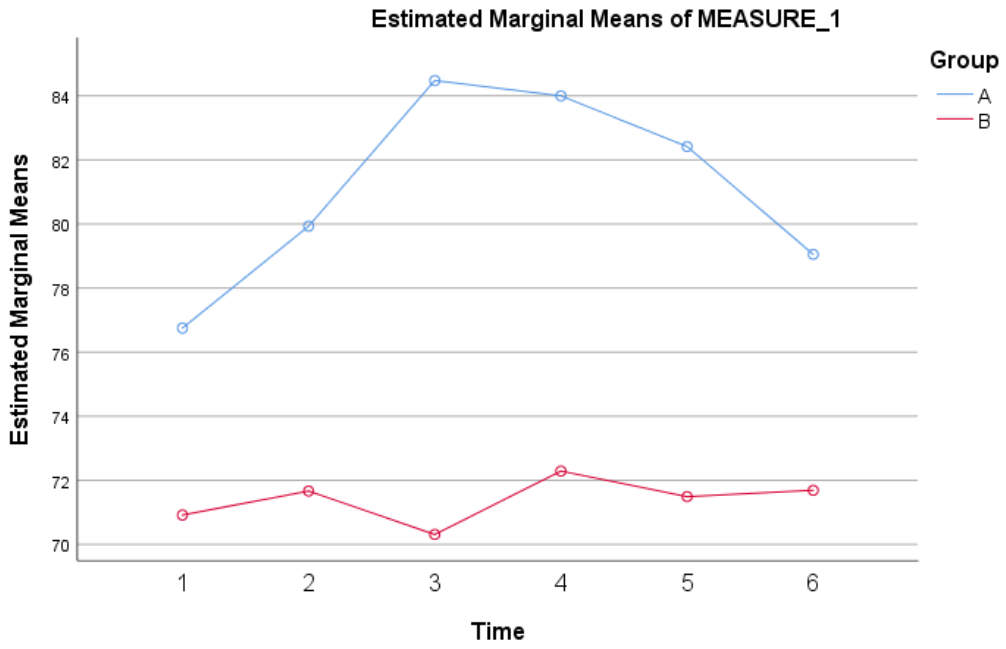
Bonferroni post hoc tests showed that heart rate significantly higher among young nurses who consume energy drink (mean = 81.1; SE = 1.24) compared to those non consumers energy drink young nurses (mean = 71.3; SE = 1.24; $p<.001$). This evidence

supports the hypothesis that the energy drink affects participants' heart rate. Specifically, these findings suggest that energy drink had a high effect size (η_p^2 =.27) on increase young nurses participants' heart rate.

4.13 Table 12: Repeated measure ANOVA for HR among the two group during the 6 points.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	η_p^2
Intercept	51777.0	1	51777.0	145.5	.000	.657
Gender	289.4	1	289.4	.814	.370	.011
Age (years)	1119.5	1	1119.5	3.14	.080	.040
Educational level	127.7	1	127.7	.359	.551	.005
Experience (years)	71.4	1	71.4	.201	.655	.003
Energy drink consumption	1347.6	1	1347.6	3.78	.055	.047
Frequency (can / day)	16.5	1	16.5	.047	.830	.001
Group	10016.8	1	10016.8	28.1	.000	.270
Error	27031.0	76	355.6			

a Computed using alpha = .05



Covariates appearing in the model are evaluated at the following values: Gender = 1.70, Age = 1.55, Educational level = 1.82, Experience = 2.49, Energy drink consumption = 1.67, frequency (can per day) = 1.54

Comparison of the repeated measures among consumer energy drink nurses was performed using Friedman's test showing a statistically significant increase in HR, $\chi 2(5) = 45.9$, $p < 0.001$. Post-hoc analysis with Wilcoxon signed-rank test was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.008$. The mean HR (±SD) was 76.00 (8.4) at baseline, 79.02 (9.4) at 30 m, 83.31 (12.5) at 1h, 82.57 (12.5) at 2h, 81.83 (10.9) at 4 h, and 78.40 (9.31) at 7 day. A significant increase in HR was seen between all times and baseline ($Z = -2.85$, $p = 0.004$, $Z = -4.66$, $p < 0.001$, $Z = -4.046$, $p < 0.001$, $Z = -4.75$, $p < 0.001$, $Z = -3.52$, $p < 0.001$).

On the other hand, comparison of the repeated measures among non-consumer energy drink nurses was performed using Friedman's test did not elicit a statistically

significant change in HR, $\chi 2(5) = 7.46$, $p = 0.18$. Indeed, median HR was nearly the same during the period of the study among control (non-consumer energy drink) nurses.

4.14 Table 13: Comparison of the HR repeated measures among consumer energy drink nurses using Friedman's test for each group

Group	HR	N	Mean	Std. D	Min	Max	X2	Sig.
Intervention	Baseline	42	76.00	8.4	65	91	45.9	<0.001
	30 min	42	79.02	9.4	65	110		
	1hour	42	83.31	12.5	62	115		
	2 hours	42	82.57	12.5	62	117		
	4 hours	42	81.83	10.9	65	115		
	Day 7	42	78.40	9.31	62	99		
Control	Baseline	42	71.67	7.31	53	87	2.77	0.73
	30 min	42	72.57	7.57	58	88		
	1hour	42	71.48	6.98	54	87		
	2 hours	42	73.71	7.92	56	97		
	4 hours	42	72.07	6.20	61	87		
	Day 7	42	72.33	5.74	63	88		

The sphericity assumption seems to be met. The results of the one-way repeated-measures ANOVA showed that there was a significant main effect of energy drink consumptions on the average ECG of the young nurse's participants ($F [1, 76] = 13.0$, $p = .001$, $\eta p2 = .146$). The history of energy consumption drinks had a statistically significant ($P=0.025$) effect on young nurses' ECG while other demographic

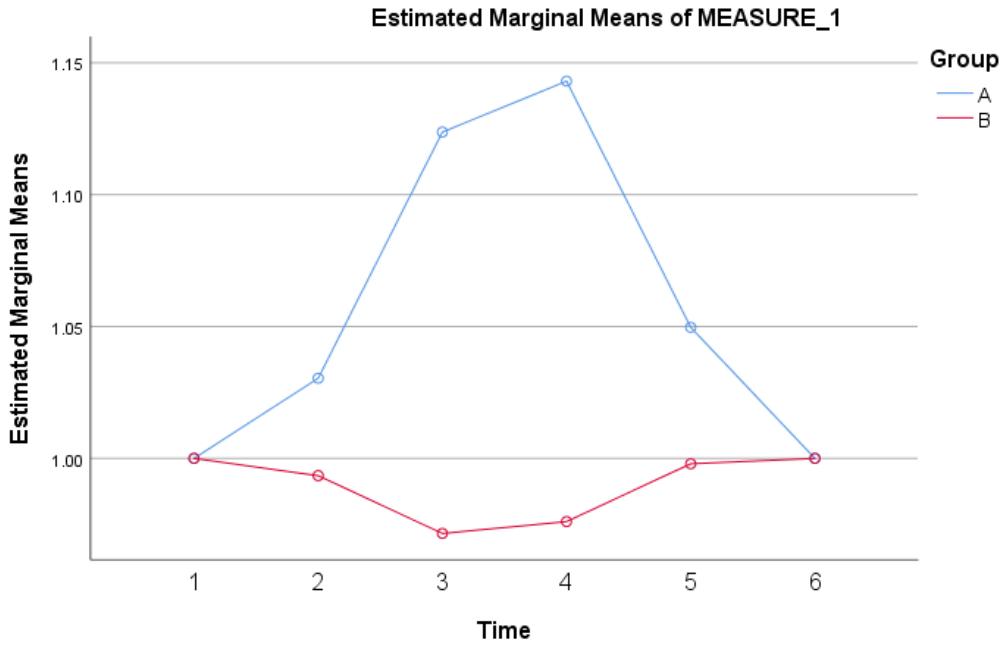
characteristics had no statistically significant effect on young nurses' ECG. Moreover, the time had no statistically significant effect on young nurses' ECG

Bonferroni post hoc tests showed that ECG significantly higher among young nurses who consume energy drink (mean = 0.013; SE = 1.24) compared to those non consumers energy drink young nurses (mean = 0.99; SE = 0.13; p=.001). This evidence supports the hypothesis that the energy drink affects participants' ECG. Specifically, these findings suggest that energy drink had a high effect size (η_p^2 =.146) on increase young nurses participants' ECG.

4.15 Table 14: Repeated measure ANOVA for ECG among the two group during the 6 points.

a Computed using alpha = .05

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	η_p^2
Intercept	11.7	1	11.7	312.0	.000	.804
Gender	.089	1	.089	2.35	.129	.030
Age (years)	.119	1	.119	3.15	.080	.040
Educational level	.001	1	.001	.026	.872	.000
Experience (years)	.032	1	.032	.849	.360	.011
Energy drink consumption	.198	1	.198	5.25	.025	.065
Frequency (can / day)	.026	1	.026	.695	.407	.009
Group	.491	1	.491	13.0	.001	.146
Error	2.86	76	.038			



Covariates appearing in the model are evaluated at the following values: Gender = 1.70, Age = 1.55, Educational level = 1.82, Experience = 2.49, Energy drink consumption = 1.67, frequency (can per day) = 1.54

Comparison of the repeated measures among consumer energy drink nurses was performed using Friedman's test showing a statistically significant change in ECG, $\chi 2(5) = 13.7$, $p = 0.017$. Post-hoc analysis with Wilcoxon signed-rank test was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.008$. The mean ECG (±SD) was 1.00 (0.0) at baseline, 1.02 (0.15) at 30 m, 1.10 (0.29) at 1h, 1.12 (.32) at 2h, 1.05 (0.21) at 4 h, and 1.00 (0.0) at 7 day. Although there were changes in ECG in different time point but these changes did not elicit a significant change between all DBP measurement times' points and baseline ($p > 0.008$).

On the other hand, comparison of the repeated measures among non-consumer energy drink nurses was performed using Friedman's test did not elicit a statistically

significant change in ECG, $\chi 2(5) = NA$, p = NA. Indeed, median ECG was the same during the period of the study among control (non-consumer energy drink) nurses.

4.16 Table 15: Comparison of the ECG repeated measures among consumer energy drink nurses using Friedman's test for each group

Group	ECG	N	Mean	Std. D	Min	Max	X2	Sig.
Intervention	Baseline	42	1.00	.000	1	1	13.7	0.017
	30 min	42	1.02	.154	1	2		
	1 hour	42	1.10	.297	1	2		
	2 hours	42	1.12	.328	1	2		
	4 hours	42	1.05	.216	1	2		
	Day 7	42	1.00	.000	1	1		
Control	Baseline	42	1.00	.000	1	1	NA	NA
	30 min	42	1.00	.000	1	1		
	1 hour	42	1.00	.000	1	1		
	2 hours	42	1.00	.000	1	1		
	4 hours	42	1.00	.000	1	1		
	Day 7	42	1.00	.000	1	1		

The sphericity assumption seems to be met. The results of the one-way repeated-measures ANOVA showed that there wasn't a significant main effect of energy drink consumptions on the average QTc (ms) of the young nurses' participants (F [1, 76] = 1.15, p = .28, $\eta p2$ =.015). The nurses experience had a statistically significant (P=0.023)

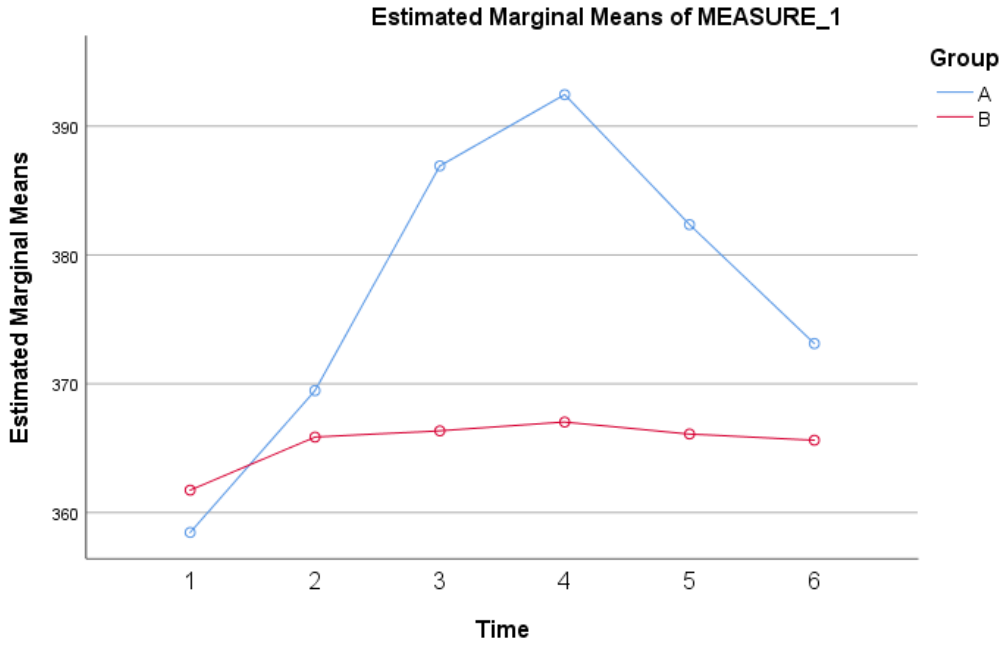
effect on young nurses' QTc (ms) while other demographic characteristics had no statistically significant effect on young nurses' QTc (ms). Moreover, the time had no statistically significant effect on young nurses' QTc (ms)

Bonferroni post hoc tests showed that QTc (ms) was not significantly but higher among young nurses who consume energy drink (mean = 377.1; SE = 7.3) compared to those non consumers energy drink young nurses (mean = 365.4; SE = 7. 3; p=.28). This evidence failed to supports the hypothesis that the energy drink affects participants' QTc (ms). Specifically, these findings suggest that energy drink had a very little effect size (η_p^2 =.015) on increase young nurses' participants' QTc (ms).

4.17 Table 16: Repeated measure ANOVA for QTc (ms) among the two group during the 6 points.

Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**	**η_p^2**
Intercept	627508.5	1	627508.5	50.0	.000	.397
Gender	123.7	1	123.7	.010	.921	.000
Age (years)	82.5	1	82.5	.007	.936	.000
Educational level	23384.2	1	23384.2	1.86	.176	.024
Experience (years)	67219.9	1	67219.9	5.36	.023	.066
Energy drink consumption	12929.3	1	12929.3	1.03	.313	.013
Frequency (can / day)	9312.0	1	9312.0	.743	.391	.010
Group	14498.7	1	14498.7	1.15	.285	.015
Error	952325.7	76	12530.6			

a Computed using alpha = .05



Covariates appearing in the model are evaluated at the following values: Gender = 1.70, Age = 1.55, Educational level = 1.82, Experience = 2.49, Energy drink consumption = 1.67, frequency (can per day) = 1.54

Comparison of the repeated measures among consumer energy drink nurses was performed using Friedman's test showing a statistically significant increase in QTc (ms), $\chi 2(5) = 77.3$, $p < 0.001$. Post-hoc analysis with Wilcoxon signed-rank test was conducted with a Bonferroni correction applied, resulting in a significance level set at $p < 0.008$. The mean QTc (ms) (±SD) was 363.4 (42.5) at baseline, 373.6 (40.8) at 30 m, 390.2 (38.2) at 1h, 394.5 (43.0) at 2h, 385.5 (41.0) at 4 h, and 376.8 (42.5) at 7 day. A significant increase in QTc (ms) was seen between all times and baseline ($Z = -2.85$, $p = 0.004$, $Z = -4.66$, $p < 0.001$, $Z = -4.046$, $p < 0.001$, $Z = -4.75$, $p < 0.001$, $Z = -3.52$, $p < 0.001$).

On the other hand, comparison of the repeated measures among non-consumer energy drink nurses was performed using Friedman's test elicited a statistically significant change in QTc (ms), $\chi 2(5) = 13.5$, $p = 0.019$. Bonferroni correction applied, resulting in a significance level set at $p < 0.008$. The mean QTc (ms) (±SD) was 356.7 (56.4) at baseline, 361.6 (58.9) at 30 m, 363.0 (59.4) at 1h, 364.9 (61.6) at 2h, 362.8 (59.2) at 4 h, and 361.8 (55.3) at 7 day.

A significant increase in QTc (ms) was seen between baseline and at 1h ($Z = -2.93$, $p = 0.003$, and between baseline and ar 2h ($Z = -2.73$, $p = 0.006$). Other point times measurement of did not elicit statistically significant change ($p > 0.008$),

4.18 Table 17: Comparison of the QTc (ms) repeated measures among consumer energy drink nurses using Friedman's test for each group

Group	QTc (ms)	**N**	**Mean**	**Std. D**	**Min**	**Max**	**X2**	**Sig.**
Intervention	Baseline	42	363.4	42.5	211	426	77.3	<0.001
	30 min	42	373.6	40.8	250	443		
	1 hour	42	390.2	38.2	280	458		
	2 hours	42	394.5	43.0	290	493		
	4 hours	42	385.5	41.0	280	485		
	Day 7	42	376.8	42.5	264	472		
Control	Baseline	42	356.7	56.4	230	438	13.5	0.019
	30 min	42	361.6	58.9	248	470		
	1 hour	42	363.0	59.4	228	447		
	2 hours	42	364.9	61.6	232	470		
	4 hours	42	362.8	59.2	242	468		
	Day 7	42	361.8	55.3	254	453		

Chapter Five

Discussion

Chapter Five

Discussion

5.1 Introduction and aims of the study

An experimental prospective crossover research design with a quantitative approach was applied to determine the effect of energy drinks consumption on hemodynamics (SBP, DPB, and HR) and changes in electrocardiogram (Arrhythmia and QTc changes) among Palestinian nurses who work in private hospitals in Nablus.

Within this chapter, the study findings are discussed in terms of the study aim and objectives along with the study variables, study strength, limitations, future recommendations, and the conclusion of the research study.

The discussion in this chapter is conducted using each objective and integrating the study findings reported in chapter four.

The discussion is based on the following study objectives:

1- Examine the association between a demographic characteristic of the nurses and the result of this study
2- Assess the Effect of energy drinks consumption on systolic blood pressure among healthy young nurses in private hospitals in Nablus over throughout the study.
3- Assess the Effect of energy drinks consumption on diastolic blood pressure among healthy young nurses in private hospitals in Nablus over throughout the study.
4- Assess the Effect of energy drinks consumption on heart rate among the healthy young nurses in private hospitals in Nablus throughout the study.

5- Assess the Effect of energy drinks consumption on an electrocardiogram (ECG) among healthy young nurses in private hospitals in Nablus over throughout the study.
6- assess the Effect of energy drinks consumption on QTc among the healthy young nurses in private hospitals in Nablus over throughout the study.

5.2 Effect of age, gender, education level, experience level, energy drinks as a daily habit & frequency of the participant in the current study.

In the current study, 95.2% of participants were aged 20 – 30 years old and it's a similar ages group when compared with the Steinke et al. (2009) study. But, the female (53%) participants in Steinke et al. (2009) study was slightly higher than males, in contrast to the current study, the majority of participants were male (70.2%), and this may be explained by NCCIH (2018) who showed the most of the energy drinks consumers were from men who belong to 18-34 years old. Furthermore, 65.5% of the participant in the current study are bachelor's degree holders and 57.1% of the participant have 1–3-year of experience. But, the age, gender, education level, and experience level of participants in this study have no effect statically when tested by ANOVA test on SBP, DBP, HR ECG, or QTc in both groups and during the whole period of the study. And this may be explained by the including and excluding criteria of the current study which control the demographic characteristic among the participant in the current study.

The characteristic of participants regarding energy drink daily habit and frequency, the participant in the current study has a higher energy drink consumption daily habit in

the intervention group compared with the control group, but both of group similarly in a daily frequency.

5.3 Effect of energy drinks consumption on hemodynamics among the healthy young nurses in private hospitals in Nablus.

5.3.1 Systolic blood pressure

In comparison with Fletcher et al. (2017) who conducted a study on the energy drink effect on hemodynamic, which showed that systolic blood pressure was substantially greater in the energy drink consumption group compared to other groups, in the current study, the systolic blood pressure was higher in the intervention group during the whole study period. Furthermore, the result of Leah Steinke et al. (2009) study is in agreement with the current study that showed elevated 10 mmHg in systolic blood pressure after the consumption of energy drinks.

This elevation of systolic blood pressure may be explained by the amount of caffeine found in energy drinks. This caffeine increases the noradrenaline release in the body (Voskoboinik et al., 2018), noradrenaline act as an inotropic agent thus induces vasoconstriction that elevated the systolic blood pressure. In addition, energy drinks consumption induced endothelial dysfunction (Worthley et al., 2010), this endothelial dysfunction increases the rigidity of the blood vessel wall which in turn raises the blood resistance in blood vessels and this can lead to an increase in the systolic blood pressure.

Although the two groups have systolic blood pressure within the normal range, the intervention group mean was above 120 mmHg which according to Unger et al. (2020) study in AHA journals classified as a prehypertension stage which predispose those to developed hypertension in the future.

5.3.2 Diastolic blood pressure

Consistently with the result of Marczinski et al. (2014) study dealing with a changing blood pressure produced by an ‘‘Energy Shot’’, the current study confirmed that diastolic blood pressure increased in the intervention group more than the control group after energy drink consumption along the study period. In contrast with the current study, Leah Steinke et al. (2009) study related to energy drinks consumption and their effect on hemodynamics, didn't mention any significant changes in diastolic blood pressure during the whole time of the study.

This elevation in diastolic blood pressure may be explained by the L-carnitine role in increasing the platelet aggregation (Weifei Zhu et al., 2017) and associated with the endothelial dysfunction in the body (Worthley et al., 2010), and thus increase the blood resistance in the blood vessel that may lead increasing in diastolic blood pressure in the body.

Despite fluctuations in diastolic blood pressure readings during the study period, these readings in the results are classified within the normal range according to Unger et al. (2020) in AHA journals. This slight change in diastolic pressure among participants in the intervention group may appear more clearly if more energy drinks are consumed or consumed frequently, and this can make energy drink consumers more likely to develop hypertension in the future.

5.3.3 Heart rate

In contrast with the current study that shows elevation of heart rate by 6 – 8 beats/min above the baseline after energy drink consumption in the intervention group during the study period, the Hajsadeghi et al. (2015) study on the effect of energy drinks consumption on hemodynamics could contribute to heart rate decline. On the other hand, a study conducts in 2009 by Leah Steinke et al. consistently with the current study result and showed elevation by 5-7 beats/min in the participant's heart rate after energy drinks consumption during the study period.

This elevation in the heart rate can be explained by the caffeine role. Caffeine paly a main role in increasing the adrenaline release in the body (Voskoboinik et al., 2018). Moreover, Geethavani et al. (2017) study showed that consumption of energy drinks raises the level of catecholamines in the body. These catecholamines act as a positive chronotropic agent which in turn increasing the heart rate.

This increase in heart rate, if it is repeated more than once or lasts for a longer period, may become worse for the heart muscle and its ability to carry out its basic functions. According to Klabunde, (2021), atrial or ventricular tachycardia reduces stroke volume and cardiac output due to a decrease in ventricular filling time that decreased the preload. In addition, the increase of heart rate increases the myocardial oxygen demand because myocardial blood supply occurs during diastole. This may lead to angina (chest pain) especially in patients with coronary artery disease. Finally, this sequence may lead to heart muscle failure if it continues and is repeated**.**

5.3.4 ECG changes

Similar to Ali's et al. (2015) systematic review study linked to energy drink consumption, the energy drink consumers are riskier to developed tachyarrhythmia and ST-segment elevation myocardial infarction, in the current study, the energy drink consumption affect the participant's ECG significantly among the intervention group with low correlation power, this may be clearer if energy drinks consumed for a longer time. In contrast with the current study result, Hajsadeghi et al. (2015) experimental study on healthy young adults conducted on 44 participants and Leah Steinke's et al. (2009) study, both studies results showed no changes in ECG modification over a study period.

These ECG changes may be explained by the antioxidant characteristics of the caffeine which may be reducing or enhancing arrhythmogenesis (Voskoboinik et al., 2018), and this arrhythmia if occur with L-carnitine role in increasing the platelet aggregation by breaking down the gut bacteria producing the TMA compound, which in turn converted in the liver to TMAO, and TMAO role in platelet feature modulation and increase platelet hyperactivity, maybe lead to thrombosis in the heart to produce ST-segment elevation myocardial infarction (Weifei Zhu et al., 2017).

5.3.5 QTc:

In agreement with Gray's et al. (2017) cross-over study, the QTc is lengthening significantly after energy drink consumption, the current study showed elevation in QTc value by 21ms in comparison with baseline value at the second hour after energy drink consumption in the intervention group, then the QTc value decreased at day 7 but still 10 ms difference above the baseline. In contrast with the current study result, Arinc

et al. (2013) study conducted on twenty healthy volunteers to assess the effects of single-dose energy drinks on QT and P-wave dispersion, showed that the energy drinks consumption didn't affect the QT interval or P-Wave.

According to studies (Duncan Turnbull et al., 2017; Fletcheret al., 2017), neither caffeine alone nor other ingredients (taurine, guarana, carnitine, yohimbine, sugars, and B vitamins) alone affected QTc, but it may produce an effect in combination between caffeine and other ingredients in the energy drinks

Although the QTc value in all measurements in the current study is still with the normal range, this lengthening in QTc in this short period put the energy drink consumer under high risky people to develop tachyarrhythmia, STEMI, or cardiac arrest (Myoclonic, 2020).

5.3 Conclusion:

Based on the current study finding, it is evident that the energy drink consumption over a while, change the systolic blood pressure to a level that can be considered as prehypertension stage based on to Unger et al. (2020) in AHA journals, while the increase in diastolic blood pressure, heart rate, and QTc measurement sustain just for a while and then returns to the baseline level, which may expect to have the same but higher level if energy drinks take for a longer period.

Out of the current study scope and accidentally the researcher during collecting data noted that some participants in the current study start complain of palpitation as a consequence of energy drink consumption during the first hour from

consumption, no changes in heart rate or ECG changes were noted during the event, and this feeling relived gradually without any intervention within 30 min after present.

Although ECG changes are statically significant, it has a low correlation and limited in 5 cases. After meeting with these 5 cases, turned out to be all of them take the energy drink for the first time except one of them he takes 1 can per day previously. otherwise, they have the same characteristics as other participants in both groups. And this may explain why they developed sinus tachycardia.

Despite potential short-term benefits, energy drinks should be seen as a substantial public health issue that requires attention. The expanding body of evidence revealing links between energy drinks use and bad health outcomes and public health issues highlights the necessity for academics and policymakers to keep a close eye on this topic.

5.4 Recommendation:

5.5.1 Recommendation of this study

- Dissemination to the Ministry of Health and the Ministry of Education of current result about the negative effect of energy drinks on the human body especially the young ages.
- Implementing systems, policies, and control over the distribution of energy drinks and their components and prevent it in health and educational institutions.
- Implementing effective labeling standards could be one method to enhance understanding, and it's a strategy that could be extended to harmful beverages in general.

- Increased awareness among the young ages of energy drinks potential hazards may lead to a reduction in their use by the general public.

5.5.2 Recommendation for future research

- In future studies, it is recommended to monitor the participant for a prolonged period, increase the sample size, and exclude people who previously drank energy drinks.

5.6 Strength and limitation:

In the current study, participants were selected healthy and young, this reinforces the results observed in the study. But unfortunately, the results are limited to the nursing field who included in the criteria, so we can't generalize it on the other field nor other cultures, and other ages group. In addition to participant withdrawal during the study period, shortage of staff working in this research, and COVID-19 pandemic that confined this study in Nablus city. Furthermore, the tools that were used in this study were one monitor and one ECG device, this gave the researcher less tool bias with the measurement, but this consumed more time in data collection.

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Energy Drinks SURVEY

Consent Form

Effect of "Energy drinks" consumption on hemodynamic and electrocardiographic parameters among healthy young nurses in Palestinian private hospitals in Nablus city

Dear Participant

The purpose of this research project is to assess the effect of "Energy Drinks" consumption on hemodynamic and electrocardiographic parameters among healthy young Nurses in private hospitals in Nablus city in Palestine.

This is a research project being conducted by Ameen Enaya under the supervision of Dr. Jamal Qaddumi at an Arab American university.
Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you can withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized.

The procedure involves intervention and it will consume approximately 5 hours of measurement on 1st day and we will be in touch with you for re-evaluation on the 7th day, this intervention and measurement will be measure inside of the hospitals in the presence of a cardiologist to protect you from any side effect that may happen. The side effect that may happen (palpitation, seizure, Nausea, Vomiting, Headache, or Abdominal pain)

Your responses will be confidential and we do not collect identifying information such as your name, email address, or IP address. We will do our best to keep your information confidential, the surveys will not contain information that will personally identify you. The results of this study will be used for scholarly purposes only.

If you have any questions about the research study, please contact via:

Mobile number: 0597530528
e-mail address: a.enaya@student.aaup.edu

Date: ----------.

signature: ----------.

Section 1: Demographics Data.

1. Gender:

1.1. Male: ☐
1.2. Female: ☐

2. Age ……. years

3. Educational level:

3.1. Diploma ☐
3.2. Bachelor's Degree ☐
3.4. Master Degree ☐

4. How many years of experience in the Emergency Department?

4.1 < 3 years ☐
4.2 3 to <5 years ☐
4.3 5 to <10 years ☐
4.4 ≥ 10 years ☐

5. Consumption of Energy drinks:

5.1 yes ☐
5.2 no ☐

6. If yes, describe frequency: (……. Can per day)

Section 2: Interventional Variables

	Baseline	30min	1 hour	2 hours	4 hours	Day 7
Blood Pressure (mmhg)	/	/	/	/	/	/
Heart Rate (bpm)						
E C G changes						
QTc (mm/sec)						

ملخص باللغة العربية :

مقدمة : مشروبات الطاقة هي واحدة من أكثر المشروبات شعبية في العالم. التي تعتبر مشروبات غير كحولية تزيد من مستوى طاقة الجسم.

الهدف: تهدف الدراسة الحالية إلى تحديد تأثير استهلاك مشروبات الطاقة على متغيرات تخطيط القلب وديناميكية الدورة الدموية في الممرضين الأصحاء والممرضات الصحاح.

الطريقة والنتيجة: اشتملت دراسة كمية استباقية جماعية على 84 ممرض/ة شاب/ة خاليين من الامراض يعملون في المستشفيات الخاصة في مدينة نابلس ، مقسمين إلى مجموعتين ، المجموعة التدخلية (أ) والمجموعة التحكمية (ب) ، تحتوي كل مجموعة على (42) ممرض/ة. في البداية تم اعطاء المشارك استراحة لمدة 30 دقيقة عند الوصول ثم تم قياس تخطيط القلب ومعدل ضربات القلب وضغط الدم و QTc وتوثيقها كقراءات اساسية ومرجعية لكل شخص ، ثم يشرب المشارك عبوتين من XL على مدى 30 دقيقة ، ثم تم أخذ القياسات نفسها بعد 30 دقيقة ، ساعة ، ساعتين و 4 ساعات و 7 أيام.

تم عمل اختبار Mann-Whitney U للكشف عن تأثير استهلاك مشروبات الطاقة على ضغط الدم الانقباضي في 30 دقيقة($U = 546.5$) ، ($p = .003$) ، بعد ساعة ($U = 415$) ، ($p <.001$) ، ساعتين ($U = 448.5$) ، ($p < .001$)، أربع ساعات ($U = 440$) ، ($p <.001$) ، و سبعة أيام ($U = 534.5$) ، ($p = .002$) والتأثير على ضغط الدم الانبساطي عند 30 دقيقة ($U = 637.5$) ، ($p = .028$) ، بعد ساعة ($U = 611$) ، ($p = .015$). بعد ساعتين ($U = 611$) ، ($p = .015$) ، بعد اربع ساعات ($U = 566.5$) ، ($p = .005$) ، بعد سبعة ايام ($U = 541$) ، ($p = .002$). والتأثير على معدل ضربات القلب عند 30 دقيقة ($U = 548.5$) ، ($p = .003$)، بعد ساعة ($U = 361$) ، ($p <.001$) ، بعد ساعتين ($U = 497.5$) ، ($p = .001$)، بعد اربع ساعات ($U = 390.5$) ، ($p <.001$) ، و بعد سبعة أيام ($U = 515.5$) ، ($p = .001$). وعلى مخطط كهربائية القلب عند الساعة الاولى ($U = 798$) ، ($p = .042$)، وبعد ساعتين ($U = 777$) ، ($p = .022$). والتأثير على QTc بعد ساعة ($U = 665$) ، ($p = .052$) ، وبعد ساعتين ($U = 656$) ، ($p = .043$) .

الخلاصة: أدى استهلاك مشروبات الطاقة إلى ارتفاع كبير في ضغط الدم الانقباضي وضغط الدم الانبساطي ومعدل ضربات القلب وتصحيح فترة QT و الى تغيرات في مخطط كهربية القلب.

ضربات القلب وتصحيح فترة QT و الى تغيرات في مخطط كهربية القلب.