

**ENERGY DRINK CONSUMPTION RATE, KNOWLEDGE AND PERCEIVED
SIDE EFFECTS AMONG LONG DISTANCE CAR DRIVERS IN MOROGORO
MUNICIPALITY TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
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ABSTRACT

Several countries have banned energy drink (ED) sales within the markets claiming to cause health effects among the consumers. A cross-sectional study was carried out in Morogoro municipal in Morogoro region, Tanzania, to determine ED consumption rate, knowledge and perceived side effects among long distance car drivers. A total of 150 respondents (2 females, 148 males) were interviewed using a structured questionnaire. In addition, 12 samples of EDs products were collected from six common ED brands and their caffeine content analyzed using UV-Vis Spectrophotometer. About 55.3% of the long distance car drivers consumed three bottles of EDs per day, only 28.0% had high level of knowledge concerning ED consumption guidelines. Almost 97.3% of the respondents reported to have experienced side effects they link with consumption of EDs. The most common reported side effects were insomnia, restlessness and addiction and heart palpitations, as mentioned by 75.3%, 64.7%, 51.3% and 48% of the respondents, respectively. Mo Energy drink brand contained about 28.1(mg/100ml) of caffeine, which was nearly 1.6 times the caffeine concentration that was presented in the product information label. Overall, consumption rate of EDs among long distance car drivers is high whereby more than half of respondents 58.0% were consuming more than two bottles per day and hence, exceeding the daily recommended intake. Public health education is urgently needed to guide consumers of EDs and inform on the potential health adverse effects that may be caused by excessive intakes. Manufactures of EDs most honestly indicate the amount of caffeine and other ingredients on the package label in order for the consumers to know the right amounts of ingredients. They consume as well as the public health authorities should provide education to guide consumers of EDs and inform on the potential health adverse effects that may be caused by excessive intake.

DECLARATION

I, **SAID RASHID KUDEMA** do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and it has neither been, nor concurrently being submitted for higher degree awards in any other institution.

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Date

This dissertation is confirmed by:

Prof. Helena Ngowi
Supervisor

Date

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DEDICATION

I dedicate this work to my mother Bahati Rashid, my sisters Mwajuma and Sada Kudema and my brother Abubakar Kudema. Their love and support during my study time gave me strength and wisdom to accomplish my goal.

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ABBREVIATIONS AND SYMBOLS

ABS	Absorbance
Anal. Vol	Analyzed Volume
AV. Conc	Average Concentration
EDs	Energy Drinks
FSSAI	Food Safety and Standard Authority of India
Lab	Laboratory
NBS	National Bureau of Statistics
NIN	National Institute of Nutrition
ppm	Parts Per Million
S1	Product Sample 1
S2	Product Sample 2
US	United States
TBS	Tanzania Bureau of Standards
USD	United States Dollar
UV-Vis Spectrophotometer	Ultraviolet Visible Spectrophotometry
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Energy drinks (EDs) are specifically non-alcoholic sweet beverages that contain variable amounts of caffeine, taurine (amino acid), glucuronolactone, herbal extracts, minerals and vitamins as the main ingredients to enhance physical and mental endurance (*Reissig et al.*, 2009). EDs are consumed mostly by people who are engaged in hard physical activities as well as those who for some reasons prefer to stay alert for longer periods of time such as athletes, drivers and students. This is because, EDs are marketed for their perceived or actual benefits as stimulants, for improving performance and for increasing energy (*Piotr et al.*, 2016). EDs were launched in Asia and European countries around 1960 (*Reissig et al.*, 2009). Their consumption achieved much popularity in 1987 when the most widely known brand, Red Bull was launched (*Miller*, 2008).

Despite the claims for beneficial effects, EDs could cause health problems to the consumers and hence, a threat to public health (*João et al.*, 2014). With increasing consumption and number of reported cases of adverse health effects associated with ED consumption, concerns have been raised both in the scientific community and among the general public about the health impact of these products (*Zucconi et al.*, 2013). EDs were banned in Turkey due to presence of higher level of caffeine, a research investigated that a 100ml of ED contains 80-242 mg of caffeine that is equivalent to consumption of eight cups of strong coffee in a day causing to a greater risk of toxicity and disturb the overall health structure (*McCusker et al.*, 2006). Health effects including sudden death are generally caused by the stimulation of sympathetic nerves from an excess consumption of caffeine which is the main ingredient constituted in the drinks (*Reissig et al.*, 2009).

A study in Sweden reported a number of victims with severe symptoms and death linked with over consumption of EDs (Lehtihet *et al.*, 2006).

Likewise, a similar case was reported in Australia where a man suffered cardiac arrest after consuming seven to eight cans of an ED while taking part in vigorous physical activity (Berger and Alford, 2009). Four patients suffering new, adult-onset seizures were reported in United States of America and presented at emergency rooms and the medical report showed that all the patient were victims of over consumption of large amounts of EDs (Iyadurai and Chung, 2007). (Avci *et al.*, 2007) reported a case from the United States where a 28-year-old man consumed three 250 ml ED cans, 5 h before a basketball match. After playing for 30 min, he lost consciousness, suffered from cardiac arrest and died 3 days later.

1.2 Problem Statement and Justification of the study

Health effects including conditions such as high blood pressure, various types of cancers, cardiovascular diseases and diabetes have been associated with ED consumption (Reissig *et al.*, 2009). Despite the possibility of serious consequences, EDs in Tanzania are sold in most grocery stores or general shops and likened as being a kind of soft drink. Despite an increase of several industries in Tanzania producing several brands of EDs as well as presence of imported products, there have been no published studies in Tanzania on the status and potential risks associated with consumption of these drinks. To date, there is limited research evidence on ED consumption in Tanzania, despite the relatively increase in the availability and popularity of these products. There is a need to assess knowledge and potential health risks associated with ED consumption in Tanzania to guide planning and implementation of practical measures to safeguard public health.

1.3 Objectives

1.3.1 General objective

- i. To determine potential health risks associated with energy drink (ED) consumption among long distance car drivers in Morogoro municipality, Morogoro, Tanzania.

1.3.2 Specific objectives

- i. To assess the rate of consumption of EDs among long distance car drivers in Morogoro municipality;
- ii. To explore knowledge concerning the side effects and basic guidelines related to ED consumption among long distance car drivers in Morogoro municipality;
- iii. To assess experienced side effects from the consumption of EDs among the long distance car drivers in Morogoro municipality;
- iv. To determine total amount of caffeine ingredient used in energy drink products in correspondence with the package label information.

1.4 Research Questions

- i. What is the consumption rate of EDs among the long distance car drivers in Morogoro municipality?
- ii. What proportion of ED consumers among the long distance car drivers in Morogoro municipality is aware of the side effects and the basic guidelines concerning ED intake?
- iii. What are the side effects of ED consumption experienced by long distance car drivers in Morogoro municipality?
- iv. What is the actual amounts of caffeine within ED products in correspondence to the packaging label information?

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter reviews various studies conducted in the area of consumption rate, knowledge on the guidelines and the health side effects of energy drinks (EDs) globally.

2.1 Energy Drinks

EDs are non-alcoholic, carbonated or non-carbonated drink capable of providing mental and physical stimulation or performance, containing caffeine and/or other permitted stimulants, vitamins (B group and C), phosphatides, minerals and dextrose, sucrose and/or other carbohydrate derivatives, dissolved in potable water with or without addition of amino acids (Taurine, lysine, arginine, threonine, phenylalanine, tryptophan, valine, methionine, leucine, isoleucine and alanine) and permitted food additives. (Higgins *et al.*, 2010). Example of ED products produced in Tanzania is Azam energy drink, Mo energy, Jambo Energy and power energy. The manufacturer's publicity claims positive effects on overall performance, mental concentration, reaction speed, vigilance, metabolism and well-being if such a beverage is consumed (Erick *et al.*, 2013).

2.2 Energy Drink Consumption Rate

Globally, annual consumption of EDs in 2013 exceeded 5.8 billion liters in around 160 countries (Bailey *et al.*, 2014). The estimated total U.S. retail market value for EDs was around 12.5 billion USD in 2012 and the market increased 56% from 2002 to 2006 (Zucconi *et al.*, 2013). In the U.S., EDs are the second most common dietary supplement used by young people about 30% consuming EDs on a regular basis. (Simon and Mosher, 2007). EDs are consumed mostly by people who are engaged in hard physical activities as well as those who for some reasons prefer to stay alert for longer periods of time such as athletes, drivers and students. This is because, EDs are marketed for their perceived or

actual benefits as stimulants, for improving performance and for increasing energy (Piotr *et al.*, 2016).

A study done in the kingdom of Saudi Arabia to determine the consumption patterns of EDs as well as perceived benefits and side effects amongst students at a Saudi university. Where a questionnaire about ED use, reasons for use, benefits and side effects experienced was distributed amongst the university students. Around half of the Saudi University students who participated in a survey admitted to regular consumption of energy. (Alsunni *et al.*, 2011). Likewise, a similar study was conducted at Lublin University in Poland, among 131 students, 81 (61.83%) declared a daily consumption of EDs and most (78.48%) admitted at least a one time consumption of EDs (Piotr *et al.*, 2016). A study by Ernesto *et al.* (2016) among 508 Hispanic college students from the University of Puerto Rico revealed that 21% consumed EDs, most were consuming EDs once to three times per month.

2.3 Awareness on the Side Effects and Guidelines Concerning Consumption of Energy Drinks

Important consumption health guidelines according to Tanzania Bureau of Standards (TBS) are found in many ED packaging labels for the safety of the consumer. The daily recommended amount as per Tanzania bureau of standards is not to drink more than 500ml per day as well as EDs are not recommended to children, pregnant women and breastfeeding mothers (TBS, 2018) other important guidelines found on package label are not recommended to persons sensitive to caffeine, people with high blood pressure, heart problems and metabolic diseases. It is also not recommended to mix EDs with alcoholic drinks or drink them during or after exercise.

Few studies have been conducted in different countries on the knowledge about ED intake guidelines required to be observed by consumers. In Pakistan (Hafiz *et al.*, 2013) reported that Out of 866 participants, EDs users were 350 (42.89%) and non-users were 516 (59.58%). Only 102 (29.3%) users and 159 (30.7%) non users know the correct definition of EDs. Regarding awareness, mostly user and non-users thought that usage of EDs had been on rise due to its usefulness in reducing sleep hours for studying or completing major projects and for refreshment purposes. Two main reasons of not using EDs by non-users were awareness from its side effects. Most common side effects reported by users were fatigue and weight gain. A cross-sectional online survey conducted by *Peacock et al.* (2016) on a convenience sample of 1922 people, approximately 38% of past-year ED consumers accurately reported the maximum recommended daily ED intake. About 31% underestimated and approximately 27% were unsure of the guidelines while 5% overestimated the recommended maximum daily intake. About 51% of lifetime consumers and 56% non-consumers reported being unaware of the guidelines, with around 23 and 19% correctly reporting the maximum recommended daily ED intake, respectively. A study in Poland (Piotr *et al.*, 2016) among students of medical university of Lublin in Poland revealed that about, 86.26% of all the surveyed students knew about the effects of ED usage, 78.63% knew the ingredients of EDs and 61.83% knew about their side effects while 43.21% had experienced some of the side effects. Still, 25.71% of the respondents declared that the experienced side effects had discouraged them from further ED consumption.

2.4 Health Risk Related to the Consumption of Energy Drinks

The health risks associated with ED consumption are primarily related to their caffeine content (João *et al.*, 2014). A caffeine overdose can cause palpitations, hypertension, diuresis, central nervous system stimulation, nausea, vomiting, marked hypocalcemia,

metabolic acidosis, convulsions (WHO, 2005) and in rare cases death (Sarah and Tania, 2005). In adults, there is also an increased risk of arterial hypertension and Type 2 diabetes (Seifert *et al.*, 2016), as high consumption of caffeine reduces insulin sensitivity (Lee *et al.*, 2005). High-caffeine consumption among pregnant women increases the risk of late miscarriages, small for gestational age infants and stillbirths (Greenwood *et al.*, 2010). Frequently consumption of caffeine may negatively impact cognition in general and perpetual memory and learning specifically (Mednick *et al.*, 2008). In Smith, 2002 published a report illustrated that caffeine at a dose of 300 mg can increase anxiety and tension. At a dose of 400 mg caffeine increases anxiety especially when paired with a stressful task. Some reports suggested that energy drinks can precipitate first-onset seizure and contribute to stroke. (Dikici *et al.*, 2013).

Caffeine ingredient in ED is a known ergogenic substance that increases the heart rate and blood pressure. It binds to adenosine receptors on heart muscle cells, which initiates a second messenger system with cyclic adenosine monophosphate within the cells, mimicking the effects of epinephrine. (Pirainen *et al.*, 2011). Cardiovascular adverse effects such as tachycardia and arrhythmia typically arise when > 200 mg of caffeine are ingested. A study report by (Worthley *et al.*, 2010) tested 50 young men and women one hour before and one after the participants ingested 250 mL of a sugar-free drink that contained approximately 80mg of caffeine. They found that the mean arterial pressure of the participants increased by 13.7% compared to a 0.3% change in the controls.

Many other health problems are associated with overconsumption of caffeine. For example, caffeine overdose has been reported as a potential cause of rhabdomyolysis (Chiang *et al.*, 2013). EDs, can cause hypokalemia because of their diuretic effect can also cause high levels of creatinine kinase and renal impairment (Armstrong *et al.*, 2007).

Persons who do not typically consume large amounts of caffeine may experience increased diuresis when they consume EDs. Hence, the drinks have a net dehydrating effect (Hew-Butler *et al.*, 2006). Furthermore, a study by Hasselkvist *et al.* (2010) demonstrated a significant association between EDs and dental erosion. The demineralization potential of energy beverages is principally due to their low pH. (Li *et al.*, 2012). Vos and Lavine (2013) reported that greater sugar-sweetened beverage-including ED consumption is positively associated with overweight and obesity and increase the risk for diabetes mellitus and cardio metabolic diseases, as the beta cells become unable to secrete sufficient insulin to maintain normal blood glucose when the body is exposed to excesses of simple sugars over long periods.

2.5 Caffeine Content in Energy Drink Products

Caffeine seems to be the main ED compound to produce stimulant effect (João *et al.*, 2014). In ED products caffeine content varies between 75 mg and 150 mg per can (FSSAI, 2010) compared to 80-120 mg and 60 mg in a cup of (250 mL) of coffee and tea, respectively (NIN, 2010). Maximum recommended intake of caffeine per day varies from 2.5 mg / kg / day to 6 mg / kg / day in children, 100 mg / day / in adolescents and up to 400 mg / day in adults (Heckman *et al.*, 2010). Caffeine tolerance varies between individuals, though most people would develop toxic symptoms in doses of 200 mg (1 mg = 4 ppm). Some of the EDs may contain as high as 300-500 mg per can. Considering the potential adverse effects EDs have been banned in some countries like Denmark, Uruguay and Turkey. EDs with caffeine more than 320 ppm are banned in Australia. European countries have stipulated that energy drinks with caffeine more than 150 ppm should be labeled as having high caffeine content (FSSAI, 2010).

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Description of the Study Area

The study was conducted in Morogoro Municipal in Morogoro region, Tanzania. Data collection was conducted between November 2018 and February 2019. Morogoro Municipal is one of the six districts making up the Morogoro administrative region. It is bordered to the North by the Morogoro Rural district, to the East by the Pwani region, to the South by the Kilombero district and to the West by the Kilosa district. The Region is located between latitudes 50 50' and 1000' South of the Equator and longitude 350 25' and 380 30' East of Greenwich Meridian.

In 2002, the area of Morogoro municipal was 260 km², which represents 0.4% of the total regional area. The Morogoro municipal is administratively divided into one division and nineteen wards. The town has a bimodal climate, with a short rain season between November and December and a long rain season between March and May, including a relatively dry period in January and February. The current population is 315 866 (NBS, 2012) of the Morogoro Municipal, in the ratio of 50.35% female and 49.65% male individuals.

The population growth is 4.6% per annum and immigration rate is increasing from 3.75 to 9.6% in 2002. The Morogoro Municipal plays a major role of being a high way to several regions of our country such as Mbeya, Iringa, Dodoma as well as for the routes to neighbourhood countries and hence, being a suitable area to obtain the long distance drivers.

3.2 Study Design

The study used a cross-sectional research design. Quantitative data collection methods were adopted using questionnaires to collect data from the selected respondents used in the study. The target population was long distance car drivers who were involved in travelling long journeys to transport goods, commodities and passengers.

3.3 Sample Size Determination

The sample size was calculated by using the following formula (John, 2003):

$$n = \frac{Z^2 P (1-P)}{d^2}$$

Where,

N= population size (1000)

n = sample size

Z score = correspond to 1.96 (at 95% Confidence interval)

d = precision level (accepted error) 5%

P= Estimated prevalence. (38%, prevalence of knowledge regarding energy drink intake guidelines in Australia (Peacock *et al.*, 2016).

Therefore,

$$n = \frac{1.96^2 0.38 (1 - 0.38)}{0.05^2}$$

$$n = 362$$

The calculated sample size for infinite population = 362

By using finite population correction formula. (Glenn, 1992) the calculated sample size for infinite population was adjusted.

$$n = \frac{n_0}{1 + (n_0 - 1) / N}$$

Where,

n= finite sample size

N = population size (1000)

n_0 = is the calculated sample size for infinite population

$$n = \frac{362}{1 + (362 - 1) / 1000}$$

$$n = 265$$

But due to the limited time to interview the respondents since most of them are still on the journey hence it's difficult to obtain a huge number to interview, as well as a limited budget for the study only 150 respondents were involved.

3.4 Sample Size Estimation for Energy Drink

Purposive sampling was used to obtain twelve energy drink samples 2 samples from each of 6 brands available within Tanzania groceries and stores. The samples were randomly purchased where by 2 groceries were visited and the shopkeeper were asked to pick up 6 samples of EDs beverages which were likely mostly preferred by the customers where 3 of the samples must consist brands produced within the county Tanzania and other 3 should consist of brands imported from outside the country this was done in all of the 2 groceries.

3.5 Sampling Frame

The sampling frame consisted of long distance car drivers basically bus drivers, truck drivers and drivers employed in government and non-governmental institutions who travel long distances transporting goods, commodities and passengers. The inclusion criteria were a licensed driver who was currently involving himself in transportation job specifically driving from one region to another or even from Tanzania to neighborhood countries via Morogoro with sound mind aged eighteen years and above who were voluntarily willing to be interviewed.

3.6 Sampling Procedure

Simple random selection was used to obtain about four car parking sites (Stands) used by long distance car drivers, including public parking sites, government institution car parking sites and private institution car parking sites within Morogoro municipality for inclusion in the study. The car parking sites included Msamvu bus terminal, Itigi truck parking sites, Tumbaku industry truck parking site (along Mazimbu road) and Nanenane parking site in each of the selected car parking sites a maximum 40 respondents were interviewed in order to attain the required sample size. Respondents were selected using quota sampling method which is a non-probabilistic sampling where by the survey population was divided into mutually exclusive subgroups, these subgroups contained the truck drivers, the bus drivers, the international transit (IT) drivers in which respondents were then sampled from each subgroup.

3.7 Pre-testing of Questionnaire

The questionnaires were translated into Swahili which is the national language of the Tanzania citizens and the pre-testing of the data collection tool (questionnaire) was done prior the study, at the Morogoro city bus stand. Ten respondents were interviewed and the exercise involved the recruited research assistants as part of practical training to give them experience of all the necessary field procedures. Results of pre-test were used to correct errors on the questionnaire.

3.8 Data Collection Methods

Two types of data were collected including the sociological data and laboratory based data.

3.8.1 Sociological data

Quantitative data were collected in the field by the research team, respondents were personally contacted by a member of a research team where by a face to face interview was conducted and each respondent was interviewed by a single interviewer. A Swahili language questionnaire containing both open ended and close - ended questions was used to collect information on the study variables, including social demographic characteristics of respondents, consumption rate of energy drinks, the preferable brands, at what quantity do they drink.

Questions concerning the knowledge on the guidelines of ED intake, familiarity with the precautions as such avoidance of over consumption. Questions involving the knowledge on the health risks associated with over consumption of EDs in a form of an interview. Questions concerning the experienced side effects such as the feeling of addiction, headache and increase in heart beat rate caused by ED consumption were asked.

3.8.2 Sampling and handling of energy drink samples

The samples were randomly purchased where by 2 groceries were visited and the shopkeeper were asked to pick up 6 samples of EDs beverages which were likely mostly preferred by the customers where 3 of the samples must consist brands produced within the county Tanzania and other 3 should consist of brands imported from outside the country this was done in all of the 2 groceries the samples were placed in a cool box with icepacks and within 1 to 2 hours the samples were transported to Food Science and Technology laboratory at Sokoine University of Agriculture (approximately, 2.5km from the sample collection sites) and stored under 1.6°C until analysis.

3.8.3 Laboratory analysis

3.8.3.1 Sample preparation

Caffeine content of each ED was analyzed as described by Rehman and Ashraf (2017) where by 1.0 mL of homogenized beverage were drawn using 10 ml pipette and poured directly in a glass separatory funnel, then 1mL of 20 % (w/v) sodium carbonate solution and 5 mL of chloroform were added and shaken for five minutes. The lower (organic) layer containing caffeine was taken in a sample cell and absorbance was read at 274 nm using UV-Vis spectrophotometer (X-ma 3000, England). Standard stock solution of 1000 ppm was prepared by taking 0.1g of pure caffeine in 100 ml chloroform. Serial dilution of 1-25 ppm was prepared and absorbencies were read and linear regression equation was obtained and the caffeine concentration of the unknowns was calculated.

3.8.4 Recruitment and training of research assistants

Two research assistants with food science or nutrition education background were recruited and trained for one day. The training included the study objectives, how to identify study participants, appropriate introductions, confidentiality aspects and familiarization with the study questions.

3.9 Data Processing and Analysis

Data were entered into Microsoft Excel, followed by data coding, checking and cleaning where SPSS statistical software was used to analyze the data. Descriptive statistics were computed for categorical variables. Respondents' level of knowledge on the side effects and the consumption guidelines of EDs were determined by the awareness score that was computed using respondents' response on the familiarity with the ten side effects caused by EDs consumption and ten basic consumption guidelines. The level of knowledge was classified into 3 categories: High level of knowledge if one responded to 7-10 items,

middle level of knowledge if the response were on 4-6 items and low level of knowledge if the response were on 3 items or less. Chi - square test was performed to assess statistical association between the demographic characteristics of respondents and the knowledge on the side effects and the consumption.

3.10 Ethical Considerations

Research permit was obtained from Sokoine University of Agriculture and Permission to conduct the study was obtained from the Morogoro Municipal council. Since this study involved some personal issues such as age level of education, occupation and names of respondents which were recorded, ethical clearance from National Institute of Medical Research (NIMR) was also obtained. Participants were given brief information on the nature of the study and requested to sign a consent form for their participation and all the information provided were kept under the custody of the researcher as confidential material.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Results

This chapter provides description of findings of the research on assessment of energy drink (ED) consumption rate, knowledge and side effects among long distance car drivers in Morogoro municipality, Morogoro, Tanzania. It describes the socio-demographic characteristics of the respondents, their consumption rate of EDs, their knowledge on the basic guidelines concerning with ED consumption, awareness on side effects caused by EDs as well as the experienced side effects due to energy drink consumption. In addition, the chapter provides laboratory findings of the caffeine content detected in samples of EDs.

4.2 Demographic Characteristics of Respondents

A total of 150 respondents participated in this study, as shown in Table 1, 98.0 %, of the respondents were males. Respondent's ages ranged from 30 to 39 (44.0 %), 40 to 49 years (33.3 %), 18 to 29 years while the smallest proportion (20.7 %) and 50 and above years. (2.0 %). Most of the respondents had primary (54.0 %) and secondary (40.0 %) education, about 98.7% of the respondents had long distance car driving as their primary occupation. The majority of the respondents had worked for more than two years.

Table 1: Social demographic characteristics of respondents to a questionnaire assessing energy drink consumption rate, knowledge and perceived side-effects among long distance car drivers in Morogoro municipality, Morogoro, Tanzania, 2018-2019

Characteristics (N=150)	Number	Percentage
Gender		
Male	148	98.7
Female	2	1.3
Age (Years)		
18 – 29	31	20.7
30 – 39	66	44.0
40 – 49	50	33.3
50 +	3	2.0
Level of education		
No formal education	3	2.0
Complete primary education	81	54.0
Complete secondary education	60	40.0
College/University	6	4.0
Primary occupation		
Long distance car driver	148	98.7
Business	2	2.0
Years involved in driving job		
Less than one year	3	2.0
One year	5	3.3
Two years	10	6.7
More than two years	132	88.0

4.3 Knowledge, Preference and Consumption Rate of Energy Drinks among Long Distance Car Drivers

Approximately, 98.0% of respondents reported to know about energy drinks while 2.0% were not familiar with the term ED. Azam energy and Mo energy drink brands were the most commonly known products, followed by Dragon energy (Table 2). Nearly 47.3% of the respondents preferred Azam energy drink, followed by Mo energy drink (45.3%). The other EDs were least preferred.

Table 2: Energy drink brands known by 150 long distance car drivers in Morogoro municipality, Morogoro, Tanzania, 2018-2019

Energy drink brand	Number of respondents	Percent
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Azam Energy	144	96.0
Mo Energy	140	93.3
Kungfu Energy	34	22.7
Wildcat Energy	4	2.7
Power Energy	4	2.7
Dragon Energy	47	31.3
Redbull	31	20.7
Jambo Energy	17	11.3
Fire Energy	3	2.0
Burn Energy	3	2.0
Switch Energy	2	1.3

More than half of respondents (55.3%) consumed three bottles per day, followed by 23.3% who consumed two bottles per day, 16.0% who consumed one bottle per day while 2.7%) was found among the respondents who consumed more than three bottles per day and the ones who were not sure with the exactly amount they consumed per day.

4.4 Knowledge on the Basic Energy Drink intake Guidelines and Side Effects

About 53.3% of the respondents said that EDs make them remain more alert compared to consumption of other soft drinks (Table 3). Other explanations in response to the question on how EDs differ from other soft drinks as shown in Table 3. While approximately 53.3% of the respondents admitted to not take any precaution when consuming EDs, about 46.7% said that they take precautions. Various types of precautions taken are shown in Table 3. The most common precaution taken is not to consume more than the recommended amount per day.

Table 3: Sensory differences between energy drinks and other soft drinks and precautions perceived by 150 long distance car drivers in Morogoro municipality, Morogoro Tanzania, 2018-2019

Factor	Frequency	Percentage
How energy drinks differ from other soft drinks		
More sweet compared to other soft drinks	11	7.3
Less sweet compared to other soft drinks (sour taste)	45	30.0
It has too much caffeine	8	5.3
Provide activeness when consumed	80	53.3
I don't know	6	4.0

Precautions taken when consuming energy drink

Not consume more than recommended amount per day	34	22.7
Consume after work	16	10.7
Consume before doing work	3	2.0
I don't take any precaution	80	53.3
I don't consume when am in medication	4	2.7
I don't consume when am about to sleep	10	6.7
I don't mix with alcohol	3	2.0

About 52.7% of the respondents did not know any guideline concerning with the energy drink consumption. About 28.7% declared to be aware of the guideline that recommends not consuming more than the indicated amount. On the other hand, approximately 10.7% of respondents were aware of the guideline that recommends not consuming while going to bed. The guideline that indicates not recommended for pregnant women and not recommended for children were declared by 4.0% each.

As indicated in Table 4, only about 5.3% of respondents were highly informed about the guidelines concerning with energy drink intake. The requirement not to consume more than three bottles of EDs per day was the most familiar instruction to 90.0% of the respondents. This was followed by 89.3% of respondent who were familiar of the instruction which states not recommended for children. Other common knowledge was prohibition of ED intake in pregnant or lactating women. Other common knowledge was reported as presented in Table 4.

Table 4: Extent of being informed about the guidelines concerning with energy drink intake among the long distance car drivers in Morogoro municipality, Morogoro Tanzania, 2018-2019

Factor	Frequency	Percent
How well informed about the guidelines concerning energy drink intake		
Very much informed	8	5.3
Moderately informed	24	16.0
Minimally informed	82	54.7
Not informed	36	24.0

Instructions one is most familiar with relation to the basic guidelines found on energy drink labels

Not recommended for children	134	89.3
Not recommended for pregnant women	107	71.3
Nor recommended for lactating women	65	43.3
Not recommended for persons' sensitive to caffeine	39	26.0
Not recommended for persons with high blood pressure	37	24.7
Not recommended for people with heart diseases	32	21.3
Not recommended for persons with metabolic diseases	37	24.7
Not recommended to mix with alcohol drinks	53	35.3
Do not use during or immediately after exercise	54	36.0
Consume not more than three bottles per day	135	90.0

Level of awareness on the basic energy drink guidelines in relation to the awareness score

High level of knowledge	42	28.0
Middle level of knowledge	67	44.7
Low level of knowledge	41	27.3

All the two female respondents had a high level of awareness on the basic guideline concerning ED consumption while only 27.0% of the 148 male respondents had a high level of awareness. Unfortunately, there sample size for females was relatively too small to make sound statistical comparison (Table 5). More than half of respondents who aged 50+ showed a high level of awareness.

Statistically significant difference in level of awareness on the basic guidelines concerning with energy drink consumption according to the level of education was ($p = 0.036$). This implies that the level of awareness increases as the level of education increases. On the other hand, there was no difference in the level of awareness on the basic energy drink consumption guidelines among gender ($p = 0.074$), different age group ($p = 0.076$), primary occupation ($p = 0.068$) and years involved in driving job ($p = 0.213$).

Table 5: Association between social-demographic characteristics and awareness score on the basic energy drink consumption guidelines

Social demographic Variable	Awareness scores			X ²	P value
	High level of knowledge	Medium level of knowledge	Low level of knowledge		

	(%)	(%)	(%)		
Gender				5.212	0.074
Male	40(27.0%)	67(45.3%)	41(27.7%)		
Female	2(100.0%)	0(0.0%)	0(0.0%)		
Age				11.440	0.076
18 – 29	3(9.7%)	15(48.4%)	13(41.9)		
30 – 39	18(27.3%)	31(47.0%)	17(25.8%)		
40 – 49	19(38.0%)	20(40.0%)	11(22.0%)		
50+	2(66.7%)	1(33.3%)	0(0.0%)		
Education level				13.510	0.036
No formal education	1(33.3%)	2(66.7%)	0(0.0%)		
Primary education	23(28.4%)	39(48.1%)	19(23.5%)		
Secondary education	13(21.7%)	26(43.3%)	21(35.0%)		
College/university	5(83.3%)	0(0.0%)	1(16.7%)		
Primary occupation				5.389	0.068
Long distance car driver	42(28.4%)	67(45.3%)	39(26.4)		
Business	0(0.0%)	0(0.0%)	2(100.0%)		
Years involved in driving job				8.355	0.213
Less than one year	0(0.0%)	2(66.7%)	1(33.3%)		
One year	1(20.0%)	3(60.0%)	1(20.0%)		
Two years	0(0.0%)	8(80.0%)	2(20.0%)		
More than two years	41(31.1%)	54(40.9%)	37(28.0%)		

Most of the respondents were minimally informed about the side effects caused by energy drink consumption (Table 6). Most respondents were familiar with insomnia, heart palpitation, addiction, miscarriage, low birth weights, stillbirths and high blood pressure as side effects caused by ED consumption (Table 6). Other minor effects were also mentioned (Table 6). Furthermore, More than half of respondent had a middle level of knowledge concerning with the side-effects related to ED consumption (Table 6).

Table 6: Extent of being informed about the health side effects caused by the consumption of energy drinks among the long distance car drivers in Morogoro municipality Morogoro Tanzania, 2018-2019

Factor	Frequency	Percent
How well informed about the side effects caused by energy drink intake (N=150)		
Very much informed	2	1.3
Moderately informed	30	20.0
Minimally informed	79	52.7
Not informed	39	26.0

Side effects one is familiar with in relation to the consumption to the consumption of energy drinks (N=150)

High blood pressure	76	52.1
Heart palpitation	122	83.6
Miscarriage, low birth weight and still birth	81	55.5
Addiction	80	54.8
Headache	26	17.8
Insomnia	125	85.6
Dizziness	18	12.3
Numbness	34	23.3
Fainting	12	8.2
Death	32	21.9

Level of awareness on the side-effects caused by energy drink consumption in relation to the awareness score (150)

High level of knowledge	31	20.7
Middle level of knowledge	83	55.3
Low level of knowledge	36	24.0

All the two female respondent had a higher level of awareness on the common health side effects that appear to be caused by ED consumption as compared to less than 20% of male respondents (Table 7).

Table 7: Association between social-demographic characteristics and awareness score on the commonly known health side effects caused by energy drink consumption

Social demographic Variable	Awareness scores			X ²	P value
	High level of knowledge (%)	Medium level of knowledge (%)	Low level of knowledge (%)		
Gender				7.781	0.020
Male	29(19.6%)	83(56.1%)	36(24.3%)		
Female	2(100.0%)	0(0.0%)	0(0.0%)		
Age				12.679	0.049
18 – 29	2(6.5%)	20(64.5%)	9(29.0%)		
30 – 39	9(13.6%)	28(42.4%)	29(43.9%)		
40 – 49	8(16.0%)	21(42.0%)	21(42.0%)		
50+	2(66.7%)	0(0.0%)	1(33.3%)		
Education level				14.144	0.028
No formal education	0(0.0%)	2(66.7%)	1(33.3%)		
Primary education	14(17.3%)	34(42.0%)	33(40.7%)		
Secondary education	6(10.0%)	29(48.3%)	25(41.7%)		

College/university	4(66.7%)	1(16.7%)	1(16.7%)		
Primary occupation				4.883	0.087
Long distance car driver	24(16.2%)	82(55.4%)	42(28.4%)		
Business	0(0.0%)	0(0.0%)	2(100.0%)		
Years involved in driving job				11.335	0.079
Less than one year	0(0.0%)	1(33.3%)	2(66.7%)		
One year	2(40.0%)	2(40.0%)	1(20.0%)		
Two years	5(50.0%)	5(50.0%)	0(0.0%)		
More than two years	24(18.2%)	74(56.1%)	34(25.8%)		

Nevertheless, the very few number of female participants make it unfair to make relevant statistical comparisons. This also applies for age group comparison, though there seems to be a trend towards increase in the awareness with age (Table 7). The same can be argued for educational level (Table 7). Respondent who had college/ university education had a high proportion of awareness on side effects caused by ED consumption where none of those who had no formal education had this high knowledge (Table 7). Indeed virtually all respondents had long distant car driving as their Primary occupation, making it inappropriate to make statistical comparisons Nevertheless, high awareness was found in those with 1-2 years of experience in driving long distances (Table 7).

4.5 Side-effects Experienced from Consumption of Energy Drink as perceived by the long Distance Car Drivers in Morogoro municipality, Morogoro Tanzania, 2018-2019

Approximately, 97.3% of the respondents reported to have experienced side-effects they link with consumption of EDs while the remaining 2.7% admitted to have not experienced such side-effects. The various side-effects mentioned by the respondents are shown in Table 8, with insomnia, restlessness, addition and heart palpitations mentioned by 75.3%, 64.7%, 51.3% and 48% of the respondents, respectively.

Other several side effects were rarely mentioned (Table 8). Most (81.3%) of the respondents experienced the side-effects immediately after they had consumed an ED, while 12.0% learned from their fellow later on that the side-effects they had experienced earlier were due to consumption of EDs. In addition, only 6.7% of the respondents realized later on that the side-effects they experienced was caused by ED after they had read the package label. About 48.0% of respondent stated that they managed the side-effects experienced by reducing the intake amount through adhering to the daily recommended amount as indicated in the package label, followed by 32.0% who respondent that they completely quitted from drinking the EDs. On the other hand, about 20.0% of the respondents said they did not manage the side-effects experienced.

Table 8: Experienced side-effects caused by energy drink consumption as reported by the long Distance Car Drivers in Morogoro municipality, Morogoro Tanzania, 2018-2019

Side effect experienced (N=150)	Frequency	Percent
Heart palpitation	72	48.0
Addiction	77	51.3
Headache	31	20.7
Insomnia	113	75.3
Dizziness	15	10.0
Numbness	30	20.0
Fainting	8	5.0
Diuresis	55	36.7
Restlessness	97	64.7
Vomiting	5	3.3
Impotency	24	16.0
Lack of appetite	12	8.0

4.6 Actual Amounts of Caffeine Ingredient used in Energy Drink Products

Analyzed

The six different brands of ED beverages in duplicates (total 12) consisted of three brands that were produced in Tanzania (Azam energy drink, Mo energy drink and Power energy drink) and three that were imported from abroad (Kungfu energy drink, Dragon energy

drink and Monster energy drink) As indicated in Table 9, out of six samples tested the sample of Dragon energy drink had the highest amount of caffeine content of 30.1mg/100ml while Power energy had the least amount of caffeine level of 28.0mg/100ml.

Table 9: Results on caffeine contents samples (beverages) analyzed in duplicate (S1 and S2) during a study to assess energy drink consumption rate, knowledge and perceived side-effects among long distance car drivers in Morogoro municipality, Morogoro, Tanzania, 2018-2019

S/N	Samples	Volume (ml)	Extraction Vol.	Anal. Vol.	ABS	Conc. (mg/L)	Av. Conc. (mg/L)	Conc. (mg/100ml)	Av. Conc. (mg/100ml)	Caffeine content (mg/100ml)
1	Dragon S1	1	100	1	3.105	298.7	299.3	29.87	29.33	30.1
		1	100	1	3.117	299.9		29.99		
	Dragon S2	1	100	1	3.206	308.8	303.55	30.88	30.355	
		1	100	1	3.101	298.3		29.83		
2	Azam energy drink S1	1	100	1	2.952	283.4	283.95	28.34	28.395	
		1	100	1	2.963	283.5		28.45		
	Azam energy drink S2	1	100	1	2.965	283.4	284.2	28.34	28.42	
		1	100	1	2.968	285		28.5		
3	Monster Energy S1	1	100	1	2.966	284.8	284.6	28.48	28.46	
		1	100	1	2.962	284.4		28.44		
	Monster Energy S2	1	100	1	2.971	285.3	285.2	28.53	28.52	28.5
		1	100	1	2.969	285.1		28.51		
4	Mo Energy S1	1	100	1	2.938	282	281.4	28.2	28.14	
		1	100	1	2.926	280.8		28.08		
	Mo Energy S2	1	100	1	2.931	281.3	281.4	28.13	28.14	28.1
		1	100	1	2.933	281.5		28.15		
5	Power Energy S1	1	100	1	2.932	281.4	279.9	28.14	27.99	
		1	100	1	2.902	278.4		27.84		
	Power Energy S2	1	100	1	2.911	279.3	279.8	27.93	27.98	
		1	100	1	2.921	280.3		28.03		
6	Kungfu 1	1	100	1	2.926	280.8	280.9	28.08	28.09	
		1	100	1	2.928	281		28.1		
	Kungfu 2	1	100	1	2.922	280.4	280.4	28.04	28.04	28.1
		1	100	1	2.922	280.4		28.04		

Considering caffeine content per serving (per packaged bottle), Monster energy drink had the highest amount of caffeine followed by Dragon energy drink together with Kungfu energy drink then followed with power energy drink and Azam energy drink while the least amount of caffeine was indicated in Mo energy drink package label (Table 10).

Table 10: Caffeine concentration per serving for different energy drinks as indicated in their package label

S/N	Energy drink brand	Total volume per serving (ml)	Caffeine concentration as per product label (mg/100ml)	Caffeine content per serving
1	Dragon energy drink	500	30	150mg/500ml
2	Azam energy drink	300	30	90mg/300ml
3	Mo energy drink	400	17.6	70.4mg/400ml
4	Monster energy drink	500	32	160mg/500ml
5	Power energy drink	400	30	120mg/400ml
6	Kungfu energy drink	500	30	150mg/500ml

Table 11 compares caffeine concentrations detected during the study with those written in the actual product information labels of the six EDs analysed. Five of the EDs analysed presented similar levels of caffeine content to those shown on the product package label. Nevertheless, Mo energy drink had actually nearly 1.6 times caffeine concentration that presented in the product information label (Table 11).

Table 11: Laboratory results of caffeine content within the sample of beverages and the published caffeine content in accordance to manufacture package label. Morogoro municipality, Morogoro Tanzania, 2018-2019

S/N	Energy drink brand	Caffeine content as per lab results (mg/100ml)	Caffeine content declared by manufacture in package label (mg/100ml)
1	Dragon energy drink	30.1	30
2	Azam energy drink	28.4	30
3	Mo energy drink	28.1	17.6
4	Monster energy drink	28.5	32
5	Power energy drink	28.0	30
6	Kungfu energy drink	28.1	30

4.7 Discussion

This study provides information on the consumption rate of energy drinks (EDs), knowledge on the basic guidelines related to ED consumption as well as knowledge on and perceived side effects caused by ED consumption by long distance drivers in Morogoro municipality. In addition, the study provides information on actual amounts of caffeine contained in six brands of EDs available in the country and compare them with amounts indicated in the product package label information. The selected study population and the convenient selection of respondents had a positive impact in getting a wide range of responses and views. The sample composed of unequal presentation of all genders, with female gender being minority, presumably because of the type of job, which is not favourable for women. The sample is also composed of respondents with various education levels ranging from no formal education to university education, though the two extremes had negligible number of respondents, making it inappropriate to statistically analyse the influence of level of education on other variables. Also the sample comprised of different age groups that enabled studying the influence of age on important variables. The sample comprised of unequal presentation of primary occupation as the majority had the long distance driving job as their main occupation. The respondents had various years of experience in driving ranging from those with less than one year to those with more than three years of experience.

4.7.1 Consumption rate of energy drinks among long distance car drivers

Results from this study show variability in the extent of consumption of EDs per day among the respondents. However, 81.3% consumed two to more than three bottles of EDs per day. This is in line with the findings from Piotr *et al.* (2016) pointed out in a study done in Poland at Lublin university that, 61.8% of students who participated in the study declared a daily consumption of EDs. Reason for the similarities include perceived

health benefits such as staying alert for a longer period of time especially night hours where students use the time for studying and the long distance drivers use the time for driving to their destinations. This indicates that the ED markets in Tanzania are gaining popularity due to their perceived benefits of providing energy and body alertness. Therefore, proper measures need to be taken before they cause health consequences to the users due to lack of knowledge on how to consume the recommended amount so that they may prevent themselves from facing side - effects.

4.7.2 Knowledge on the basic energy drink intake guidelines

Extent of being informed about ED consumption guidelines was low in this study population. The low knowledge in our study could partly be attributed by language barrier as package labels of most EDs are written in foreign language e.g. English with the exception of Azam energy drink and Mo energy drink that contains both Swahili (Tanzania national language) and English. This finding is consistent with the study by Peacock *et al.* (2016) in Australia where only 38% of study population was highly informed on the energy drink consumption guidelines. Similarly, Hafiz *et al.* (2013) in Pakistan reported low awareness of ED guidelines by users.

Though not statistically significant, this study revealed slight difference among males and females' respondents on awareness of basic guidelines concerning with energy drink consumption. Female respondents seemed to be more aware of food labelling than male respondents. This may be due to the reason that females always are concerned on their diet on what they consume for their bodies hence they always read the package label looking for ingredients consisted in the food sample, unlikely to the males. However, considering that female respondents constituted only 1.3% of the study population, it is unfair to draw major conclusions regarding sex difference on other variables in this study.

Nevertheless, Basarir *et al.* (2012) reported in the United Arab Emirates, found higher level of awareness on food labelling in female respondents than in males. Findings of the present study also show that, respondents were more familiar with the guidelines prohibiting consumption of more than the recommended amounts per day, consumption by children and or pregnant women. Low knowledge on the guidelines may somehow pose a risk to the consumers hence it is widely to ensure much awareness is provided to the users within Tanzania in order to prevent them from associated side-effects.

4.7.3 Knowledge on the side effects related to energy drink consumption

Extent of being informed on the side-effects related to ED consumption was very low within the study population. The low knowledge on the side-effects could be attributed by limited information from the public health experts, EDs producers, as well as media advertisement on the side-effects that may be caused through ED consumption. This is different from a study in Poland, which found out that 86.26% of medical students knew about the side-effects of ED usage (Piotr *et al.*, 2016). Such difference may be due to educational level of respondents. As the study included only medical students whom could be more knowledgeable on matters of human health, unlike car driver careers.

This study has shown some indication of a trend increase in awareness on the side-effects related to ED consumption with age. This is likely to be caused by the factor that the adults or elders are more concerned with their health condition than the youth hence they become more aware and sensitive to each food product their about to consume and the health benefits provided within that food product, but also the potential increase in awareness by age could be due to possibly long exposure to side effects of EDs over age. The borderline statistical significance revealed in this comparison could be due to the small number of respondents for many age categories.

The most commonly known side-effects related to ED consumption among respondents were insomnia and heart palpitations. It can be speculated that the insomnia (sleeplessness) is what is preferred by the long distance car drivers to prevent themselves from sleeping in order for them to drive longer distances without falling a sleep or getting tired while heart palpitations is considered as unfavourable but unavoidable effect. Heart palpitations may be due to overdose of caffeine content consumed from EDs.

4.7.4 Side-effects experienced from consumption of energy drink among the long distance car drivers

More than 90% of respondents in this study declared to have experienced some side-effects due to ED consumption. This high proportion could be possibly attributed by consuming more than the recommended amounts since the study revealed consumption of larger volumes of EDs per day than recommended. Considering that the caffeine content of mostly marketed EDs can be up to 150mg/500ml which is a single serving, a person drinking 3 bottles per day consumes 450mg of caffeine which is higher than the daily recommended amount. The maximum recommended intake of caffeine per day varies from 400 mg caffeine/day in healthy adults' 300 mg caffeine/day in healthy pregnant women and 2.5 mg caffeine / kg body weight / day to children (Heckman *et al.*, 2010).

The most common side-effects experienced by the respondents were insomnia, restlessness, addiction, heart palpitations diuresis headache numbness dizziness fainting and vomiting. This side - effects may be due to the reason that most of the drivers prefer to consume EDs so that they can stay awake for a longer period of time and hence purposely consumers in order to experience insomnia. Similarly, some of experienced side-effects were reported by Brenda *et al.* (2007) on a survey of ED consumption pattern among college students where 29.0% of respondents reported to experience weekly jolt

and crash episodes, 22.0% reported ever having headaches and 19.0% reported to have experienced heart palpitations. This differs to what Hafiz *et al.* (2013) reported where the side-effects experienced by respondents were fatigue (31.7%) and weight gain (29.4%). This difference may be due to the parameters considered while collecting data whereby the study didn't under take some of the parameters such as bodyweight of the respondents as well as their medical history of their health conditions in case they have medical problems that may have the same symptoms as the ones caused by EDs consumption.

A study done by Worthley *et al.* (2010) reported effect on the cardiovascular system such as tachycardia and arrhythmia. In the present study, other minor side-effects mentioned were impotency and lack of appetite. This study also showed that more than half of respondents experienced the side-effects immediately after they consumed the drink. As reported by Adan and Miguel (2008), caffeine drinks have almost an immediate effect where after the consumption the effect begins as little as 10 minutes. Some ED consumers in the present study reported to prevent future side effects by reducing the amount they consume and adhering to the daily recommended amount indicated in the product package labels.

4.7.5 Actual concentrations of caffeine ingredient used in energy drink products compared with the package label information

This study has shown that, Mo energy drink had actually considerably higher amount than presented in the product package label. This is a misleading and may cause health problems to consumer resulting from over dosage unknowingly. The relevant authority should direct the company to rectify the product's caffeine concentration and make an honesty labelling.

4.8 Study Limitation

Some of the perceived side-effects reported by respondents in this study may be attributed by other factors, including stress due to the nature of their job of the respondents. In addition, the study results are based on a sample from Morogoro municipality, Morogoro Tanzania and thus may not broadly generalize to drivers in other geographic areas of the Tanzania. Furthermore, this study was cross-sectional and hence, the findings may be subject to temporal variations. Longitudinal studies would be necessary to acquire a deeper understanding of this phenomenon. However, in the absence of other previous studies in Tanzania, the current findings provide a crucial starting point on such studies. Most of the drivers employed in the government sector were afraid to participate in the study hence no much information was collected from them. Also, the sample size of 150 respondents may have underestimated some variables and limited comparison between some important variables.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study has revealed that consumption rate of energy drinks (EDs) among long distance car drivers in Morogoro municipality, Morogoro Tanzania is high and most of the consumers consume more than recommended amounts per day. Hence, increasing the possibility of facing the side-effects that are caused by overdose. However, some of the perceived side-effect indicated in the study may also be attributed by other factors such as tobacco smoking and alcohol intake and somehow stress due to the nature of their job. The study has also revealed low knowledge on the basic guidelines concerning ED consumption as well as side-effects associated with ED consumption, these was possibly due to lack of proper knowledge and awareness to the public from the health experts as well as ED manufacturers on the health effects of EDs. This may also be among the reasons why the respondents are unknowingly highly consuming the products without considering the health consequences they may face. Furthermore, the study reveals mislabelling of the total amount of caffeine content available in the products of the tested brands, where this may lead to the possibility of over dosage to the consumers of ED ignorantly or unknowingly because of dishonesty labelling of some manufacturers. Therefore, proper measures should be taken in order to ensure the consumers are being saved the recommended intake as indicated in the package label in order to reduce the risk of facing side effects.

5.2 Recommendations

This study recommends the following:-

- i. The long distance drivers need to be provided with awareness of the possible side effect that may be caused by consumption of EDs so that they may take serious measures and avoid over dosage since the study indicates they are at high risk of facing the perceived side effects due to their high intake of the drinks.
- ii. Some of the perceived side effects caused by high consumption of EDs may lead to serious health problems such as heart palpitations, fainting or even death. Therefore, the consumers are advised to seek medical attention as soon as they observe signs likely caused by overdose.
- iii. Manufacturers of EDs must honestly indicate the amount of caffeine and other ingredients on the package label in order for the consumers to know the right amounts of ingredients they consume.
- iv. Public health authorities should provide education to guide consumers of EDs and inform on the potential health adverse effects that may be caused by excessive intake.
- v. Further studies should assess potential benefits, side-effects of various ingredients used in the beverage and the long-term complication's associated with the consumption of EDs. It is also important to assess ED consumption rates and potential health effects to high-risk groups such as children, pregnant women, elderly and persons with low immune system.

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APPENDICES

Appendix 1: A questionnaire for assessment of energy drink consumption rate, knowledge and side effects among long distance car drivers in Morogoro municipality, Tanzania

A. GENERAL INFORMATION

- 1. Questionnaire No.
- 2. Date of interview
- dd mm yyyy

B. SOCIAL DEMOGRAPHIC CHARACTERISTICS OF THE CAR DRIVER

- 1. Gender
- a) Male
- b) Female
- 2. What is your age? Years
- 3. What is your level of education?
- a) No formal education
- b) Primary education
- c) Secondary education
- d) College/university
- 4. What is your primary occupation?
- 5. How long have you been a car driver?
- a) Less than a year
- b) One year
- c) Two years
- d) More than two years

C. CONSUMPTION RATE OF ENERGY DRINK AMONG LONG DISTANCE

CAR DRIVERS

- 6. Do you know or have you heard of “energy drink”?
- 7. If yes to question 6, what brands of energy drinks do you know? (mention all that you know)
-
-
-
-
- 8. What brand of energy drink do you prefer mostly?.....
- 9. On average, how many bottles of energy drink do you consume per day?
- a) One bottle
- b) Two bottles
- c) three bottles
- d) more than three bottles
- e) Not sure of exactly amount

**D. KNOWLEDGE ON THE BASIC ENERGY DRINK INTAKE GUIDELINES
AND SIDE EFFECTS**

- 10. How do energy drinks differ from other soft drinks?
.....
.....

- 11. Is there any extra precaution that you take when drinking energy drink?
.....

- 12. If yes to question 11, what precaution do you take?
.....
.....

- 13. Do you know of any guideline concerning the consumption of energy drink?
 - a) Yes (mention)
.....
 - b) No

- 14. How well informed would you say you are about the guidelines concerning energy drink intake
 - a) Very much informed
 - b) Moderately informed
 - c) Minimally informed
 - d) Not informed

- 15. Which of the following instructions are you most familiar with in relation to the basic guidelines found on energy drink labels (tick all mentioned)
 - a) Not recommended for children
 - b) Not recommended for pregnant women
 - c) Not recommended for lactating women
 - d) Not recommended for persons' sensitive to caffeine
 - e) Not recommended for persons with high blood pressure
 - f) Not recommended for people with heart diseases
 - g) Not recommended for persons with metabolic diseases
 - h) Not recommended to mix with alcoholic drinks
 - i) Do not use during or immediately after exercise
 - j) Consume not more than three bottles per day

- 16. Is there any health effect caused by the consumption of energy drink?
 - a) Yes (mention)
 - b) No

- 17. How well informed would you say you are about the side effects caused by energy drink intake

- a) Very much informed
- b) Moderately informed
- c) Minimally informed
- d) Not informed

18. Which of the following side effects are familiar with in relation to the consumption

of energy drinks? (tick all mentioned)

- a) High blood pressure
- b) Heart palpitations
- c) Late miscarriage, low birth weight, and stillbirths in pregnant women
- d) Addiction
- e) Headache
- f) Insomnia
- g) Dizziness
- h) Numbness
- i) Fainting
- j) Death

E. SIDE-EFFECTS EXPERIENCED FROM CONSUMPTION OF ENERGY

DRINK AMONG THE LONG DISTANCE CAR DRIVERS

19. Have you ever experienced any side-effect during or after consumption of an

energy drinks?

- a) Yes
- b) No

20. Which of the following side-effects have you experienced after the consumption of

energy drink? (tick all mentioned)

- A. Heart palpitations
- B. Addiction
- C. Headache
- D. Insomnia
- E. Dizziness
- F. Numbness
- G. Fainting
- H. Diuresis
- I. Restlessness
- J. vomiting
- K. Others (specify)

21. How did you know that the side effect you have mention was due to

consumption of energy drink?

.....

.....

22. How did you manage the side affects you have mentioned?.....

Appendix 2: Laboratory procedures for analysis of caffeine

Caffeine Extraction Procedures and Sample Measurements

A 1.0ml of homogenized beverage was taken from each working standard or sample solution. This sample was placed into a separating funnel, then 1ml of 20% (w/v) and 5ml of chloroform was added and shaken for five minutes. The lower (organic) layer containing caffeine was taken in a sample cell and absorbance was read at 274nm using UV – Vis spectrophotometer (X- ma 3000, England). The extraction procedure was repeated twice per each sample.

Absorbance of resulting solutions at 274 nm

Caffeine equivalent conc.(mg/L)	Absorbance at 274nm
0	0.091
5	0.365
10	0.583
15	0.821
20	0.996

Standard stock solution of 1000ppm was prepared by taking 0.1g of pure caffeine in 100ml chloroform. Serial dilution of 1 – 25 ppm was prepared and absorbance was read and linear regression equation was obtained and Microsoft Excel was used to tabulate the measurement data and perform a linear regression analysis. This allowed a concentration factor to be calculated which was then used to quantify the caffeine. The final caffeine content of the beverage under test was then calculated from the extracted sample solution's concentration the following equation.

$$\text{Caffeine content mg} = \text{Conc (ppm)} \times \text{(total sample Vol(ml)}^2)$$

Measured sample Vol (ml) X 1000

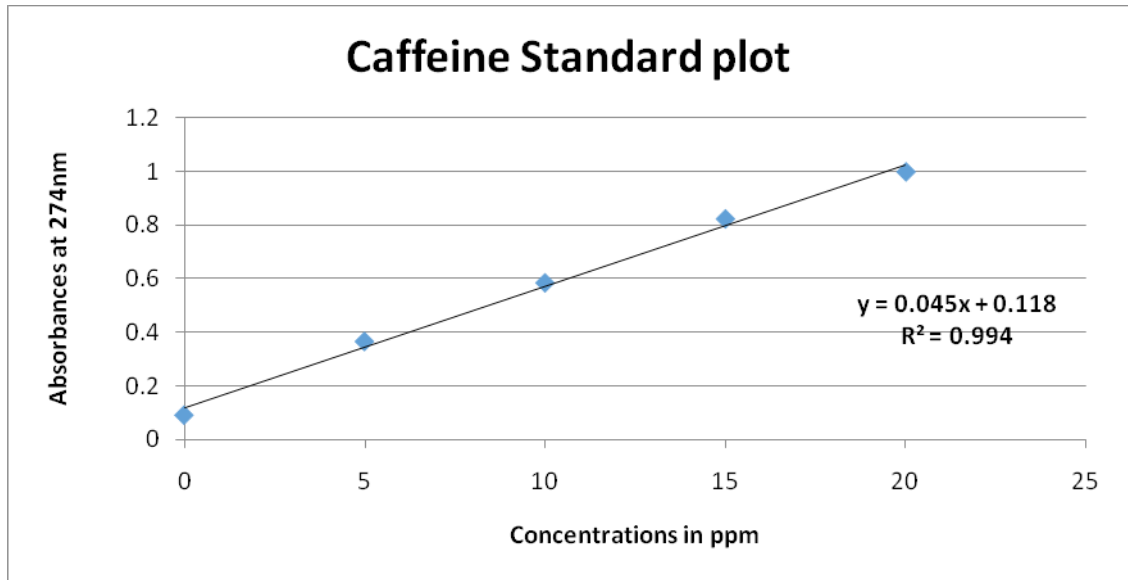


Figure 1: Standard Calibration Curve