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ENERGY DRINKS: PERCEPTION, CONSUMPTION, AND FACTORS ASSOCIATED WITH ITS CONSUMPTION AMONG THE YOUTH IN TAMALE METROPOLIS

KOBIK WILLIAMS

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ENERGY DRINKS: PERCEPTION, CONSUMPTION, AND FACTORS ASSOCIATED WITH ITS CONSUMPTION AMONG THE YOUTH IN TAMALE METROPOLIS

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(UDS/MPHN/0013/18)

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2022

DECLARATION

The research work described in this thesis was carried out at the School of Allied Health Sciences, UDS, Tamale. This work has not been submitted for any other degree here or elsewhere.

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(UDS/MPHN/0013/18)

13/06/2022
Date

I hereby declare that the preparation and presentation of the thesis were supervised under the guidelines on supervision of the thesis laid down by the University for Development Studies.

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Prof. Paul Armah Aryee
(Supervisor)

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Date

ABSTRACT

The Energy Drink (ED) market has grown into a multi-billion-dollar industry globally. In Ghana, the trend is similar with consumption among the youth on the rise. This is despite their association with short and long-term negative health outcomes. This study, therefore, sought to assess the prevalence and consumption pattern, perception, and factors associated with ED consumption among the youth of the Tamale Metropolis. It was a population-based cross-sectional study of 541 conveniently sampled respondents. They comprised 340 males and 201 females respectively, who were aged 15-45 years. Data was collected using a questionnaire that covered socio-demographic characteristics, consumption, and perception of EDs. The study showed that 78.7% currently consumed EDs and 98.7% have ever consumed EDs. EDs were perceived to give extra energy (81.00%) and reduce stress (62.30%). Respondents also perceived EDs to cause side effects like insomnia (60.60%) and restlessness (51.40%). Although a high proportion perceived caffeine to be an ingredient of EDs, the majority of respondents (83.4%) had low knowledge of the classification of drinks as EDs, their ingredients, side effects, and benefits. Also, age ($p = .002$), marital status ($p = .043$), level of education ($p = .001$), work intensity ($p < .001$), EDs served at gatherings ($p < .001$), and knowledge level of EDs ($p = .010$) were factors significantly associated with ED consumption. Consumption was also high among those without a formal education, high work intensity, singles, and those aged 26 to 35 years. More advocacy should be done by public health and nutrition professionals to positively impact perception of the youth on EDs. Also, lawmakers should influence consumption rates via legislation to protect the health of consumers.

DEDICATION

This work is dedicated to my late supervisor Professor Abdul-Razak Abizari for all the guidance he gave me when he had the strength, and my son Jesse Mba-Lebina Kobik, for the joy and love from him that gave me the drive to finish this program.

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First of all, I wish to acknowledge with gratitude the Almighty God for His grace and mercy, wisdom, and the strength He has given me throughout my education, and to undertake this project.

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Finally, I wish to express my heartfelt appreciation to Professor Abdul-Razak Abizari (late) for his enormous contributions to this work. To my parents Madam Suzie and Mr John Kobiga (Late), I say thank you for your love, care, and support for all these years, and may the Almighty God bless you abundantly.

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INTRODUCTION

1.1 OVERVIEW

This chapter introduces the body of work on the perception and consumption patterns of the youth of the Tamale metropolis. It consists of a background, problem statement, main and specific objectives, significance, and a conceptual framework. These sections come together to lay a foundation for the general and specific focus and direction of the study.

1.2 GENERAL INTRODUCTION

Over the years, humans have sought physical and cognitive 'boosts' in the face of daunting tasks. Today, the advent of energy drinks (EDs) and the way their marketing strategies target the need for physical and cognitive boosts (Reissig et al., 2009a). Ingredients that make up energy drinks include; guarana, ginseng, glucose, taurine, caffeine, L-carnitine, glucuronolactone, and B vitamins. They aim at offering improved levels of academics, athleticism, alertness, endurance, and even sexual performance. As a result, a great number of the young population is engaged in its consumption (Higgins, 2014a). Aside from the supposed beneficial effects of energy drinks, the strong desire for these beverages is driven by factors such as low price, taste, brand loyalty, and gendered marketing while alluding to a linkage with sports. This perceived inclination to masculinity in advertisements could be the reason fewer girls consume energy drinks than boys (Visram et al., 2016, 2017c). Such conditions have probably contributed to the energy drink market and evolved into one of the fastest-growing in the non-alcoholic beverage industry (Capps et al., 2012). The *notoriety* of these drinks has been bluntly summarized in the following words, "…energy drinks are the Wild West of the soft drinks industry: often shockingly and unnecessarily high in sugar and caffeine..." ("Energy Drinks Fuel the Obesity Epidemic," 2015).

The dangers associated with energy drinks have been overlooked for a long time. Even the European Union has insisted that there is no evidence to back the argument that energy drinks pose a degree of toxicity, to the magnitude of adverse health outcomes. But there

are counter-indications of various case reports from all around the world that suggest otherwise (Goldfarb et al., 2014; Wassef et al., 2017).

Consumption of these beverages has been associated with high-risk behaviours, deaths among young people, and health effects especially related to cardiovascular risk (Higgins, 2014b; Smit et al., 2004). Albeit energy drinks have plausible beneficial effects beyond mere illusion, their usual ingredients, which include guarana, ginseng, taurine, and caffeine have been associated with a myriad of adverse health outcomes. Several complications have been associated with energy drink use. A few acute effects include sudden cardiac death, high BP, and endothelial dysfunction among others. Patients who are at risk show significant morbidity and mortality. Also, acute changes affect patients with underlying cardiovascular conditions as well as young people. Such adverse outcomes are the consequences of dangerous consumption patterns among young people (Higgins et al., 2015).

Further, while it is true that energy drinks usually contain high amounts of sugar, it has also been established that excessive sugar intake is known to be a contributor to overnutrition (BA et al., 2004; Gibson, 1993; James et al., 2004). It has been estimated that the double disease burden and loss of economic output associated with chronic diseases stand at 80% (Abegunde et al., 2007). Notably, in recent years Sub-Saharan Africa has seen an upward trend in diet-related diseases including hypertension, obesity, stroke, and heart disease. In the face of the longstanding challenges Sub-Saharan Africa experiences, there is a rapid increase in the epidemic of non-communicable diseases (NCDs) (Nyirenda, 2016). Yet unsurprisingly, studies have shown that the food we eat plays a role in the occurrence of NCDs (Rivera et al., 2002).

Correspondingly, energy drink consumption is on the rise in Ghana (Saku et al., 2020). In like manner, a survey conducted in Ghana detected that 62% of student-athletes consumed at least one can of energy drink in a week. Indeed, unlike Ghana where the sale and use of energy drinks are not regulated, in certain developed countries such as France, Denmark, and Norway, energy drinks with high levels of caffeine and taurine have been banned, while in countries such as Sweden and Canada it is required that they are sold as medicinal products and with warning labels respectively (Buxton & Hagan, 2012b).

1.3 PROBLEM STATEMENT AND JUSTIFICATION

While energy drinks have been linked with various adverse health outcomes, they have also been linked with risky substance use behaviour and socially deviant behaviours such as; vandalism of public property, and reckless driving leading to accidents (Caviness et al., 2017; Chang et al., 2017). An anecdotal observation within the Tamale Metropolis points out that energy drink consumption is on the increase and has been implicated in some social vices including reckless and risky social behaviour such as drug and alcohol abuse, fighting, reckless driving and truancy. Meanwhile, there is scanty research done in the area nationally. Therefore, this study must be conducted to characterize energy drinks concerning how much is being consumed, perceptions, and risk factors associated with their consumption.

1.4 AIM OF STUDY

To assess perception, consumption patterns, and factors associated with energy drink (ED) consumption among the youth of the Tamale Metropolis.

1.4.1 Specific Objectives

- To assess the consumption patterns and prevalence of energy drinks consumption among the youth of the Tamale Metropolis.
- To assess the perception of energy drink consumption in the metropolis.
- To assess the risk factors of energy drink consumption among the youth of the Tamale metropolis.

1.5 SIGNIFICANCE OF THE STUDY

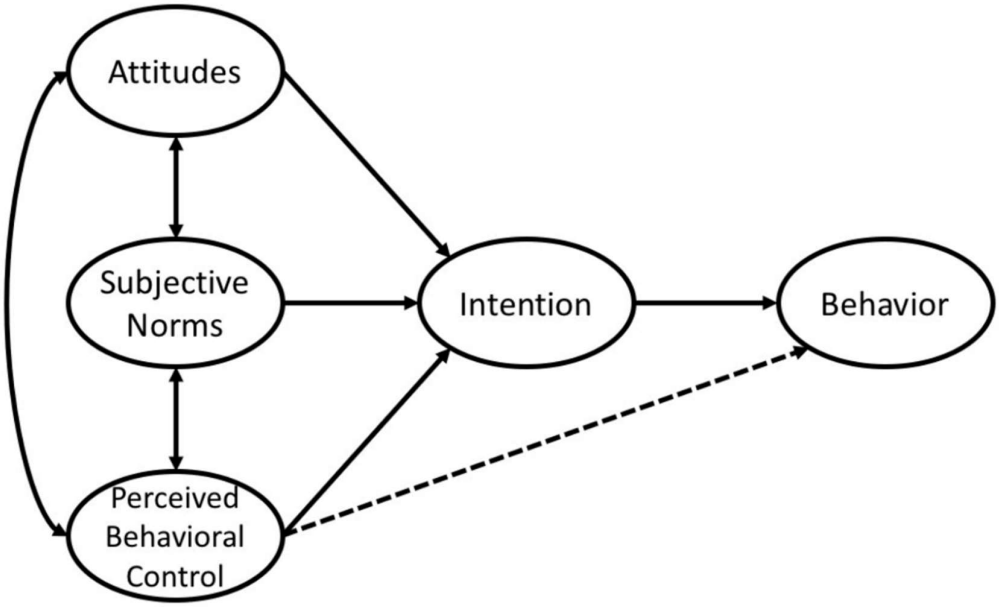
This study will contribute to raising awareness on how much energy drinks are being consumed as well as the perception of the youth about energy drinks. Understanding the general pattern of consumption and perceptions of youth relating to energy drinks will contribute to knowledge that will be useful in contributing to formulating policies to regulate its consumption.

1.6 CONCEPTUAL FRAMEWORK

Examining health promotion and behaviour change requires the use of a conceptual and/or theoretical approach because it helps to understand why people engage in health-risk or health-compromising behaviours (DiClemente et al., 2009). The Theory of Planned Behavior might be able to explain why a person chooses to engage in particular health behaviours. According to the Theory of Planned Behavior, "individuals' intention to engage in a particular behaviour depends on their attitude toward engaging in the behaviour, their beliefs regarding what others believe they should do, and their perception regarding the ease or difficulty of engaging in the behaviour" (Ajzen, 2012; Cottrell & McKenzie, 2010).

Energy drink producers spend huge amounts of money on advertisements. Such adverts are largely aired on sports, music, and youth entertainment channels. These marketing avenues target youthful demographics who are likely to consume large quantities of energy drinks with gendered and social activity approaches. The marketing approach impacts the intention to consume energy drinks via perception targeting (Stacey et al., 2017a; Visram et al., 2017a). Other themes of perception of energy drinks include themes of age, alcohol, brand, efficacy, energy seeking, gender, sugar, peer influence, product attributes, safety and, taste (Bunting et al., 2013). When users have desired or non-desirable outcomes from ED consumption, they are likely to stop or continue their use. Also, based on the outcome of the experiences of users, the perception of other users is shaped in favour or against the products. The outcome of these factors impacts the general consumption among the youth population. To understand the consumption of energy drinks among the youth, concerning their intention and associated influencing factors, the Theory of Planned Behavior has been used as an underlying foundation.

Figure 1 *Ajzen's Theory of Planned Behavior*



Chapter 2

LITERATURE REVIEW

2.1 OVERVIEW

The purpose of this study is to understand the population's usage patterns and perceptions of energy drinks. This chapter has been broken down into sections by reviewing literature that examines aspects of issues surrounding energy drinks including history; trends in the energy drink market; the general composition of energy drinks; factors influencing consumption; health impact of high consumption; consumption patterns; laws and policies that impact energy drinks sales and consumption; as well as advertisement and marketing.

2.2 HISTORY OF THE ENERGY DRINK INDUSTRY

Dr Enuf was the first to bring energy drinks to the US market in 1949. The product was branded and promoted as a healthier alternative to sugary drinks. This was partly because the beverages were vitamin-fortified. Energy drinks first appeared in Asia and Europe around 1960. Since the dominance of the energy drink dubbed Lipovate D in 1962, some firms have risen, citing the opportunity that the energy drink market offered. They did not, however, have a substantial influence until the Austrian entrepreneur launched the "Red Bull" product. This resulted in a rapid expansion of the energy drink sector, with over 300 flourishing energy drink types in the United States of America alone. (Bull, 2016; *The History of the Beverage Industry (Part 5): Which Brands Furthered the Evolution? – Bill Sipper*, n.d.).

2.3 TRENDS IN THE ENERGY DRINK MARKET

The consumption of energy drinks constitutes a global public health problem, typically among adolescents and young adults aged 18-34 years (Heckman et al., 2010a; N. K. Ibrahim & Iftikhar, 2014a). Whilst the products of energy drinks are often presented as beverages containing natural ingredients that increase energy, and attention, and improve sports performance as well as concentration time; the adverse effects linked to these products have remained a concern to healthcare workers (Mcgraw, 2013).

Energy drink consumption has become rapidly popular across age groups and has become the fastest-growing beverage product for instance in the United States where it is estimated that $744 million were spent by consumers within a year (June 2006 to June 2007) in the purchase of these products (Braganza & Larkin, 2007). Since the introduction of the first energy drink in Austria in 1987 and launched in the United States (US) in 1997, its level of consumption has increased dramatically although its prices are double the prices of traditional soft drinks (Reissig et al., 2009b). In the United States (US), about 200 new brands of energy drinks were launched between 2006 and 2007 alone (Clauson et al., 2008), and 1.5 billion cans of one of the popular drinks (Red Bull) were sold in 2011 (Reissig et al., 2009b). A similar rise in energy drink consumption has been observed in many countries worldwide. It has been documented that energy drinks are available to buy in more than 140 countries globally (Seifert et al., 2011a).

There are reports of deaths often linked to aggressive energy drink consumption in some developed countries. This, therefore, has motivated some governments to implement restrictive policies on their importation and sale. For example, countries like Denmark, France, Iceland, Norway, Turkey, and Uruguay have banned high-caffeinated and taurine drinks from their markets. Other countries such as Sweden only permit the sale of energy drinks in pharmaceutical shops as medicinal products. In Canada, it is required that warning labels caution against their use by children or pregnant women, consumption in large quantities, and with alcohol. However, the sale and use of energy drinks remain unregulated in many developing countries such as Ghana (Atsreh Buxton, 2014).

Before the onset of the local production of energy drinks, the Domestic Department of the Ministry of Trade and Finance stated in 2008 that the number of imported energy drinks was estimated at 14,825,505kg, amounting to $11,549,783.77. Countries where they were predominantly imported from, were Belgium, Germany, the Netherlands, Thailand, and the U.K. There was a projection that there will be an increase in the amount by the next year because those figures had increased from the 2007 levels of US $4, 403,520 and a net weight of 7,834,544 kg. It was predictable that Ghanaian society is buzzed with energy drinks due to the volumes of imported energy drinks. With all these intriguing figures, it is difficult to accept the fact of the limited research into energy drinks consumption and its determinants in Ghana.

2.4 COMPOSITION OF ENERGY DRINKS

The assumption that energy drinks contain bio-active ingredients aside from sugars, carbon dioxide, phosphates, and in some cases alcohol is far more elaborate. The baseline ingredients common to most energy drinks are calories, and caffeine in combination with other presumed energy-enhancing ingredients such as taurine, herbal extracts, and to some point, B vitamins (Yunusa & Ahmad, 2012).

In a study in the Western region to determine the composition of 23 energy drinks in the Ghanaian market, there was a positive response of the screened drinks to the reducing sugar test, where there were high doses of those sugars in each product, it usually ranged from 9 to 11 grams per 100 grams of the soft drinks, this was equivalent to about 44 calories per serving. A similar findings study in Nigeria implicated reducing sugars albeit sucrose was also dominant in most locally made and marketed soft drinks. They asserted in their study that, the presence of sugars in soft drinks could result from the hydrolysis of sucrose into either glucose or fructose due to exposure to changing environmental conditions such as heat or acidic conditions. This implied that, though these soft drinks might not contain reducing sugars as ingredients, their processing conditions and expositions during marketing could lead to the hydrolysis of sucrose to release reducing sugars. The positive response to the test for reducing sugars implies that there is a high amount of sugar in these soft drinks (Darkwah et al., 2020; Godwill et al., 2015). Aside from the sweet taste sugar provides, it is also recognized as the currency of energy in the body and the bloodstream, and has also been found to be a substantial component of human breast milk, hence its physiological importance is indispensable (Rubio et al., 2006). Nevertheless, simple sugars including glucose and fructose have been discovered to undergo rapid digestion which causes a fast increase in blood sugar levels. Failure in the compensatory mechanism that reduces the sugar level to normal may result in obesity and can also increase the risk for diabetes and other heart diseases (Malik et al., 2010). Consequently, because of the high energy composition in energy drinks, their consumption should be well-checked to reduce one's susceptibility to any of the associated undesirable side effects.

Also, it is common to note that most soft drinks have been determined to contain carbon dioxide (Teague et al., 2019). Carbonated soft drinks are often found to contain dissolved

carbon dioxide in their composition. The presence of carbon dioxide in energy drinks defines a long shelf life for them due to the disinfecting and preservative roles it plays in food products. For instance, the presence of carbon dioxide in foods helps in the reduction of oxygen content which therefore inhibits the growth of aerobic microbes thereby prolonging the life span of the food product, contextually, the energy drinks (Amit et al., 2017). Again, upon its reaction with water, carbon dioxide forms carbonic acid which decreases the pH and also imparts acidic flavour into soft drinks. The reduction in pH provides an unfavourable environment for the proliferation of non-acidophilic microbes (Bajpai et al., 2018). Though carbon dioxide (CO_2) may be harmless to human health in small quantities, high exposure to it may be very detrimental. It has been reported that acidosis (the pH of the blood becoming less than 7.35) occurs when there is an excessive composition of CO_2 in the human body. A redeemable process occurs to neutralize this condition. However, when the exposure becomes significant, the compensatory mechanisms become overpowered and this yields a malfunction in the central nervous system (Chu & Xiong, 2012). This implied that the consumption and production of energy drinks should be regulated to ensure that products adhere to enhancing the health of consumers.

In many studies, soft drinks are considered to be non-alcoholic, however, they may contain alcohol of less than 0.5% by volume (Seward & Nethercote, 2005). Also, it has been generally accepted that the description of energy drinks excludes tea, coffee, dairy-based beverages, and "alcohol". In meeting international standards, energy drinks in the Ghanaian market are mostly nonalcoholic as was observed (Nti et al., 2014). The presence of alcohol in some energy drinks is a result of the use of alcohol as a solvent for several flavourings. The absence of alcohol in the locally made and marketed Ghanaian energy drinks as observed by Darkwa et al. (2020) implied that it can be consumed by a relatively substantial part of the country's population, with the younger population in the linear spectrum. Alcohol has been marked to be very harmful to human health, especially in young adults (Aarons et al., 1999). It has been reported that young people are less susceptible to the exhibition of severe chronic disorders associated with alcohol dependence such as liver cirrhosis, hepatitis, gastritis, and pancreatitis (Newbury-Birch et al., 2009). However, excessive alcohol consumption by young people may increase their susceptibility to such disorders and may be very damaging to their developing brain,

perhaps leading to a disorder in their cognitive functions in their later life (Crews et al., 2000).

Phosphate appears not to be a key component in energy drinks. For instance, cola drinks in Ghana have high levels of phosphate upon testing while other non-cola energy drinks were tested to have no phosphates (Darkwah et al., 2020). This trend shows that most of the drinks with cola contain phosphate as a central ingredient. Their results corroborate a report by (Moser et al., 2015) which states that, although there seems to be a lot of concern about phosphorus in the diet from energy drinks yet some of the drinks are not a significant source of phosphorus. Cola-based energy drinks, however, contain about 37 mg of phosphorus which shows that cola drinks contain a significant amount of phosphates, unlike other soft drinks. The presence of phosphate in the cola-containing soft drinks indicates that phosphoric acid, which plays essential roles in prolonging the shelf life; enhancing flavour; retaining moisture, and improving the colour of food items, was an integral additive in the production of locally made and marketed energy drinks (Wickham, 2014). Though phosphorus is significant in most reactions in biological systems, especially, in the formation of the cell membrane and nucleic acid; generation of ATP (Adenosine Triphosphate); bone mineralization; urinary buffering; etc., excessive exposure to it may cause hypocalcemia (electrolyte imbalance indicated by a low level of calcium in the blood) and other bone impairment-related diseases (Tani et al., 2007). Consumption of soft drinks with a positive response to phosphate should therefore be limited amongst individuals to reduce the risk for such detriments.

Since energy drinks fall into the category of functional beverages, which also encompasses sports and nutraceutical drinks, they are designed to be consumed before or during exercise to prevent dehydration, supply carbohydrates, provide electrolytes, and sometimes contain caffeine (Van Biervliet, 2019).

2.5 FACTORS THAT INFLUENCE ENERGY DRINK CONSUMPTION

The consumption of energy drinks is associated with living away from home. In a study by Chang et al (2017), conducted among undergraduate students, it was established that living away from home had a link with energy drink use. This may have been the result of reduced parental supervision and related lifestyle changes and risky behaviours like

substance abuse. Parents have been found to disapprove of the use of energy drinks because they possess knowledge of the possible adverse effects of energy drinks and also have some influence on access to EDs (Chang et al., 2017; Visram et al., 2017c). Young consumers are influenced by a sense of belongingness as energy drinks have been found to aid the promotion of social relationships (Chang et al., 2017; Visram et al., 2017c). This finding could have a bearing on the use of substances, peer influence as well as related consumption patterns and amounts. The most notable reason for energy drink consumption by Chang et al (2017) was sustained alertness at work. However, another reason for energy drink consumption is advertisements. It is common knowledge that humans have, always sought a 'boost' in the face of daunting tasks. The advent of energy drinks and their style of marketing targets those needs (Higgins, 2014b). These beverages are marketed as enhancements for energy, alertness, athletic performance, and endurance (Higgins et al., 2015). The relatively low price and widespread availability of energy drinks are key factors influencing adolescents' and young adults' purchasing decisions (Visram et al., 2017c).

Other critical driving factors for the popularity and use of energy drinks are taste, brand loyalty, and supposed beneficial effects. For policies and interventions to adequately address this issue, the complication of young people and children's consumption choices must be understood. (Visram et al., 2016).

2.6 HEALTH IMPACT OF ENERGY DRINK CONSUMPTION

New findings point to the fact that the in-utero phase is the most critical time concerning the impact of dietary or environmental factors. The outcome of such adverse exposure begets exacerbated chronic health outcomes in both childhood and adulthood through adverse fetal programming (Luo et al., 2010; Newbold et al., 2008; Sullivan & Grove, 2010). There are various chemicals found to impact fetal programming and one such chemical is caffeine (Chen et al., 2014).

Although the root cause of obesity is still not known, it has been thought to be influenced by a complex interaction of environmental and genetic factors (Newbold et al., 2008).

It has been theorized that the aetiology of the state of adult health and disease may be the result of disrupted fetal development. Furthermore, it has been proposed that an outcome

such as low birth weight mirrors the state of the prior fetal environment. Hence the precedent for increased risk of non-communicable diseases including type 2 diabetes, hypertension, and coronary heart disease, is adverse fetal development (Barker et al., 2002).

2.6.1 How Caffeine Consumption Impacts Birth Outcomes

Caffeine, one of the most widely used substances in the world today, which is also an ingredient of energy drinks that is usually present in high amounts is a pharmacologically active agent (Matijasevich et al., 2005). Upon ingestion, caffeine is rapidly into the bloodstream through the gastrointestinal tract. The caffeine in the bloodstream easily permeates the placenta and gets distributed into the fetal tissues including the central nervous system. This is especially hazardous because the fetus does not have the enzymes to metabolize caffeine (Aldridge et al., 1979, 1981). The half-life of caffeine during pregnancy is doubled, a state that leads to an increased period of exposure for the fetus. In addition, caffeine may influence fetal development through vasoconstriction in the uteroplacental circulation placental blood flow (Frary et al., 2005; Kirkinen et al., 1983; Li et al., 2015). Further, the reach of the impact of caffeine consumption during pregnancy has been positively associated with a high risk of miscarriage but unrelated to pregnancy-related symptoms and fetal death (Matijasevich et al., 2006; Weng et al., 2008). In an experimental study by Yoshino et al (1994) using pregnant rats, they supported the claims that caffeine metabolites easily enter into the embryo, metabolism of caffeine is poor during pregnancy which leads to accumulation in fetal tissue and added that it may also have lasting adverse effects in the nervous system – particularly suckling reflexes and general motor activity (Yoshino et al., 1994). Studies in animals have shown how critical brain functioning is to the maintenance of homeostases such as metabolic processes and appetite regulation (Kennedy & Dimitropoulos, 2014; Pannacciulli et al., 2006) – potentially resulting in poor eating habits and altered metabolic processes that could impact the development of the fetus as it has been established that there is an association between maternal caffeine consumption and a low birth weight pregnancy outcome (Chen et al., 2014). In addition to the mal-development of the hippocampus, the interaction with genetic polymorphism, and fetal hypothalamic-pituitary-adrenal axis-associated neuroendocrine alteration are potential mechanisms that have been associated with in-utero caffeine exposure. Of course, this interaction is possible because caffeine is

a potent neural stimulant (Bech et al., 2006; Signorello et al., 2001; Xu, Wu, et al., 2012; Xu, Zhang, et al., 2012). Furthermore, caffeine affects increased insulin resistance and consequently creates an abnormal metabolism of glucose. In-utero exposure to caffeine has also been found to increase the risk of abnormal fetal growth. Meanwhile, it is well documented that there is a link between abnormal fetal growth and obesity (Xu, Zhang, et al., 2012). Therefore, many human and animal studies point toward evidence that supports the association between in-utero exposure to caffeine and the risk of childhood obesity (Li et al., 2015). It can be inferred herein, that, while abstinence from smoking and alcohol are strong recommendations for a healthy pregnancy outcome and subsequent aversion to chronic diseases in adult life, reduced or controlled caffeine consumption can be a feasible means of improving fetal growth and positively impacting pregnancy outcomes (Chen et al., 2014).

2.6.2 Cardiovascular Problems and Their Link to Energy Drinks

Energy drink consumption has been linked with a broad spectrum of acute and chronic cardiovascular complications. They include "elevated blood pressure, increased heart rate, increased corrected QT (QTc) interval, supraventricular arrhythmia, ventricular arrhythmias, coronary artery spasm, coronary artery thrombosis, Takotsubo cardiomyopathy, ST-segment elevation myocardial infarction (STEMI), aortic dissection, postural orthostatic tachycardia syndrome, sudden cardiac death, endothelial dysfunction" categorized as acute and "hypertensive heart disease, coronary artery disease, atherosclerosis, cerebrovascular disease, peripheral arterial disease" categorized as chronic (Higgins et al., 2015).

2.6.2.1 Elevated Blood Pressure

Although some reports reason that certain components of energy drinks such as taurine and L-carnitine may have a positive effect on an outcome such as hypertension, it is argued on the other hand that other components of the energy drinks like ginseng, guarana, and caffeine have posed a high risk of developing acute hypertension (Wassef et al., 2017). The second argument is in agreement however with the understanding of caffeine consumption and its related hemodynamic effects (Higgins et al., 2010; Higgins & Babu, 2013b). It has been observed that the nervous system can be stimulated to increase heart rate and blood pressure. This is possible as a result of increased plasma

rennin, dopamine, and catecholamines as an effect of acute consumption of caffeine (Heckman et al., 2010b; Robertson et al., 1978a). Especially for athletes that consume energy drinks, likely before physical activity, the hemodynamic effects are amplified. These effects usually are capable of lasting up to 5hours (Baum & Weiss, 2001; Papaioannou et al., 2006).

In a study that randomized the exposure of subjects to either energy drinks or control, it was found that within 24 hours, the means of systolic, diastolic blood pressure, and mean arterial pressure readings were higher among subjects that ingested energy drinks compared to the control (Franks et al., 2012).

In another study, it was found that systolic blood pressure increased by 7.9% and 9.6% while diastolic blood pressure increased by 7% and 7.8%. This result was observed within 2-4hours of the first and seventh days. Subjects were healthy people between the ages of 15-40years of age and they were exposed to 500ml of energy drinks every day for seven days (Steinke et al., 2009).

In addition, the combination of caffeine and taurine has been shown to have a causal relationship with hypertension. This was demonstrated by Doerner et al. (2015) in a study showing that consumption of caffeine and taurine-containing energy drinks consumed by healthy volunteers with a mean age of 28 led to a marked increase in peak systolic rate an hour after consuming the energy drink (Doerner et al., 2015).

Although the above findings agree with the influence of energy drinks on the acute blood pressure of consumers, they may not have a significant health effect on normal healthy individuals. However, the case is different with people who have a history of hypertension. There are also case reports of children who developed the condition as a result of constant energy drink use (Higgins et al., 2010; Usman & Jawaid, 2012).

Caffeine may cause persistent BP effects in persons who are regular consumers, even when daily consumption is at moderately high levels (Fletcher et al., 2017).

2.6.2.2 Increased Heart Rate

To establish an association between increased heart rate and energy drink consumption, Grasser et al, (2014) showed a comparatively higher heart rate among Red Bull energy drink users compared to water drinkers. Recorded values were as high as 90min (3.7 ± 0.7 beats per minute) (Grasser et al., 2014). Another study agreed with the finding when

they reported an average increase in heart rate from 78 to 85 beats per minute (Elitok et al., 2015).

2.6.2.3 Increased Corrected QT (QTc) Interval

Caffeine and taurine are ingredients of energy drinks that usually make up a large proportion of the component "chemicals". These components have been known to affect multiple cardiac ion channels and in some cases, they may be arrhythmogenic. The occurrence of QTc intervals associated with these components of energy drinks has been reported as the association between energy drink consumption and the occurrence of QTc intervals in healthy young subjects (Satoh, 2003).

Steink and his colleagues, (2009) also found that QTc intervals increased by 2.4% and 5.0%(Steinke et al., 2009). Reinforcing Steink's findings, there is a case report that involved a 22year old female adult. She consumed six cans of a caffeinated energy drink within 4hours. This resulted in a cardiac arrest at a discotheque. Moment to not is the fact that tests confirmed she had not consumed either alcohol or drugs. From the site of the attack to the intensive care unit her QTc was recorded as 526ms and 492ms but it subsequently declined to a normal value of 419ms. Due to the patient's preexisting long QT syndrome status, excessive energy drink consumption prolonged her QT interval which possibly evolved into a cardiac arrest. Before this recorded case a 28-year-old male was recorded to suffer a cardiac arrest after consuming eight cans of energy drinks with caffeine. The event can be attributed to caffeine-induced vasospasm (Rottlaender et al., 2012).

Another case study involving a 13-year-old girl was reported when she was referred to a clinic with type 1 LQTS. She had a prolonged QTc but also admitted to taking at least a can of an energy drink containing 160 mg of caffeine. She reported symptoms such as palpitations, dizziness, shakiness, and chest pain. Her QTc upon reading was 651 and she had a heart rate of 108 beats per minute. Based on the long QT levels in this case study it can be inferred that cardiac arrests have an association with energy drink consumption (Dufendach et al., 2012; Rottlaender et al., 2012).

2.6.2.4 Supraventricular Arrhythmia

The mix of ingredients found in energy drinks is suspected to trigger arrhythmias but caffeine consumption, in particular, has been linked with amplified supraventricular

arrhythmia (Artin et al., 2010; Sanchis-Gomar et al., 2015). However, in a study among young adults, it was not unknown whether individuals observed to have atrial fibrillation after consuming energy drinks were genetically predisposed to arrhythmia or whether the events were caused by the energy drinks consumed (Turagam et al., 2015). On the back of the knowledge that atrial fibrillation is one of the rarest conditions among pediatric patients, a healthy 13-year-old boy without prior history of sickness and drug use endured an episode of atrial fibrillation accompanied by an astounding heart rate of 130 beats per minute during a physical activity session 5 days before which he had ingested energy drinks. The boy's caffeine half-life may have been long due to his chronic use of caffeinated energy drinks. In another study, the case of a 16-year-old boy was examined. He had consumed an unknown quantity of energy drinks mixed with alcohol which induced an arrhythmia; the authors suspect that the blend of energy drinks and alcohol is the likely cause of his arrhythmia (Di Rocco et al., 2011; Izquierdo Fos et al., 2012). The results are similar within an older age group. Not long after consuming a carbonated soda and energy drink, a 23-year-old woman was admitted for palpitation and chest tightness despite not having any medical history(Nagajothi et al., 2008). In another case report, a 58-year-old male who started ingesting energy drinks for 6 months to extend his working hours was admitted for atrial fibrillation. This new habit probably influenced the global dilation of his heart and reduced ejection fraction by 45% although his arteries were normal. He was subsequently clinically better after six months of discontinuing energy drink ingestion (Peake et al., 2007). When the case reports summarized above are considered it can be concluded that even for normal individuals it is possible to develop supraventricular arrhythmias following energy drink consumption; pointing towards an association between supraventricular arrhythmias and energy drink use.

2.6.2.5 Ventricular Arrhythmia

Ventricular tachycardia and ventricular fibrillation are two types of ventricular arrhythmias that can particularly result in cardiac arrests or instant cardiac death. It is also interesting to note that this condition has an association with energy drink consumption. When caffeine is consumed it elevates the levels of catecholamines in the body as well as hypokalemia while having a suppressing effect on the sodium channel. These conditions set the stage, predisposing patients to ventricular arrhythmias (Goldfarb et al., 2014; Robertson et al., 1978b). Ion channelopathies and hypertrophic cardiomyopathy are genetically common cardiomyopathies that are sensitive to high doses of caffeine.

These cardiac conditions can be exacerbated by such contraindicating stimulants (Seifert et al., 2011b). Also, due to the proarrhythmic properties of taurine, caffeine, and guarana, their consumption has likely fatal consequences for patients with intrinsic structural heart conditions (Ward et al., 2014).

A 28-year-old man died after he ingested three cans of energy drinks as part of preparations for a basketball game. Due to secondary ventricular tachycardia, he lost consciousness thirty minutes after the game began (Avcı et al., 2013).

In addition, another isolated case report describes another death resulting from the use of a guarana drink, "a 25-year-old woman had been working at a bar when she was seen to collapse. Police at the scene started cardiopulmonary resuscitation shortly afterwards. After a few minutes, an ambulance came and she was defibrillated according to the procedure, with a total of 12 tries. She came with ventricular fibrillation and was resuscitated for another 20 minutes using advanced cardiac life support protocols. She never reached a spontaneous cardiac output. Further history (which became available later) indicated that the patient had been diagnosed with mitral valve prolapse. She had palpitations. Her cardiologist raised the issue of caffeine consumption, and she agreed to limit this to a cup of tea daily. On testing, there had been no previous indication of QT prolongation. She had been handed a 55 mL squirt bottle of "Race 2005 Energy Blast with Guarana and Ginseng" on the day of her death, which she had virtually finished. She had not consumed other caffeine-containing substances. The patient's mitral valve leaflets were found to have sclerosis and myxoid change at autopsy. All commonly prescribed and non-prescribed drugs (including opiates, cannabis, amphetamines, and cocaine metabolites) were tested toxicologically. Caffeine was detected by GC-MS; the toxicology screen was negative for other substances. High-pressure liquid chromatography revealed a caffeine concentration of 19 mg/L (non-preserved) in aortic blood. At the Chemistry Centre of Western Australia, the caffeine content in a bottle of Race 2005 Energy Blast was measured at 10 g/L, which is more than 60 times the caffeine concentration in cola drinks. A similar bottle was later shown to have a caffeine concentration of 19 g/L" (Cannon et al., 2001).

In another case, a healthy 28-year-old motocross racer developed a cardiac arrest after racing. Before the race, he had consumed many cans (7-8) of caffeinated energy drinks. The authors suspect that, combined with arduous physical activity, the consumption of

caffeine and taurine can induce coronary vasospasm that can lead to myocardial ischemia (Berger & Alford, 2009a).

Citing another case study, the following account was recorded:

> A 24-year-old Caucasian man presented to the Emergency Department with a one-hour history of crushing chest pain, nausea, and vomiting. He was brought from a nightclub, where he works as a doorman. He reported consuming about 20 cans of energy drink (XL) over the previous night but denied taking any drugs or drinking any alcohol. His medical history included being overweight (BMI of about 40) and having mild hypertension for which he denied taking medications. There was no family history of ischemic heart disease. On arrival, he was anxious, sweating, and had tachycardia (110 beats/minute), with a blood pressure of 90/60 mmHg. Heart sounds were normal on auscultation, and respiratory examination revealed slight basal rales, with no jugular vein distension. An electrocardiogram (ECG) showed widespread ST-segment elevation confirming acute myocardial infarction. He was given aspirin, oxygen, and morphine, and was preceded to primary percutaneous intervention (PCI). While waiting for the Cath-Lab team, the patient developed a wide complex tachycardia, which was resistant to the administration of DC shocks and a bolus of amiodarone. His level of consciousness deteriorated, and he was then intubated. His cardiac rhythm further deteriorated to ventricular fibrillation. Resuscitation according to ACLS protocols was carried out, while a cardiologist inserted a pacemaker. The time for pacemaker placement was 15 minutes. Despite all the resuscitative efforts, the medical team in place had to announce the patient's death after more than half an hour of resuscitation, and after a bedside, echocardiogram failed to demonstrate any spontaneous cardiac activity (Hanan Israelit et al., 2012).

Literature published by Rutledge et al., (2012) also reported the following case:

> We present a case of a 24-year-old male with no previous medical history who was celebrating a play opening at a local bar. The patient was consuming a Red Bull energy drink containing 80 mg of caffeine and 1000 mg of taurine, which was combined with Vodka. While drinking this beverage, the patient collapsed after only a few sips. As he became unresponsive, a bystander in the bar began to

perform cardiopulmonary resuscitation (CPR). Emergency Medical Services (EMS) arrived and found the patient to be in ventricular fibrillation. He was subsequently intubated and given amiodarone, naloxone, and epinephrine. The patient was defibrillated 6 times, and he subsequently converted to sinus rhythm with prolonged QRS duration. Vital signs stabilized. The patient's family stated that he had a recent bout of diarrhoea, but no other recent illnesses. It was reported that throughout the last year the patient has had occasional symptomatic palpitations, but no previous syncopal episodes. He was physically active, on no medications, and had no known history of illicit drug or tobacco use. There was no family history of sudden cardiac arrest. Of note, the patient has never consumed an energy drink with alcohol in the past. The physical exam was unremarkable with the absence of any abnormal cardiac findings. Vital signs were: blood pressure 128/ 78 mm Hg, a pulse of 78 bpm, respiratory rate 22/min, and temperature of 36.7 °C. Pertinent laboratory work-up revealed: K 2.7 mmol/L (N: 3.5–5.1 mmol/L), HCO3 17 mmol/L (N: 22–32 mmol/L), Mg 1.7 mg/ dL (N: 1.8–2.4 mg/dL), PO4: 2 mg/dL (N: 2.5–4.9 mg/dL). The blood-alcohol level was: 0.017% (b0.08%) and the urine drug screen was negative. An electrocardiogram showed the presence of R′ with ST-segment elevation in V1 and V2 (Fig. 1). Chest X-ray revealed bilateral pulmonary oedema, but no cardiomegaly. After staying in the Intensive Care Unit for 2 days, he was extubated, and an Automatic Intracardiac defibrillator (AICD) was placed. He was subsequently discharged in stable condition (Rutledge et al., 2012).

The cases outlined above prove that the consumption of many energy drinks in a short period is associated with ventricular arrhythmias both in normal individuals as well as those with preexisting Brugada syndrome.

2.6.2.6 Coronary Artery Spasm

The vascular smooth cells have sarcoplasmic reticulum which could endure a rapid efflux of calcium. This is the result of the release of catecholamine which has been linked with high caffeine-containing products like energy drinks (Holmgren et al., 2004; Scott et al., 2011b). Taurine is known to have a controlling influence on calcium signalling which can upset calcium concentration on either side of the cell wall if it reaches toxic levels (Heckman et al., 2010b). There is a case of a 19-year-old gentleman who presented

himself to the emergency unit of a health facility. He did not feel well with symptoms including clamminess, feeling cold, and shortness of breath. He was not a smoker or someone who drinks alcohol. And he did not have any prior conditions that had associations with coronary heart disease. Although, he had commenced weight lifting and consumed 2-3 cans of energy drinks daily. After he received treatment and was observed for an additional 5 days he did not have any recurring episodes of chest pain while taking his medication and abstaining from energy drinks (Scott et al., 2011c). In another case involving a 28-year-old male who suffered a cardiac arrest outside the hospital, it was found through tests that he was not exposed to illicit drugs. According to some authors, the likelihood of a cardiac arrest occurring among people under the age of 40 is low. This is evident in the fact that the man had no history of or associated with any risk factors except for the fact that he had drunk 7 to 8 cans of energy drinks within the 7 hours leading up to the episode. High amounts of caffeine and taurine were found in his system.

2.6.2.7 Coronary Artery Thrombosis

Coronary artery thrombosis has also been linked with energy drink consumption. Consumption of a mixture of alcohol and energy drinks probably plays an exacerbating role. There was a case report of a healthy 24-year-old African American man with no family history of coronary artery disease reported to a hospital emergency room with a 10-hour history of symptoms including palpitations, nausea, and acute retrosternal chest discomfort. While denying the use of illicit drugs, he admitted to drinking alcohol (VODKA) mixed with three cans of energy drinks at a party. The symptoms manifested after 1 to 2 hours of taking in the concoction. It was also noted that two other people around the same age showed similar symptoms after consuming the same alcohol-energy drinks mixture. In a follow-up angiogram test, it was discovered that a large thrombus occupied about 70% of the diameter of the left coronary artery and most of its length. Also, another thrombus obstructed the left anterior descending coronary artery (Benjo et al., 2012).

These situations point to the implicative status of energy drinks with or without alcohol in the occurrence of coronary artery thrombosis.

2.6.2.8 ST-Segment Elevation Myocardial Infarction (STEMI)

Some cited works associate STEMI with energy drink consumption. In a case report highlighting the dangers of the excessive use of energy drinks, the instance of the

admission of a 26-year-old male was presented to an emergency unit. The symptoms he presented were nausea, numbness in the left arm, vomiting, and diaphoresis. He had ingested 4 litres of energy drinks including brands like 'monster' and 'rock star' about 9hours before his admission. This was consistent with his daily consumption of eight to ten 473ML drinks per day. Aside from the use of energy drinks that stood out, he had no prior history nor did he have any current issues with heart rate, lungs, etc. however, ST-elevation in the interior leads, as well as reciprocal effects in the anterior leads, were shown in his EKG. A similar situation occurred with a 28-year-old who consumed 7-8 cans of energy drinks with similar quantities of caffeine and taurine. Besides, the number of cans of 8 per day suggested by these cases to be excessive, the point of association with ST-Segment Elevation Myocardial Infarction may be false. In another case of an even younger person of 19years of age, whose EKG showed an ST-Elevation; he consumed 2-3 cans of Red Bull daily for a week before admission with symptoms (Berger & Alford, 2009b; Higgins et al., 2015; Scott et al., 2011a; Solomin et al., 2015).

2.6.2.9 Takotsubo Cardiomyopathy

A 24-year-old male, shortly after consuming a series of small amounts of an energy drink presented acute respiratory failure, palpitations, and chest pains. He had frequent runs of supraventricular and ventricular tachycardia and underlying sinus tachycardia. Also, an echocardiogram showed a slightly decreased left ventricular ejection fraction of 35%. It was also revealed that the patient had "moderate to severe hypokinesis of the basal segments of the left ventricle with apical sparing and globally increased myocardial wall thickness" which resulted in the presence of oedema. The case described is consistent with stress-induced stress cardiomyopathy (SCM). It is a rarity to find healthy consumers of energy drinks having Takotsubo Cardiomyopathy (Kaoukis et al., 2012). However, energy drinks have sympathomimetic properties. In addition, the adenosine receptors A1 and A2 found in the central nervous system and myocardium are antagonized by caffeine, one of the main components of energy drinks. This leads to the modification of neurotransmitter release and a rise in heart rate as well (Higgins & Babu, 2013b). Intracellular calcium in myocytes is a function of catecholamine release which is known to be induced by caffeine (Doerner et al., 2015; Higgins & Babu, 2013b). Yet it is worth considering that, the rapid consumption of excessive amounts of energy drinks is likely to influence a catecholamine surge (Reissig et al., 2009a). Although Takosutsubo

Cardiomathy is not common among healthy energy drink consumers, the event is plausible(Higgins et al., 2015).

2.6.2.10 Aortic Dissection (DeBakey type I and II)

A 26-year-old male was admitted to the hospital with chest pain starting 5 hours before the admission. He had a history of the bicuspid aortic valve and dilated ascending aorta of 5cm. the patient reported that the pain in his chest started after he consumed 5-6 cans of energy drinks at a party. Aside from hypertension with a systolic blood pressure of 145mmHg his toxicology report had no abnormalities. Nonetheless, acute aortic dissection (DeBakey type II) was confirmed by his CT chest scan and echocardiography. He was operated on successfully and discharged subsequently. Additional reading revealed two more cases: First, 3 hours before admission, a 48-year-old male developed chest pain. Although there was nothing to find in his personal history, his family history however had links with myocardial infarction and arterial hypertension. He reported that he had consumed energy drinks before developing chest pain while driving. He admitted that he ingested the energy drinks to prevent him from sleeping at the wheel. Like in the case of the 26year old male above, his toxicology report was negative. But in his case, his arterial hypertension was high at 145/95 mmHg. Also, based on his echocardiogram's confirmation of aortic dissection (DeBakey type I), he was prepped for a successful surgery. Second, in another case involving a 56year old Caucasian male, the patient was hospitalized for symptoms as a result of the presence of shortness of breath, chest pain, and fatigue. The man admitted that as a truck driver, he consumed 4-5 indifferently each night while he drove. Although the patient's toxicology report was negative, he had a history of obesity and arterial hypertension. Additional laboratory investigations revealed that he had a multi-organ failure and an increased systemic inflammatory reaction, tachycardia, and arterial hypertension of 110 bpm and 190/110 mmHg respectively. Finally, a CT chest scan and transthoracic echocardiography revealed a sub-acute aortic dissection (DeBakey type I). This merited urgent corrective surgery which was performed successfully (Jonjev & Bala, 2013). Findings point to the fact that consuming 5 cans of energy drinks per night i.e. 400mg and 5000mg of caffeine and taurine respectively can trigger potentially fatal cardiovascular incidents among high-risk people in the population (Jonjev & Bala, 2013).

2.6.2.11 Postural Orthostatic Tachycardia Syndrome (POTS)

Cardiovascular functions are directly or indirectly impacted by caffeine and taurine, regular ingredients of energy drinks (Terlizzi et al., 2008). There is a likelihood of cardiovascular regulation interference associated with high concentrations of taurine (a nonessential amino acid) in the brain (Alford et al., 2001; Baum & Weiss, 2001; Bichler et al., 2006; Huxtable, 1992; Yang & Lin, 1983).

Healthy athletes potentially will not manifest with chronic energy drink consumption (4-5 cans per day) (Higgins et al., 2015). In the case of a 16-year-old professional athlete who reported that she developed a case of orthostatic intolerance and lost consciousness from time to time. She added that a week before these symptoms she commenced the ingestion of 4-5 cans of energy drinks each day. Neurological and cardiovascular tests pointed to a case of postural orthostatic tachycardia syndrome (POTS). Also, her table tilt test was positive. After discontinuing energy drinks for a week her clinical symptoms disappeared. And tests showed normal reports a month later (Terlizzi et al., 2008).

2.6.2.12 Sudden Cardiac Death

With the increased popularity and consumption of energy drinks, the number of case reports associating cardiac death with energy drink consumption along with physical activity is steadily increasing (Goldfarb et al., 2014; Higgins et al., 2010). The role of energy drinks is implicit in sudden death since caffeine reduces the myocardial blood flow during exercise – a period where the demand for increased blood flow is high in support of the high demand for myocardial oxygen; thereby creating an imbalance in the supply-demand equilibrium of oxygen during exercise. Also, myocardial ischemia and ventricular arrhythmias are clinically significant effects that are induced by the combination of exercise and caffeine (Berger & Alford, 2009b; Higgins, 2014b; Higgins et al., 2010, 2017a; Higgins & Babu, 2013b; Worthley et al., 2010a). Most cases of sudden cardiac death are affected by confounding factors including arduous exercises, co-ingestion, and genetic susceptibility. This makes the exact causality impossible to be ascribed to only energy drink ingestion. Hence sudden cardiac death is plausible among consumers of energy drinks who are either normal healthy individuals or people with a history of cardiac disease (Ernest et al., 2010; Higgins et al., 2010, 2013, 2015; Wolk et al., 2012).

2.6.2.13 Endothelial Dysfunction

Endothelial cells are part of the inner lining of lymphatic and blood vessels which also play metabolic and basal functions in such a way that they have a role to play in multiple biological processes (Deanfield et al., 2007). Endothelial cells are required in blood clotting, tissue growth and repair, vascular resistance regulation, and provision of barrier function (Blanch et al., 2015; Deanfield et al., 2007). Positive lifestyle habits such as exercise and consumption of healthy diets reduce the exposure to factors harmful to endothelial function while promoting the function of the endothelial cells. Meanwhile, endothelial dysfunction is a term that describes anomalous endothelial cell function normally associated with pro-inflammation, pro-adhesion, poor vascular reactivity, and vasoconstriction among other symptoms. It has also been found to have an association with some other conditions including peripheral arterial disease, cerebrovascular disease, and coronary artery disease (Ashor et al., 2015; Blanch et al., 2015; Veerasamy et al., 2015).

The immediate effect of endothelial dysfunction manifests when coronary blood flow and oxygen delivery are decreased due to an inability to dilate the coronary arteries. When people with endothelial dysfunction get exposed to stress including certain poor lifestyles like smoking, consumption of alcohol, and drug abuse, they could suffer a coronary spasm. The coronary spasms can later degenerate into myocardial ischemia and/or cardiac arrhythmias. On the other hand, caffeine and other substances that act like it impact endothelial function when consumed in large quantities. It is especially prevalent among those who exercise and consume caffeine (Higgins, 2014c; Higgins & Babu, 2013a; Jones et al., 1995; Looi et al., 2012; Suwaidi et al., 2000).

The following case studies demonstrate the influence of caffeine on endothelial function. A published work by Higgins et al., (2017) revealed that:

> In a study involving 9 males and 2 females, they were grouped in such that one group drank 24oz cans of an energy drink after they had fasted and abstained from smoking for 8 hours. Before and after the consumption of the energy drink beverage, the subjects were made to undergo various tests including an electrocardiogram, blood pressure, and pulse check, and underwent baseline testing (BL) of endothelial function using the technique of endothelium-dependent flow-mediated dilatation (FMD) with high-resolution ultrasound. The

outcome showed that, although the heart rates for both groups were not significantly different; endothelium-dependent flow-mediated dilatation was reduced (Higgins et al., 2017b).

Another previous work tested platelet aggregation and endothelial function and how energy drinks alter platelet aggregation and endothelial function. The study involved 50 healthy volunteers consisting of 34 males with a mean age of 22. The results compared to the baseline before consuming energy drinks showed that there was a significant rise in platelet aggregation; reactive hyperemia index decreased; and while heart rate remained unaffected, mean arterial pressure increased (Worthley et al., 2010b).

Acute exposure to energy drinks appears to present an impact on endothelial function in healthy young adults. Hence, the consumption of energy drinks with exercise could lead to complications in young adults (Higgins et al., 2015).

2.7 POTENTIAL EFFECTS OF SUGAR IN ENERGY DRINKS

Despite the role of other factors such as genetics, exercise, diet, and the environment, there is currently evidence that establishes that the consumption of sugar beverages containing sugar plays a role in metabolic syndrome. But sugar was initially discarded as a contributor to obesity and diabetes in the 1930s. Also, throughout history, there has been a parallel between the increase in the use of sugar and its corresponding progressively lower prices and obesity (Johnson et al., 2017). Sugar has hedonic and homeostatic effects that make it a potent natural reward that can be likened to addiction (Greenberg & St. Peter, 2021; Olszewski et al., 2019). Sugar added to EDs can lead to a potential increase in weight (Mattioli et al., 2018). This is possible because liquid EDs are liquids that do not provide satiety, and this can lead to increased consumption of solid foods. Sugars from beverages like EDs also contribute to diabetes and cardiometabolic diseases by affecting the beta cells in such a way that it is unable to maintain blood glucose levels by secreting enough insulin especially, in times the body is exposed to excessive sugar over a prolonged period (N. K. Ibrahim & Iftikhar, 2014b). In addition, because of the low pH of EDs, they have the potential to demineralize which leads to dental corrosion (N. K. Ibrahim & Iftikhar, 2014b).

2.8 PERCEPTIONS SURROUNDING ENERGY DRINK CONSUMPTION

Although there are reported possible negative effects of energy drinks, many consumers are unaware and a great proportion of them are uneducated. In a study conducted in Taiwan among undergraduate students, it was found that a great proportion of the respondents has a negative perception of tobacco, alcohol, and betel nut. However, among the same group of respondents fewer of them, that is, less than half (45.9%) were found to have a negative perception of energy drinks. It was also reported that respondents who were users of energy drinks believed that energy drinks have the following benefits "improve alertness, boost academic, work, and sports performance, and promote health and social relationship, compared with non-users". This extended to the finding that energy drink users generally found energy drinks were more helpful than non-users (Chang et al., 2017).

2.9 RELATED CONSUMPTION PATTERNS

Consumption rates are lower in some regions such as Taiwan due to energy drinks being a relatively new functional drink (Chang et al., 2017). It has been established that energy drinks beverages that have high doses of caffeine are advertised as reducing fatigue and increasing alertness (Howard & Marczinski, 2010; McCusker et al., 2006). Beyond the intended use of energy drinks by their producers, these beverages have become increasingly popular with the habit of mixing them with either alcohol or drugs (Marczinski, 2011). It has been observed that the higher the dose of alcohol consumed the more likely the slowing of motor response when reaction times are observed.

Although the mixing of energy drinks and other substances such as alcohol is found to become popular, it has been reported that only a small proportion, 15.3% of energy drink users engage in the act of mixing alcohol with energy drinks. Energy drinks were also found to be consumed in private and public places related to sports, parties, or other social activities. Although parents may influence their consumption, it has also been discovered that peer influence is a factor that could contribute to consumption and direct its pattern of use. This is a result of young people having the desire to fit in – a characteristic

associated with the need to "fit in" or "look tough" (Chang et al., 2017; Visram et al., 2017c).

2.10 LAWS THAT DIRECTLY IMPACT ENERGY DRINK CONSUMPTION

C&YP ED consumption complexities make it difficult to design and implement interventions. However, restrictions (e.g. age), refined marketing and labelling, and involving willing retailers are suggestions for policy and intervention design. It is worth noting that no single policy of intervention attempts surfaces to address the complex issue (Visram et al., 2017c).

In the UK no legislature restricts the use of energy drinks like in the case of alcohol and cigarette sales and use. Even though respondents of the study believed that there needs to be a restriction on age-related use of energy drinks. In the case of Ghana and many other countries around the world, this is the state of the legislature regarding energy drink use (Visram et al., 2017a).

2.11 ADVERTISEMENT AND MARKETING

The popularity of energy drinks is fueled by gendered marketing while often alluding to a linkage with sports. This perceived inclination to masculinity in advertisements could be the reason fewer girls consume energy drinks than boys. It is worth noting that for a marked improvement in energy drink consumption behaviour, counter-health education targeting individuals, as well as definitive information about energy drink consumption, must be provided by healthcare professionals (Visram et al., 2016). Considering the marketing tactic employed for energy drinks, its consumer base, especially young people may be misinformed or utterly unaware of the potential health risks and nutritional contents of energy drinks (Kumar et al., 2015). In fact, according to a study conducted in Northern England, it was discovered that traditional marketing revolved around a marketing mix – price, product, place, promotion, peers, parents, and policy. Respondents that took part in the study were aware of brands with an associated perception of value for money. Most brands are easily accessible, especially the cheap ones but beyond that, there were also shop promotions that enhanced sales (Visram et al., 2017c).

Chapter 3

MATERIALS AND METHODS

3.1 OVERVIEW

In alignment with the purpose of this study, which is to determine the consumption patterns and perceptions surrounding energy drink consumption is the Tamale Metropolis. This chapter describes the processes involved in the determination of the study area, sample size, sampling technique/method, and research approach.

3.2 STUDY DESIGN

The study design is a descriptive cross-sectional study. This is appropriate for discovering the prevalence of energy drink consumption, current consumption patterns, and perceptions of the population. While also allowing the study to utilize data collection instruments including a structured questionnaire.

3.3 STUDY AREA

The Tamale Metropolis is one of 28 districts of the Northern Region. It shares boundaries with Mion district to the east, Sagnarigu district to the west and north, Central Gonja to the southwest, and East Gonja to the south. The total population of the Tamale Metropolis stands at about 360,579. The proportion of people living in urban areas stands at 80.8%, a number far greater than those living in rural areas, 19.1%. The target population makes up 46% of the metropolis's population. In line with the area being 80. 8% urban, there are indications that diet habits are changing with more preference for processed foods and fast food (GSS, 2014). The Tamale Metropolis is an area with a fast-growing business landscape where the trading of energy drinks thrives. The area has some small and major markets including; Aboabu, Central, Sakasaka, Kukuo, and Lamashegu markets (Adzitey et al., 2011; Ansah et al., 2009). A cursory look at the beverage market in the metropolis suggests that energy drinks are easy to obtain. This is especially so through *convenience* shops and street vendors who sell these beverages to the busy motorists and pedestrians of the metropolis. All of these levels of business in the metropolis present and more so,

act as outlets for the sale of energy drinks. These observations around the energy drinks subject are based on the fact that I have lived in the area. This, in my view, makes the Tamale Metropolis the best fit for this study.

Figure 2 *Map of Tamale Metropolitan*

3.4 RESEARCH APPROACH

Data on consumption patterns, prevalence, and risk factors associated with energy drink consumption was collected and analyzed using the quantitative research approach. Owing to these reasons this study will be using a mixed-methods research approach.

3.5 STUDY POPULATION

This study was interested in youth between the ages of 15 and 45 years of age. This age group was selected for two reasons: About 63.3% of the metropolis's population aged 15 and older are economically active (GSS, 2014). This puts them in a position to be able to afford to purchase energy drinks. They have a certain perception about its benefits that influences the choice to purchase.

Inclusion Criteria

- Individuals within the age category of 15 to 45 years in the Tamale metropolis.
- They should be permanent residents of the metropolis. This will be determined by checking if the respondent has lived in the metropolis for up to 5 years.

3.6 SAMPLE SIZE DETERMINATION

Using Cochran's formula for estimating sample size:

$\mathbf{n = \frac{t^2 * p(1-p)}{m^2}}$, where:

"n" is the required sample size;

"t" is the z-score associated with the required confidence interval set at 95%, that is, 1.96;

"m" is the margin of error required for precision, 0.05;

"p" is the prevalence of energy drink consumption. The estimated prevalence of energy drink consumption is 46.7% (Bekoe, 2015).

Therefore, the sample size required for this study was 383.

3.7 SAMPLING PROCEDURE

The Tamale Metropolis was selected purposively. Individual respondents were selected based on convenience. Individuals encountered in the region of the major streets of the randomly selected districts were selected. The selection was however dependent on the selection criteria.

3.8 DATA COLLECTION AND QUALITY MANAGEMENT

The data collection focused on individual respondents in the metropolis. The demographic information of participants (including age, ethnicity, gender, level of education, and occupation), individual knowledge and perceptions, adverse health effects, consumption of energy drinks and weight and height for anthropometry. The data were collected using semi-structured interviews that were based on closed-ended questionnaire items. Also, data were obtained by interfacing with respondents via face-to-face interviews using a pretested-structured questionnaire with the aid of a Computer Assisted Personal Interview (CAPI) device. The questionnaires were administered by enumerators with tertiary-level education qualifications. They were given a one-day training on how to administer the questionnaire and to translate the questionnaire into the local dialect. One day was used to pre-test the questionnaire to iron out any redundancies and fine-tune the questions for field use. The pre-test was conducted in the main market

area of the Tamale metropolis using 5% of the sample size. Some questions were found to be unclear and difficult to ask, there were some question repetitions as well. These were dealt with by rephrasing some questions and deleting unnecessary ones. The data enumerators were able to fine-tune the local vocabulary required to ask the questions with better precision for accurate answers.

The questionnaire was developed to cover four sections:

1. Section I: The sociodemographic characteristics – this section comprised of questions focusing on independent variables such as age, gender, marital status, education level, work type and work intensity. Questions in this section were mostly close-ended.
2. Section II: Anthropometry – weights and heights of respective respondents were measured to identify their obesity.
    a. Height: variable was measured using a tape measure. The respondents were asked to stand on a levelled floor with their backs against the wall barefooted. It was ensured that their buttocks and heels touched the wall. A light mark was made using a ruler and a pencil. The tape measure was then used to measure the distance between the ground and the marking on the wall.
    b. Weight: Each respondent's weight was recorded using an electronic scale. Respondents were instructed to stand barefoot, with their hands by their sides, and with their eyes straight ahead on the levelled scale. After a digital display, the weight was immediately recorded.
3. Section II: Perception – this section sought to probe the perception of study respondents with close-ended questions. This was simply done by first identifying if respondents had ever heard about energy drinks. if the answer was “yes”, there were follow-up questions that what the respondents knew about energy drinks including the source of their information on energy drinks, their ingredients, brands, benefits and adverse effects.
    a. Knowledge: based on the responses on the follow-up responses from section II, a score was generated from each response given by the respondents based on what they knew to be correctly attributed to energy

drinks. For every respondent, each correct response was scored "1". The highest score among the respondents was considered the 100% score. Based on the highest mark the percentage score of each respondent was calculated. The scores were subsequently categorized into "poor", "good" and "excellent" knowledge (Saku et al., 2020).

4. Section IV: Consumption – prevalence of consumption was measured by confirming whether respondents currently consume energy drinks. There were follow-up questions that focused on consumption patterns such as reasons for consumption, preferred energy drink brands, frequency of consumption, time of consumption and ease of access.

3.9 DATA ANALYSIS

Data collected via face-to-face interviews using the Kobo toolbox on mobile phones was exported, to excel and cleaned, and subsequently exported to IBM Statistical Package for Social Sciences (SPSS version 21) for analyses. Frequencies and percentages were used to determine the retail distribution and consumption patterns of energy drinks. Correlations, means, and standard deviations were used for continuous data. Chi-square tests were used to examine the association between exposure variables (demographics and perceptions) and consumption patterns. In all analyses, a p-value less than 0.05 was considered statistically significant.

3.10 ETHICAL CONSIDERATIONS

Ethical clearance for this study was obtained from the Committee on Human Research, Publications & Ethics of the Kwame Nkrumah University of Science and Technology (approval letter is in appendices below). During the data collection phase, informed consent was obtained without coercion or deception. The identities of subjects have been protected at all stages of conducting the study. Finally, volunteering subjects were accorded the opportunity to withdraw at any point in the interview if they saw fit to do so.

Chapter 4

RESULTS

4.1 OVERVIEW

This chapter outlines the results of analyzing the data collected. It covers the socio-demographic characteristics of respondents, knowledge, attitude, and practice of energy drink use, the correlation between energy drinks and socio-demographic characteristics, the relationship between attitudes, practice, and gender, the influence of socio-demographic characteristics on attitude and practice, and examined factors influencing energy drink consumption. Analysis was done using independent samples T-tests, chi-square tests, Pearson's *r* correlation, and logistic regression. All statistical tests were set at 0.05 significance.

4.2 SOCIO-DEMOGRAPHIC AND ANTHROPOMETRIC CHARACTERISTICS

The mean age (SD) of the respondents was $M = 25.55$, $SD = 8.11$ years with the majority (59.7%) in the 15–25 age groups. The majorities of the respondents were male (62.8%), single (70.6%), practising the Islamic religion (66.0%), and mostly from the Dagomba ethnic group (55.1%). The greater proportion of the sample did not have a pregnancy history (65.2%), had no child (72.5%), and 69.1% of those with children had 1-2 children. About forty-four per cent of the respondents were students with a greater proportion of respondents having had formal education. A greater proportion (65.2%) of the study sample have labour-intensive work (See Table 1).

An independent samples T-test was used to explore the differences between the male and female age, and BMI. An alpha of .05 was used. There were significant differences (t (366.66) =-2.04, $p < .001$) in the ages with the mean age for females ($M = 36.51$, $SD = 8.92$) was higher than males (M = 24.98, SD = 7.55). Differences in BMI were not significant with male respondents, t (539) = 1.623, $p = .105$ (See Table 1).

Using the chi-square test of association relationships between gender and some general characteristics were analyzed. The percentage of respondents' marital status did not differ by gender, $X^2(4, N = 541) = 4.67$, $p > 0.05$. There were significant differences in the

frequency of male (275) and female (138) consumers, $X^2(1, N = 525) = 7.36$, $p = .007$. Despite the high rate of consumption, among both groups, small proportions of the respondents mixed EDs with other substances $X^2(1, N = 413) = 10.65$, $p = .001$. There were no significant differences in proportions of employment status according to gender, $X^2(3, N = 541) = 5.11$, $p = .164$. However, by the frequencies cross-tabulated in table 4-2, there is a significant relationship between work intensity and gender, $X^2(1, N = 541) = 8.01$, $p = .005$. Level of education did not show any significant differences among the male and female respondents, $X^2(4, N = 541) = 2.21$, $p = .697$. When alcohol consumption was observed by gender, a small number of males (82) and females (8) were found to be consumers of alcohol, $X^2(1, N = 541) = 36.94$, $p < .001$. For the habit of smokers, while there was a small proportion of males who smoke, there were no female smokers, $X^2(1, N = 541) = 14.83$, $p < .001$ (See Table 1).

Table 1 *General Characteristics of the Sample Population Stratified by Gender*

Variable	Total (541)	Male (340)	Female (201)	P-value
Age (yrs.), *n(%)*				.021
15-25	323 (59.70)	213 (39.40)	110 (20.30)	
26-35	128 (23.70)	82 (15.20)	46 (8.50)	
36-45	90 (16.60)	45 (8.30)	45 (8.30)	
Age, *mean (SD)*	25.55 (8.11)	24.98 (7.55)	36.51 (8.92)	.034
Weight, *mean (SD)*	61.65 (9.08)	63.69 (8.31)	58.3532 (9.39)	<.001
Height, *mean (SD)*	1.64 (.10)	1.66 (0.11)	1.6019 (.07)	<.001
BMI, *mean (SD)*	23.19 (3.86)	23.40 (3.85)	22.8418 (3.86)	.105
Marital status, *n(%)*				.335
Never Married	382 (70.61)	249 (73.20)	133 (66.20)	
Married/Cohabiting	141 (26.06)	82 (24.10)	59 (29.40)	
Separated	8 (1.48)	5 (1.50)	3 (1.50)	
Divorced	2 (.37)	1 (.30)	1 (.50)	
Widowed	8 (1.48)	3 (.90)	5 (2.50)	
Ethnicity, *n(%)*				.001
Dagomba	298 (55.10)	211 (39.0)	87 (16.10)	
Others	243 (44.90)	129 (23.8)	114 (21.10)	
Religion, *n(%)*				.059
Christianity	181 (33.50)	100 (18.50)	81 (15.00)	
Islam	357 (66.00)	238 (44.00)	119 (22.00)	
Traditional	3 (.50)	2 (.40)	1 (.10)	
Employment status, *n(%)*				.164
Student	228 (42.10)	134 (39.40)	94 (46.80)	
Unemployed	49 (9.10)	28 (8.20)	21 (10.40)	
Self-employed	143 (26.40)	99 (29.10)	44 (21.90)	
Employed	121 (22.40)	79 (23.20)	42 (20.90)	
Work intensity, *n(%)*				.005
Yes	353 (65.20)	237 (69.70)	116 (57.50)	
No	188 (34.80)	103 (30.30)	85 (42.30)	
Education level, *n(%)*				.697
None	44 (8.10)	29 (8.50)	15 (7.50)	
Primary	28 (5.20)	19 (5.60)	9 (4.50)	
JHS	80 (14.80)	49 (14.40)	31 (15.40)	
Secondary/vocational	184 (34.00)	121 (35.60)	63 (31.30)	
Tertiary	205 (37.90)	122 (35.90)	83 (41.30)	
Alcohol intake, *n(%)*				<.001
Yes	90 (16.60)	82 (24.10)	8 (4.00)	
No	451 (83.40)	258 (75.90)	193 (96.00)	
Smoking, *n(%)*				<.001
Yes	24 (4.40)	24 (4.40)	0 (.00)	
No	517 (95.60)	316 (92.90)	201 (100.00)	

4.3 KNOWLEDGE AND PERCEPTION OF ENERGY DRINK CONSUMPTION

Almost all of the respondents had heard about energy drinks (97.8%). The source of their information on EDs mainly came from Television (87.3%), friends (83.2%), the internet (51.6%), and radio (41.4%). With regards to known ingredients used for manufacturing EDs, Caffeine (76.4%), Taurine (24.6%), Guarana (24.4%), and sugar (38.4%) were also considerably known compared to lesser possible ingredients such as ginseng (3.6%), and vitamins (5.1%). The popular brand was Rush energy drink (93.2%) and the most perceived benefit of taking energy drink was to provide extra energy (81.0%). A greater proportion (81%) of the respondents perceived that the benefit of energy drinks is to get extra energy and about sixty-two per cent perceive stress reduction as a benefit. About sixty-one per cent of the sample perceived that the adverse effect of energy drinks is insomnia (See Table 2).

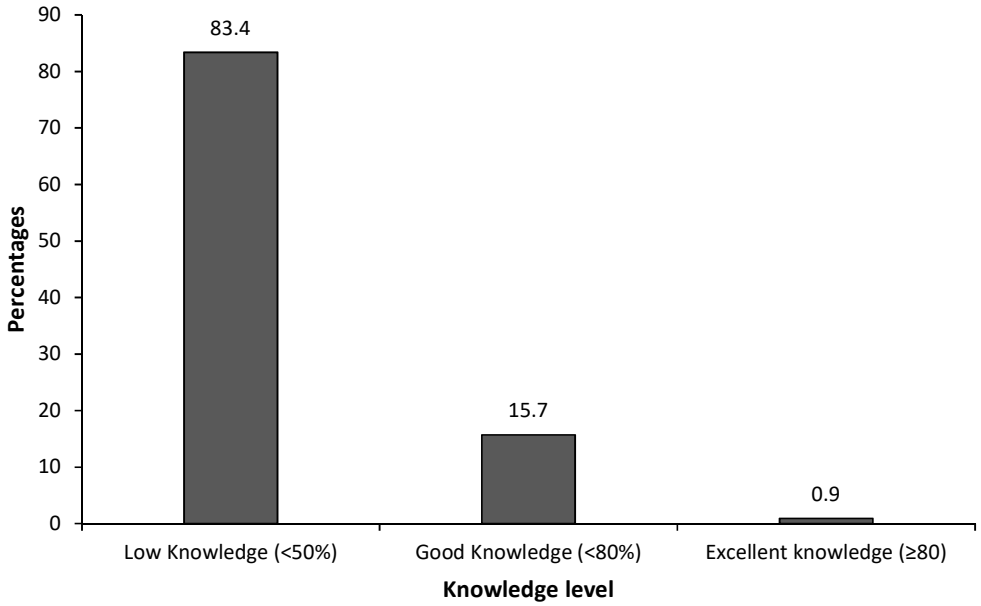
The highest proportion of respondents (83.4%) had poor knowledge of EDs. Those with good and excellent knowledge of EDs were made of significantly smaller proportions (15.7% and .9% respectively) (See Figure 2).

Table 2 *Knowledge and Perception of the Sample on Energy Drink Consumption*

Variable	Frequency (n)	Percentage (%)
Ever Heard of Energy Drink		
Yes	529	97.80
No	12	2.20
Heard About Energy Drinks Through		
Television	462	87.30
Radio	219	41.40
media/internet	273	51.60
Friends	440	83.20
Billboard	11	2.10
Known Ingredients in Energy Drinks		
Guarana	129	24.40
Taurine	130	24.60
Salt	24	4.50
Caffeine	404	76.40
Water	326	61.60
Sugar	203	38.40
Ginseng	19	3.60
Colour	6	1.10
Flavour	20	3.80
Vitamins	27	5.10
Alcohol	45	8.50
Acid	19	3.50
Known Brand of Energy Drinks		
Storm	468	88.10
5-Star	472	88.90
Rush	495	93.20
Burn	37	6.80
Red Bull	46	8.70
Blue Jeans	119	22.40
Tamarinda	1	.20
Power Up	5	.90
Explode	10	1.90
Rox	53	10.00
Passion	12	2.30
Easy Sport	123	23.20
Run	146	27.30
Lucozade	31	5.80
Vim	56	10.40
10-10	66	12.20
Boss	16	3.00
Vody	26	4.90
Bullet	17	3.20
Next Level	12	2.30

Variable	Frequency (n)	Percentage (%)
Perceived Benefit of Energy Drink		
Increase work/study concentration	106	20.00
Give extra energy	430	81.00
Boost Appetite	61	11.50
Reduce stress	331	62.30
Nutrient source	1	.20
Prevents malaria	1	.20
Reduce or manage hunger	1	.20
High	1	.20
Pain killer	5	.90
Sexual stamina	5	.90
Aid digestion	2	.40
Increase work rate	1	.20
Lose weight	2	.40
Keep awake	48	9.00
Refreshment	4	.80
Perceived Side Effects of Energy Drinks		
Insomnia	322	60.60
Drowsiness	59	11.10
Restlessness	273	51.40
Headache	105	19.80
Addiction	20	3.80

Figure 3 *Energy Drink Knowledge Levels of Respondents*

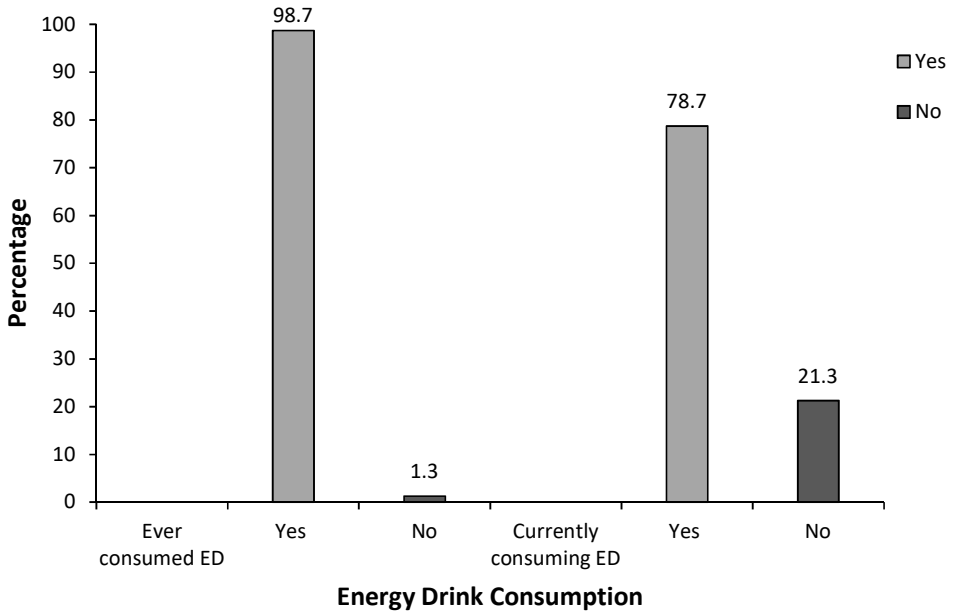


4.4 PRACTICE

4.4.1 The Prevalence of Energy Drink Consumption

The proportion of youth in Tamale who had ever consumed an energy drink was 98.7% and 78.7% of them currently consume energy drinks as illustrated in figure 3 (See Figures 3).

Figure 4 *Prevalence of Energy Drink Consumption*



4.4.2 Consumption Pattern of Energy Drinks

The data analysis revealed that the highest frequency of energy drink consumption among the study samples was weekly (70.9%). Daily (36.9%) and monthly (2.2%) consumers have smaller proportions (See Table 4).

A greater proportion of the study sample consumes one bottle of drink per sitting (93.9%). Only 4.1%, 1.2% and, .7% drank two, three and four bottles or cans of energy drinks in a sitting. A little over half the proportion of consumers preferred drinking energy drinks in the evening (55.0%) with the time for commencement of consumption being 2 to 3 years now (62.0%) and most do not have a reason for consuming (See Table 4).

Figure 4 shows an analysis of reasons for the consumption of energy drinks revealing that reducing stress and tiredness was the chief reason (60.3%). 34.1% and 29.5% of respondents also stated energy boost and the desire to stay awake respectively. Smaller proportions stated other reasons for energy drink consumption including; an increase in concentration for studying or work, boosting appetite, refreshment, pain relief, sexual endurance, aid digestion, high, taste and facilitating weight loss.

Only 31.26% of respondents encountered energy drinks at social gatherings. Most respondents encountered energy drinks at weddings (50.3%) with 39.4% of respondents encountering EDs at outdoorings. However, a relatively smaller proportion of respondents encountered EDs at parties (See Figures 5 & 6).

Among the respondents, 25.9% experienced side effects. Among that proportion of respondents, 55.1% experienced insomnia, 18.1% experienced fatigue after the effects of the ED wears off, 16.8% experienced palpitations and 13.1% experienced restlessness (See Figures 7 & 8).

Figure 5 *Reasons for Consuming Energy Drinks*

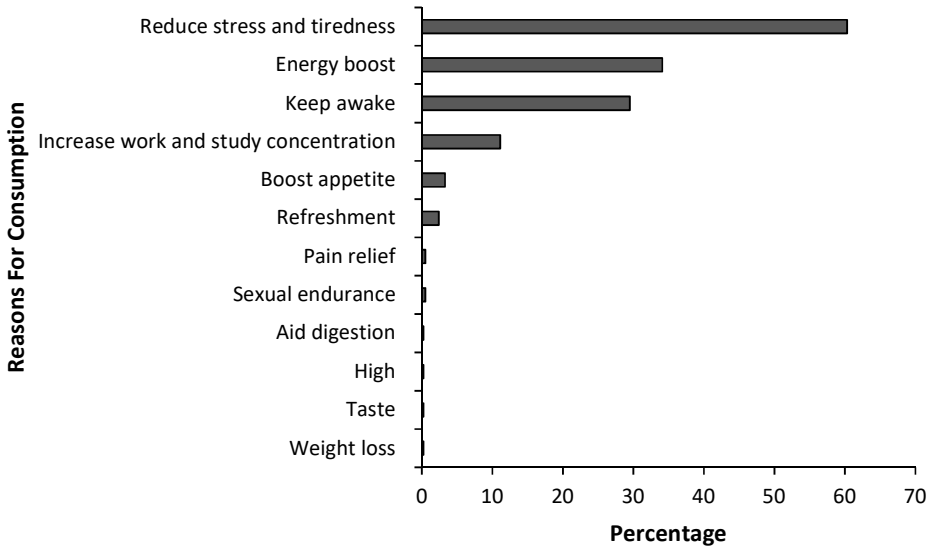


Table 3 *Consumption Pattern Among the Youth in Tamale*

Variable	Frequency (n)	Percentage (%)
Frequency of consumption of energy drink		
Daily	111	26.90
Weekly	293	70.90
Monthly	9	2.20
Number of bottles drank per sitting		
One	388	93.90
Two	17	4.10
Three	5	1.20
Four	3	0.70
Duration since consumption commenced		
One year and below	46	11.10
2 to 3 years	256	62.00
4 years and above	11	26.90
Preferred time of consumption		
Morning	31	7.50
Afternoon	155	37.50
Evening/ night	227	55.00
Reason for preferred time for consumption		
Energy boost for work or studies	83	20.10
To relax or refreshment	32	7.70
No reason	119	28.80
Manage fatigue and stress	76	18.50
Keep awake and concentrate	56	13.60
Craving	27	6.50
For its effects to dissipate by a certain time	20	4.80

Figure 6 *The Proportion of Energy Drink Sightings at Social Gatherings*

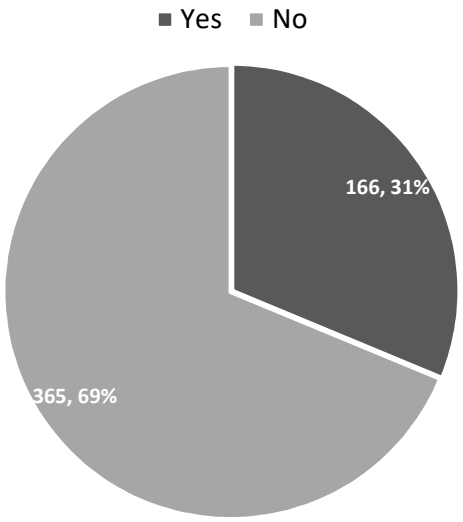


Figure 7 *Social Gatherings Where Energy Drinks Have Been Sighted*

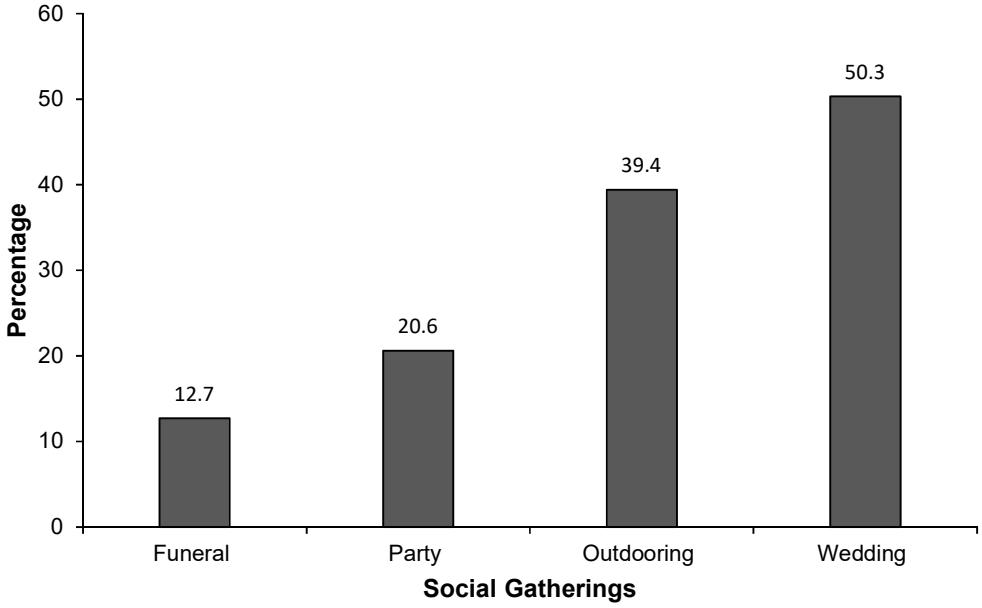


Figure 8 *The Proportion of Energy Drink Users Who Have Experienced Side Effects*

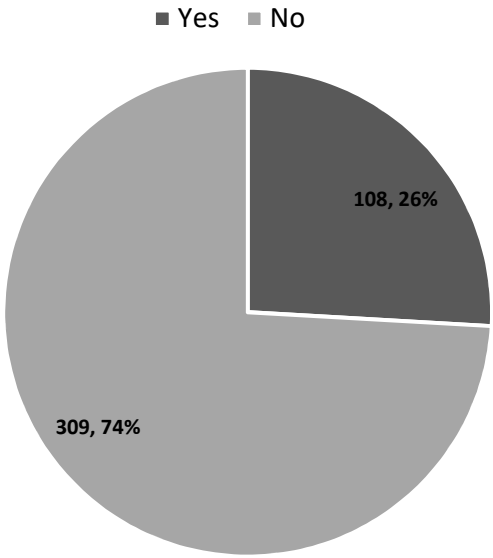
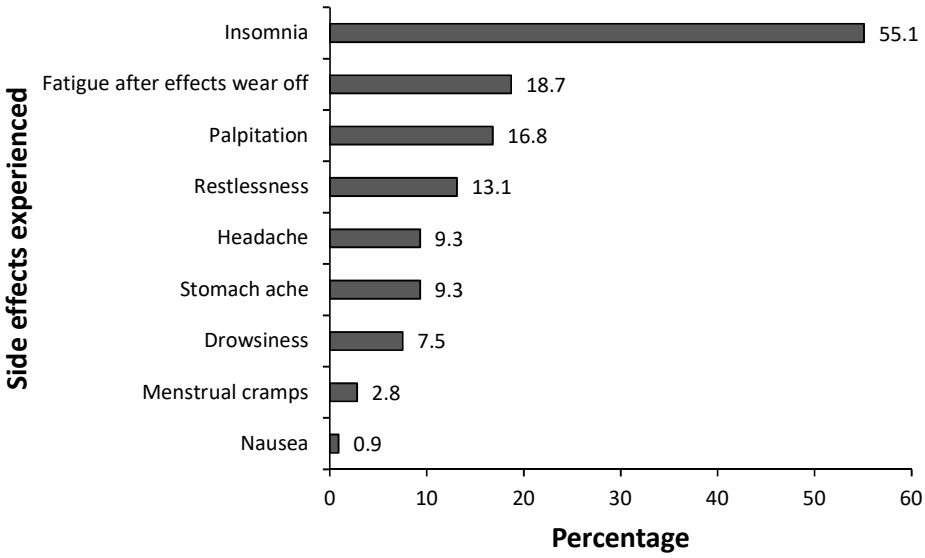


Figure 9 *Side Effects Experienced by Energy Drink Users*



4.4.3 Relationship Between ED Use and Socio-Demographic Characteristics

Table 4 shows a comparison of the socio-demographic characteristics of consumers and non-consumers of EDs. With the aid of an independent samples T-test it was found that the consumers (M = 24.4, SD = 7.6) were generally younger than non-consumers (M = 29.5, SD = 8.6), $t(160.79) = -5.64$, $p < .001$.

Using Chi-square statistics, it is shown that consumption reduces between age categories from 264 (83.8%), 102 (82.9%), and 47 (54%) for the 15-25, 26-35, and 36-45 age categories respectively. Comparatively, there is a greater proportion of consumers in each age group than non-consumers. It also reveals that the highest proportion of users is the youngest, that is, those in the age category of 15-25 years. These frequencies were significantly different, $X^2(2, N = 525) = 37.8$, $p < .001$.

However, there were no significant differences in the BMI of consumers (M = 23.16, SD = 3.86) and non-consumers (M = 23.27, SD = 4.01), $t(523) = -.268$, $p = .789$. Results from the chi-square test of association show that compared to females (33.4%) there is a significantly higher proportion of males (66.6%) who consume EDs, $X^2(1, N = 525) = 7.36$, $p = .007$. Educational level was found to be significantly associated with consumption, $X^2(4, N = 525) = 19.14$, $p = .001$. Students and self-employed respondents made up the highest proportion of ED consumers in the occupation category, that is, 26.9% and 44.8% respectively with the differences observed in this category being marginally significant, $X^2(3, N = 525) = 7.19$, $p = .066$. As shown by the frequencies and percentages in table 4, respondents with a high work intensity are more likely to consume energy drinks, $X^2(1, N = 525) = 24.03$, $p < .001$. While the results from the chi-square tests show that there is no significant association between consumption and alcohol intake, $X^2(1, N = 525) = 1.299$, $p = .254$, there is a significant association between consumption and smoking, $X^2(1, N = 525) = 6.196$, $p = .013$. A high proportion of non-smokers (96.6%) do not consume energy drinks compared to smokers (3.4%) (See Table 4).

Table 4 *Association Between Energy Drink Use and Socio-Demography*

Variables	ED consumers, Yes (N= 413)	ED consumers, No (N= 112)	P-value
Age, *mean (SD)*	24.41 (7.62)	29.47 (8.64)	<.001
Age Categorized, *n (%)*			<.001
15-25	264 (63.90)	51 (45.50)	
26-35	102 (24.70)	21 (18.80)	
36-45	47 (11.40)	40 (35.70)	
Gender (M/F), *n (%)*			.007
Male	275 (66.60)	59 (52.70)	
Female	138 (33.40)	53 (57.30)	
Educational level, *n (%)*			.001
None	36 (8.70)	8 (7.10)	
Primary	25 (6.10)	2 (1.80)	
JHS	66 (16.00)	12 (10.70)	
Secondary/vocational	151 (36.60)	29 (25.90)	
Tertiary	135 (32.70)	61 (45.50)	
Work type, *n (%)*			.066
Employed	85 (20.60)	33 (29.50)	
Self-employed	111 (26.90)	28 (25.00)	
Unemployed	32 (7.70)	13 (11.60)	
Student	185 (44.80)	38 (33.90)	
Work intensity, *n (%)*			<.001
Yes	294 (71.20)	42 (46.40)	
No	119 (28.80)	60 (53.60)	
Alcohol intake, *n (%)*			.254
Yes	66 (16.00)	23 (20.50)	
No	347 (84.00)	89 (79.50)	
Smokers, *n (%)*			.013
Yes	14 (3.40)	10 (8.90)	
No	399 (96.60)	102 (91.10)	

4.5 RISK FACTORS RELATED TO ENERGY DRINK CONSUMPTION

A logistic regression analysis was performed to determine whether age, gender, marital status, level of education, work intensity, alcohol intake smoking, BMI, the incidence of energy drinks served at social gatherings, and knowledge of EDs were significant predictors of ED consumption.

The logistic regression model was statistically significant, $X^2(23, N = 525) = 149.17$, $p < .001$. The model explained between 24.7% (Cox & Snell R^2) and 38.3% (Nagelkerke R^2) of the variance of consumption and correctly classified 83.0% of cases. As shown in Table 5, marital status, level of education, work intensity, servings at gatherings, and knowledge level of EDs significantly contributed to the model.

The odds of an individual in the 26-35 age group not consuming drinking energy drinks is .359 times lower compared to those in the 15-25 age group ($p = .014$, 95% CI .159, .814). The odds of not drinking EDs among those in the 36-45 age group is 1.515 times higher than those in the 15-25 age group ($p = .398$, 95% CI .578, 3.975). Separated people have a 12.626 times odds of not consuming EDs compared to singles ($p = .007$, 95% CI 2.001, 79.644). Also, tertiary-educated people have 3.634 times the odds of not consuming EDs compared to those who have never had a formal education ($p = .025$, 95% CI 1.175, 11.237). It was also discovered that those with low work intensity have 3.692 times the odds of not consuming EDs compared to people with high work intensity ($p < .001$, 95% CI 2.055, 6.634). Meanwhile, the likelihood of consuming energy drinks is 84% higher when EDs were drunk in private compared to when EDs were served at public gatherings ($p < .001$, 95% CI .092, .277). In addition, people with good knowledge of EDs are 2.714 times more likely to not consume EDs compared to those with poor knowledge of EDs ($p = .004$, 95% CI 1.375, 5.348). However, age category 36-45 ($p = .398$, 95% CI .578, 3.975), gender ($p = .075$, 95% CI .951, 2.865), married ($p = .738$, 95% CI .392, 1.942), divorced ($p = .979$, 95% CI .003, 319.780), widowed ($p = .300$, 95% CI .354, 29.027), work type ($p = .220$), alcohol intake ($p = .646$, 95% CI .387, 1.802), smoking ($p = .535$, 95% CI .192, 2.359), BMI ($p = .941$) and excellent knowledge of EDs ($p = .198$, 95% CI .467, 39.493) did not significantly impact the model (See Table 5 below).

Table 5 *Logistic Regression Predicting the Likelihood of Consuming Energy Drinks*

Variables		OR	95% C.I.		P-value
			Lower	Upper	
Age in categories	15 – 25	1			.002
	26 – 35	.359	.159	.814	.014
	36 – 45	1.515	.578	3.975	.398
Gender	Male	1			
	Female	1.652	.951	2.869	.075
Marital status	Single	1			.043
	Married	.872	.392	1.942	.738
	Separated	12.626	2.001	79.644	.007
	Divorced	.925	.003	319.780	.979
	Widowed	3.208	.354	29.027	.300
Education level	None	1			.001
	Primary	.465	.075	2.890	.411
	JHS	1.069	.287	3.979	.921
	SHS/ vocational	.993	.316	3.124	.991
	Tertiary	3.634	1.175	11.237	.025
Type of work	Employed	1			.220
	Self-employed	1.624	.747	3.532	.221
	Unemployed	1.130	.398	3.208	.818
	Student	.700	.329	1.490	.355
Work intensity	Yes	1			
	No	3.692	2.055	6.634	<.001
Alcohol intake	Yes	1			
	No	.835	.387	1.802	.646
Smoking	Yes	1			
	No	.672	.192	2.359	.535
BMI categories	Underweight	1			.941
	Normal	.713	.242	2.098	.539
	Overweight	.696	.206	2.356	.560
	Obese	.730	.183	2.910	.655
EDs served at gatherings	Yes	1			
	No	.160	.092	.277	<.001
Knowledge level	Low knowledge	1			.010
	Good knowledge	2.714	1.378	5.348	.004
	Excellent knowledge	4.295	.467	39.493	.198

Chapter 5

DISCUSSIONS

5.1 OVERVIEW

The purpose of this study was to assess and understand energy drink consumption patterns and risk factors among the youth of the Tamale metropolis. Consequently, this report which is one of the few of its kind in this field delved into knowledge, attitudes, and practice concerning the consumption of energy drinks, consumption prevalence, frequency of use, and prevalence of adverse effects among the youth of the Tamale Metropolis as no such study has been conducted in the Northern Region. It focused on the advertisement and content analysis, also other studies in Ghana have been conducted studies conducted have focused on tertiary students and commercial drivers (Bragg et al., 2017; Buxton & Hagan, 2012a; Nsiah-Asamoah & Buxton, 2021; Saku et al., 2020).

5.2 PERCEPTION AND KNOWLEDGE

Energy drinks are beverages that are growing in popularity progressively. Through various studies, they have been associated with several harmful effects. On the other hand, due to its increasing popularity, more people are consuming these beverages and also for various reasons. With the lack of policies in Ghana and the unhinged marketing by energy drink companies, it is important to appraise the consumption patterns and factors that may predict its consumption. This could contribute to policies and educational actions by public health professionals to deal with this growing phenomenon.

Albeit higher, this research suggests that nearly the whole study population is aware of the existence of energy drinks, which is in line with other studies that also showed a high awareness among their target populations (Casuccio et al., 2017; Saku et al., 2020).

The perceived benefits of energy drinks are in alignment with what they are advertised to do for the consumer cognitively and physically. This may point to strong marketing points through various media minus the negative health effects these products could have on the human body. This study also had some findings of perceived negative effects of EDs. But these known negative effects may only be learned from interacting with users who have experienced them rather than from the information in the drink advertisements and

promotions. Therefore, the significance of getting information from relatives and friends could have a more positive impact on the decisions surrounding ED use than from direct advertising. This is because, the information is more likely to be balanced – informing on what a user finds positive or negative about ED products. Other studies have shown that there is a significant effect of friends and advertisements, on the awareness of energy drinks although they have not determined if it is positive or negative (N. K. Ibrahim et al., 2014; Saku et al., 2020). There is a high brand awareness among the respondents of this study. This may be an indication of the reach of advertising and promotion as well as the visibility of the various brands. Such a presence in the market space is likely because it has been reported that ED producers invest heavily in advertising, and ensure the use of some major promotion outlets including television, public signs and posters, and sponsorship. Consumers in another study associated the popularity of EDs with advertising media (Subaiea et al., 2019a). To back this up, Stacey et al. reported a strong link between ED use and exposure to ED brand advertisements. Adverts are predominantly designed to target the youthful population. In the current fast-paced nature of society, high work and study demands are placed on the youth and for reasons such as saving time and saving money, they may turn to a quick fix – energy drinks. These products are often marketed in relation to sports or entertainment. They also endeavor to bestow a greater appeal on the ED products by associating celebrities that influence the youth with such brands. The youth are usually impressionable and look up to such people. Hence, they are likely to be influenced to consume the ED products. Adverts air on channels with youthful audiences with males being the primary target. Also, advertising is gendered with males being targeted. This is because males are generally associated with higher physical activity, and more males are generally involved in sports. Another study confirms that messaging is usually associated with sports and entertainment (Stacey et al., 2017b).

The most prevalent ingredients in energy drinks above 50% are caffeine, vitamin B6, sodium, niacin, and vitamin B12 (Coso et al., 2022). Caffeine is the best-known ingredient contained in energy drinks (76.4%). However, taurine (24.6%), sugar (38.4%), and guarana showed a contrast in comparison with similar studies concerning awareness of such ingredients (Casuccio et al., 2017). Caffeine is reported to be known the most among the ingredients because it is the main ingredient advertised to be contained in energy drinks. The lesser-known ingredients are not marketed as much and could be

overly technical for a layperson to be concerned with. This shows that consumers of processed products including EDs do not pay attention to what is contained in a product but to the perceived or real benefits the product may present. Individuals may not understand what they read on ED labels or simply have high trust in the producers.

It appears to be the case that Rush (93.2%), 5-Star (88.9%), and Storm (88.1%) are the most popular energy drink brands among 20 different brands reported to be sold in the northern region. However, these results are inconsistent with the EDs found to be popular in other studies, for instance, Black and Red Bull (Aslam et al., 2013). This difference could be a result of economic, and demographic factors, product effectiveness, taste, location, and availability (Poulos & Pasch, 2016; Subaiea et al., 2019a). The Rush, 5-Star and Storm ED brands may be popular in the Tamale Metropolitan area because they have been marketed more effectively. They are also affordable to purchase and taste good to consumers. Compared to other well-known premium brands that are more expensive like Red Bull and Blue Jeans, the youth gravitate towards these three drinks when choosing to buy.

EDs are perceived as beneficial because they tend to boost alertness, work, and academic performance, and promote health and social relationships (Chang et al., 2017). In the study, increased work or study concentration (20%), energy boost (81%), and stress management (62.3%) are the most perceived benefits. However, when comparing this study's results to those of older studies, it is shown that there are loose similarities. In the case of perceived adverse effects of energy drinks, it is a similar situation with insomnia, restlessness, headache, and drowsiness being the notable mentions (Casuccio et al., 2017).

A glance at the data on knowledge level from the analysis of data from this study shows that a significantly high proportion of the sample population has poor knowledge of EDs (83.4%). It is a decreasing trend compared to those with good and excellent knowledge (15.7% and 0.9% respectively). Similarly, some studies have reported a high rate of poor knowledge of EDs in the sample population (Saku et al., 2020). The poor knowledge can be attributed to a lack of warning labels and an inadequacy in the inclusion of risks and potential side effects of EDs in advertisement and messaging (Gunja & Brown, 2012; Saku et al., 2020; Subaiea et al., 2019b). Contrary to findings by Saku et al., (2020), this study found a significant predictor relationship between the knowledge level of the

sample population and the consumption of EDs. This explains the similar trends in knowledge level and consumption of EDs. Low knowledge implies that there is a corresponding high prevalence of consumption among the sample population. A lot is known about energy drinks but there are several wrong perceptions among youthful consumers that require correction. Information about energy drinks is also not available, especially on the adverse effect of default marketing. Generally, knowledge of EDs is low as even some respondents misrepresent other carbonated drinks as EDs.

5.3 ATTITUDE AND PRACTICE

Although in some environments consumers have a comparatively low consumption rate (Degirmenci et al., 2018), this study revealed that a high proportion (78.7%) of the population currently consumes energy drinks. This is consistent with studies conducted among adults and commercial drivers in Sicily (78%) and Ho, Ghana (75%) respectively (Casuccio et al., 2017; Saku et al., 2020). This translates into an even higher proportion of people who have ever tried EDs. This study found that nearly the entire study population (98.7%) have ever consumed energy drinks which agrees with the study conducted in Ho (85.6%) and another study conducted among adolescents in Shanghai, China (70.5%) which show a high trend in the rate of ever consuming EDs (Ghozayel et al., 2020; U. M. Ibrahim et al., 2021; Saku et al., 2020). The observation that nearly the entire study population has ever consumed an ED may have to do with curiosity and the apparent utility of the product. Among other things, the continued growth in the popularity of energy drinks is attributable to individual factors (perceived benefits, side effects experienced, and lack of adequate knowledge of energy drinks), interpersonal factors (peer pressure, social image, and parental influence), and environmental factors (advertisement and branding, affordability, availability, and the lack of policies and regulation).

Respondents mostly consumed energy drinks for some kind of performance enhancement or the other and to a lesser extent, for refreshment and medicinal functions. In that regard, participants of this study stated stress management, energy boost, keeping awake, and increasing work or study concentration as the major reasons for ED consumption. In a study conducted among commercial drivers in the city of Ho in Ghana, it was revealed that a majority of drivers consume energy drinks to manage fatigue. Similarly, a study

that was conducted among students also showed that they rely on the effects of energy drinks to stay awake and concentrate for long periods. In the case of workers who use energy drinks to boost performance, it may be hazardous to themselves and others within the work environment. In the case of students, they tend to consume energy drinks to enable them to cope with the pressure of studies at school (Carsi Kuhangana et al., 2021; Malinauskas et al., 2007; Saku et al., 2020; Sharwood et al., 2012). A huge number of ED users do so because it is majorly useful in the reduction of sleep hours, work and study concentration, boosting energy, and refreshment. However, most non-users avoid them because of the awareness of side effects (Aslam et al., 2013). As reported by the findings of this study, consumers of EDs suffer withdrawal symptoms after the effects of the ED wear off. This could make consumers dependent on such products to function in the workplace. In addition, the consistent use of these products may hide fatigue and could lead to accidents in the workplace when they reach a state of burnout. With the awareness of the potential effects of EDs, some ED users mix water with EDs to reduce their effects. These are positive health behaviours on the part of those who are not able to avoid consuming EDS. This study reported abdominal pain, chest pain, fatigue, constipation, insomnia, palpitations, diuresis, and muscle weakness as adverse effects they experienced. There are a wide variety of adverse reactions that have been reported by ED users regardless of the quantity consumed. However, the findings of this study indicate that there is a small proportion of ED users who have reported experiencing side effects after consuming EDs. This may be due to the nature of consumption by the sample population. A high proportion tends to take EDs weekly, and ingest one bottle or can at a sitting. This suggests a consumption pattern that is not abusive. The sample population consumes EDs responsibly. Hence the low prevalence of reported side effects. The manner of usage may be attributed “bad” perception of EDs generated from user experiences. Since adverts hardly contain any information about the adverse health outcomes that could result from consuming EDs, the only source of such information for the general public is through user experience and the spread of such information by word of mouth.

According to this study, energy drinks are popular among younger populations, especially those in their early twenties. This is confirmed by some other studies (U. M. Ibrahim et al., 2021; Peacock et al., 2017; Subaiea et al., 2019a). Young people have more energy-intensive activities to undertake and because of some reasons including the need to save

time, young people are more likely to consume EDs than older people. One of the characteristics of youth is curiosity. Their high curiosity nudges them to try new things and follow trends. Ergo, the possible reasons why younger people tend to drink EDs compared to older people. Females are often minor consumers of ED. This study also reveals that males also generally had a higher consumption frequency, and reported using EDs at night, and more incidents of side effects. These revelations agree with the prevailing marketing tactic that appears to target young males with youth-related and male-dominant activities such as sports. This focus of ED marketing strategies is confirmed by some studies (U. M. Ibrahim et al., 2021; Peacock et al., 2017; Puupponen et al., 2021; Stacey et al., 2017b; Troxel et al., 2018; Visram et al., 2017b).

There is a direct demonstration of education level being associated with ED use from the findings of this study. This relationship may be due to the number of students in the population and their tendencies to use EDs to study. In addition, people who deem their activities and work to be intensive consume more energy drinks than those who have less intense work. Intense work will usually be characterized by situations where the execution of the job tasks requires immense physical effort and energy, long hours of work, and few breaks. One interpretation of this result is that such consumers find EDs to be a quick means to boost energy for work without breaking to eat a meal. Youth within such a work bracket will find it convenient to depend on a product that is advertised to boost energy by spending less money compared to purchasing food, spending less time consuming it, maintaining the workflow by not taking long breaks, and topping up energy after major meals. Energy drinks may affect energy levels. However, it may not be adequate and its preference and decreased reliance on natural foods, managing time to incorporate rest etc. On the other hand, people with low work intensity are likely to not consume energy drinks as much as those with high work intensity because it is not necessary for the energy boost due to their low energy requirements at work. ED consumers who smoke make up a small proportion of smokers and this could be taken to indicate that people who consume other substances prefer other substances compared to cigarettes. Meanwhile, there appears to be no significant difference between employment status, alcohol intake, and BMI among ED consumers. Alcohol consumers may not be interested in EDs because of differences in taste. Consumption of EDs mixed with alcohol may also affect high performance – the reason with the highest proportion among consumers in this study. Similarly, Casuccio et al. did not find an association between the

use of EDs and these variables (Casuccio et al., 2017; Chang et al., 2017). Also, this study revealed that with easy access to EDs, there is a corresponding high consumption. EDs are highly accessible and available to children and young adults. Many brands can be found in every shop. In addition, all brands are sold without any regulation by the government. With the free and aggressive marketing, sale and utilization of EDs their appeal and popularity keep increasing and making them available and easily accessible. The knowledge or experience of side effects also affects the use of EDs according to the results of this study.

Meanwhile, respondents within the age category of 15-25 make up 63.9%, 26-35 make up 24.7% and 36-45 make up 11.4% of consumers. This is consistent with other studies conducted on open populations which depicted that people are less likely to consume energy drinks with increasing age (Casuccio et al., 2017; Pennay et al., 2015; Pomeranz et al., 2013). This may be related to the finding that knowledge of EDs increases with age (Lorenzi et al., 2021).

A high proportion of consumers (70.9%) among participants of this study consumed energy drinks weekly. Fewer people consumed EDs daily (26.9%) and monthly (2.2%). Conversely, the study by Subaiea, et al. (2019) found that a greater proportion of consumers do so monthly while fewer people tend to consume EDs weekly and daily. Although both studies were conducted in open populations, this study has a smaller age range, 15-45years against 15-63years. Also, the majority of consumers (40 years) in that study were considerably older than those in this study 26-35years (Subaiea et al., 2019b). It points to a relationship between a low consumption rate and increasing age, which may account for the difference in frequency patterns between the studies. However, several studies point out that most consumers tend to do so every week and consume one ED per day (Carsi Kuhangana et al., 2021; Puupponen et al., 2021; Svensson et al., 2021).

Interestingly, most consumers started to drink EDs 2 to 3 years ago. This finding coincides with the recent influx of new and affordable ED brands in the Ghanaian market. Such factors will probably serve to progressively boost the popularity of EDs. Also, the frequency of consumption is quite high and can be attributed to the low price of EDs on the market. Due to their low price, people with low purchasing power can easily purchase and consume EDs. This is evident in the data which shows that the most consumed EDs are the cheapest brands – EDs. such as Storm, Rush and 5-Star.

Whereas another study reports that ED consumers do not have a preferred time of consumption, the participants of this study revealed that consumers were more inclined to consume EDs in the evenings or at night (Subaiea et al., 2019a). Chang et al. (2017) however, have findings that are in line with this study. With more than half of consumers doing so at the night (Chang et al., 2017). This seems to be related to usage patterns, especially for those who consume EDs to study, stay awake or manage stress and fatigue after working during the day. Most consumers will not consume EDs in the morning because they are rested at night and do not need the "boost" of energy from EDs. However, that proportion increases among those who consume EDs in the afternoon. By afternoon, workers start to feel tired from working all morning

ED consumption is associated with smoking, alcohol intake, cannabis, medical drugs, and opioid use (Benkert & Abel, 2020b; Sampasa-Kanyinga et al., 2020). But EDs pose dangers to mental health, cardiovascular, dental, and metabolic health, and social order (Al-Shaar et al., 2017; Curran & Marczinski, 2017). Meanwhile, the use of alcohol has been associated with several risks including brain damage, depression, headaches, and sleep disturbance among others (Newbury-Birch et al., 2009). However, the results of this study agree with a study by Peacock et al. (2017), reporting no association between ED use and alcohol intake. On the other hand, Chang et al. reported an association between alcohol use and also confirms the finding that smoking is associated with ED use. In this study's population, there are few alcohol users and smokers because of the strong religious affiliations among the population.

Public places and events are the main places EDs are consumed the most (Visram et al., 2017b). This study found that a proportion less than half of the study participants sighted EDs in public gatherings. A similar proportion of ED users in another study reported that they drank EDs at parties. On the other hand, most of the users reported that special occasions did not affect their use of EDs (Casuccio et al., 2017). In association with ED mixed with other substances, ED consumption at social gatherings promotes such behaviour compared to consumption at home (Linden-Carmichael & Lau-Barraco, 2017). The results show that approximately half of the sightings of EDs at social gatherings were at weddings. Whereas past research found that consumption was done mostly in public; on the streets, and at leisure facilities (Visram et al., 2017b). The results from this study are inconsistent with previous literature because the study populations, demographics,

and cultures may differ widely. It is however positive that most users and non-users of EDs do not agree with the idea of mixing them with substances (Chang et al., 2017).

The results of this study reported that consumers endure side effects including insomnia, fatigue after the effects of EDs wear off, palpitations, restlessness, headache, stomach ache, drowsiness, menstrual cramps, and nausea. These results differ slightly from the study by Subaiea et al. (2019) that deals with the consumption pattern of EDs among the Saudi population (Subaiea et al., 2019a). This variation in side effects reported could be a result of the difference in brands sold to both populations.

Keeping alert or awake, curiosity, flavour or taste, and concentration for tasks such as school or work tasks (Chang et al., 2017). In line with other studies, this study did not find a significant relationship between ED use and BMI, alcohol intake, and employment status (Casuccio et al., 2017; Chang et al., 2017). Although this study did not find a significant predictor relationship between BMI and ED consumption, in a study that assessed ED consumption among young adults in Saudi Arabia, it was found that illness, living arrangements, academic period, and BMI predict the consumption of EDs (Islam et al., 2020). Contrary to Islam et al. (2020), Benkert and Abel (2020) found that BMI does not predict ED use (Benkert & Abel, 2020b; Islam et al., 2020). This study found age not to be a significant predictor of energy drink consumption but showed a decrease in consumption with every unit increase in age. This is consistent with a study by Norman-Burgdolf et al. (2021) that revealed that young adults are more likely to drink energy drinks than older adults (Norman-Burgdolf et al., 2021). Work intensity and education level were also found to be predictors of ED use which is consistent with the claim that, the impact of activities such as work and academics has an influence on calorie intake and consequently, ED consumption (Benkert & Abel, 2020a; Casuccio et al., 2017; Islam et al., 2020). According to Butler et al. (2019), beverage availability is not related to consumption (Butler et al., 2019). The results of this study are also inconsistent with the claim that gender, smoking, alcohol use, and positive ED perception predict the use of EDs (Chang et al., 2017).

5.4 PREDICTORS OF ENERGY DRINK CONSUMPTION

The findings of this study show that when studying energy drink consumption certain factors that may influence its consumption or otherwise should be looked at in more detail. Age has a relationship with consumption and people in the age category of 15-25 years are less likely to consume EDs compared to those in the 26-35 age category. This may be because the older group of people has purchasing power. They may also tend to consume it more because they feel more drained of energy in their daily lives. This could lead to people turning to EDs to quickly replenish their energy. Meanwhile, younger people may not consume it as much because they have a belief in innate energy levels and may consume it for pleasure and curiosity. On the contrary, in other studies, EDs are consumed among adolescents more than older people (Degirmenci et al., 2018). Marital status is associated with energy drink consumption as well. This appears to be the case because relationships with people play a key role in their psychology which encompasses decision-making on nutrition and health-seeking behaviour. Therefore, it is not out of place that the findings of this study have revealed marital status to be a factor that influences consumption. The intensity or perceived intensity of work done by an individual inadvertently causes the need for more energy to complete tasks, especially for those in the blue-collar job bracket. This is in line with this study's findings that indicate that people who perceive their work to be low in intensity are less likely to consume energy drinks. meanwhile, another study conducted among adolescents contradicts this finding by reporting that ED consumption is highest among those who are less physically active (Degirmenci et al., 2018). The difference may be a result of a difference in culture in the way adolescents are raised as well as the span of age categories covered by this study in its study population. Education plays a key role in exposure and understanding of information including the types related to health. And this is demonstrated in the findings - the level of education has a relationship with ED consumption. As shown, those with tertiary education are less likely to consume EDs when compared to those who have never had a formal education. This could mean that the exposure to and ability to understand health information such as what EDs are and what their potential side effects may be, people with formal education are better informed to make the right choices. Those who have not had a formal education usually struggle to accept new information and end up accepting myths and discarding truths and facts in some cases. A related factor of interest is the level of knowledge people have of EDs in general. An understanding of

what drinks are referred to as EDs, their potential benefits, side effects, and even constituent ingredients could influence the decision to consume ED products. Therefore, special attention should be given to those with low education status and low health literacy because formal and health education could play a critical role in the way in which people consume EDs (Puupponen et al., 2021). Consumption of EDs was found to be 84% higher when consumed in private compared to consumption at public gatherings. This may be the case because public gatherings do not occur often enough for each individual to consume enough EDs. Also being served as a refreshment means that most people will only get a can or a bottle at the said function in addition to the possible availability of other drinks as options for refreshment. On the other hand, it is the private intrinsic needs of individuals that may push them to consume EDs. Hence, they can easily obtain it more often to satiate that need.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 OVERVIEW

This chapter concludes this study report by summarizing the significant findings related to the study objectives. It also suggests recommendations and potential areas of research concerning the topic of this study.

6.2 CONCLUSIONS

The study assessed the prevalence and consumption of EDs, the perceptions people have of them, and the factors related to ED consumption among the youth of the Tamale Metropolis. It was found that more than half of the respondents currently consume EDs. It was also revealed that there is low knowledge of what EDs are, their ingredients, and potential benefits and harmful effects. Also, factors that were found to be independently associated with ED consumption include age, marital status, work intensity, education level, knowledge of EDs, and the availability of EDs at public gatherings such as weddings and parties.

This research clearly illustrates that there is high consumption of energy drinks with low knowledge of them. However, it also raises questions on laws governing the specifics of advertisement, marketing and distribution, and use, as well as the quantification of the energy drink market size.

Most of the studies focused on other special groups such as commercial drivers, students, and athletes. However, this study observes some characteristics of energy drink use and the related knowledge in the general population.

6.3 LIMITATIONS OF THE STUDY

The current study's methodology was cross-sectional, which means that data were collected at a single moment in time. There was no pre- and post-event testing, and no longitudinal processes were investigated. Cross-sectional studies have a temporal

restriction; if the construct under examination is likely to change over time or in reaction to external life situations, this limitation should be considered.

In Chapter 3, the sample in this study is described as convenience samples. As a result, they may not be representative of the populations being studied. To improve the reliability of the results, a sample size larger than the calculated sample size was used. Readers should consequently proceed with care when it comes to the existing results and conclusions. Furthermore, the data's non-random and cross-sectional character suggests that the interpretation of results should be confined to the groups evaluated at the time of this research.

6.4 RECOMMENDATIONS

Given the above conclusions' public health and other health, practitioners should consider; intensive advocacy to inform the youth about energy drinks and their potentially harmful effects.

Also, further research to probe other aspects of the energy drinks is recommended including; their use by vulnerable groups like pregnant women and children, quantifying their market size in Ghana and their market structure and intentional gathering of case studies of adverse effects related to these products in Ghanaian health facilities. This will build on existing research to contribute to various decisions surrounding ED marketing, sale and use.

Given the above conclusions' public health and other health practitioners should consider;

- advocacy on energy drinks and their constituents and potentially harmful effects

and for lawmakers:

- laws should be considered to prohibit the sale of EDs to pregnant women
- should consider outlawing giving energy drinks to children
- should make the inclusion of warnings in energy drink advertisements and labels compulsory

- should impose higher taxes on energy drink producers to influence the price and consumption of these products

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APPENDICES

SOME ENERGY DRINKS ON THE TAMALE MARKET

RUSH

5 STAR

BLUE JEANS

BOSS

GO ON

RED BULL

LUCOZADE

ROX

RUN

STORM

VODY

KABISA

QUESTIONNAIRE

IDENTIFICATION

1. **ID**_____

2. **Do you want to participate in this survey? (a)**Yes (b)No

SOCIO-DEMOGRAPHIC CHARACTERISTICS

3. **Age of respondent** *(In years)*_____

4. **Gender** (a)Male (b)Female

5. **Religion** (a)Christianity (b)Islam (c)African Traditional Religion (d)Others

6. **Please specify the religion**_____

7. **Marital status** (a) Single (b)Married (c)Separated (d)Divorced (e)Widowed (f)Others

8. **Please specify the marital status**_____

9. **Have you been pregnant before?** (a)Yes (b)No

10. **Do you have children?** (a)Yes (b)No

11. **How many children do you have?**_____

12. **Ethicity** (a)Dagomba (b)Mamprusi (c)Gonja (d)Konkomba (e)Others

13. **Please specify the ethnicity**_____

14. **Highest level of education** (a)None (b)Primary (c)JHS (d)SHS or vocational (e)Tertiary

15. **What type of work do you do?** (a)Employed (b)Self-employed (c)Unemployed (d)Student

16. **Is your work labour intensive?** (a)Yes (b)No

ANTHROPOMETRY

17. **Weight (kg)**_____

18. **Height (cm)**_____

PERCEPTION ON ENERGY DRINKS

19. **Have you heard about energy drinks?** (a)Yes (b)No

FOLLOW-UP ON PERCEPTION

20. **What is the source of your information?** ***(****You may select more than one option****)*** (a)Television (b)Radio (c)Social media or internet (d)Friends (e)Other
21. **Please specify the source of your information**_____
22. **Mention ingredients that are in energy drinks** ***(****You may select more than one option)*** (a)Guarana (b)Taurine (c)Salt (d)Caffeine (e)Water (f)Sugar (g)Other (h)No idea
23. **Please specify the ingredients**_____
24. **What brands of energy drinks do you know?** ***(****You may select more than one option)*** (a)Storm (b)5 Star (c)Rush (d)Burn (e)Red Bull (f)Blue Jeans (g)Others (h)No idea
25. **Please specify the energy drink brands you know** _____
26. **What are the benefits of taking energy drinks?** ***(****You may select more than one option)*** (a)Increase work or study concentration (b)Give extra energy (c)Boost appetite (d)Reduce stress (e)Others
27. **Please specify the benefits**_____
28. **What adverse effects can energy drinks cause?** ***(****You may select more than one option)*** (a)Insomnia (b)Drowsiness (c)Restlessness (d)Headache (e)Others
29. **Please specify the adverse reactions**_____

ENERGY DRINK CONSUMPTION

30. **Have you ever consumed energy drinks?** (a)Yes (b)No
31. **Do you currently consume energy drinks?** (a)Yes (b)No

QUESTIONS FOR CONSUMERS

32. **What are your reasons for consuming energy drinks?** ***(****You may select more than one option)*** (a)To increase work or study concentration (b)To keep awake (c)To boost appetite (d)To reduce stress (e)Others
33. **Please specify your reason(s) for consuming energy drinks** _____
34. **Which type of energy drink do you consume?** (a)Regular (b)Sugar free (c)Both (d)I don't know
35. **Which brand of energy drinks do you consume the most?** ***(****You may select more than one option)*** (a)Storm (b)5 Star (c)Rush (d)Burn (e)Run (f)Others
36. **Please specify the brand(s) you consume** _____

37. **Why do you prefer this particular brand?** *(You may select more than one option)* (a)Tastes good (b)Inexpensive (c)Makes me active (d)Gives me appetite (e)Others

38. **Please specify your reason for preference**_____

39. **In a month how often do you take energy drinks?** (a)Daily (b)Weekly (c)Monthly

40. **How many bottles do you consume in that period?** _____

41. **How many times do you consume energy drinks in a month?** (a)1 to 2 times a month (b)1 to 2 times a week (c)3 to 4 times a week (d)Once a day (e)2 or more times a day

42. **How many bottles/cans do you consume at a sitting?** (a)1 bottle or can (b)2 bottles or cans (c)3 bottles or cans (d)4 or more bottles or cans

43. **How many bottles or cans do you drink per week** (a)4 - 6 bottles or cans a week (b)1 -3 bottles or cans a week (c)Less than 1 bottle or can a week

44. **For how long have you been consuming energy drinks?** (a)One year and below (b)2-3 years (c)4 years and above

45. **What time of the day do you usually consume energy drinks?** (a)Morning (b)Noon (c)Evening/night

46. **Why do you like to consume energy drinks at that time?**_____

47. **Do you usually mix energy drinks with other drinks or substances?** (a)Yes (b)No

48. **What drinks or substances do you mix energy drinks with?** *(You may select more than one option)* (a)Alcohol (b)Cigarette (c)Coffee (d)Others

49. **Please specify the drinks and substances you mix with energy drinks**_____

50. **Why do you mix energy drinks with other substances?**_____

51. **Have you ever been served and consumed energy drinks at a social gathering?** (a)Yes (b)No

52. **Mention the social gathering(s)** *(You may select more than one option)* (a)Wedding (b)Funeral (c)Outdooring (d)Others

53. **Please specify the social gathering** _____

54. **Where do you obtain energy drinks for consumption?** *(You may select more than one option)* (a)Retail store (b)Hawkers (c)Others

55. **Please specify the place where you obtain energy drinks** _____

56. **Please rate how easy it is to obtain energy drinks to buy** (a)Very easy (b)Easy (c)Difficult (d)Very difficult

57. **Have you ever experienced any side effects after taking energy drinks?** (a)Yes (b)No

58. **What side effects have you experienced?** *(You may select more than one option)* (a)Drowsiness (b)Restlessness (c)Insomnia (d)Nausea (e)Others

59. **Please specify the side effects that you experienced**_____

QUESTIONS FOR PEOPLE WITH HISTORY OF PREGNANCY

60. **Have you ever consumed energy drinks during pregnancy?** (a)Yes (b)No

61. **Why did you consume energy drinks during your pregnancy?**_____

QUESTIONS FOR PEOPLE WITH CHILDREN

62. **Have you ever given your child an energy drink?** (a)Yes (b)No

63. **Why did you give your child the energy drink?** (a)For refreshment (b)For energy (c)Because they enjoy it (d)Other

64. **Please specify your reason for giving your child energy drinks**_____

CONSENT FORM

Investigator:
"**My name is** (name of investigator), **and I am a** graduate student, faculty of nutritional sciences, **at** UDS. **I am inviting you to participate in a research study. Involvement in the study is voluntary, so you may choose to participate or not. I am now going to explain the study to you. Please feel free to ask any questions that you may have about the research; I will be happy to explain anything in greater detail.**

"**I am interested in learning more about** energy drink consumption in the Tamale metropolis. **I will be interested in what you know about energy drinks. This will take approximately 20min of your time. All information will be kept** confidential. **In any articles I write or any presentations that I make, I will not reveal details or I will change details about where you work, where you live, any personal information about you, and so forth.**

"The benefit of this research is that you will be helping us to understand how people perceive and consume energy drinks in Tamale. **This information should help us to** better understand how energy drinks may influence our diet and health. **If you do not wish to continue, you have the right to withdraw from the study, without penalty, at any time."**

Participant-"All of my questions and concerns about this study have been addressed. I choose, voluntarily, to participate in this research project. I certify that I am at least 15 years of age.

_____
Name of participant

_____ _____
Signature of participant Date

_____
Investigator

_____ _____
Signature of investigator Date

Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Health Sciences
SCHOOL OF MEDICINE AND DENTISTRY

COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/256/22

14th June 2022.

Mr. Kobik Williams
Department of Nutritional Sciences
University for Development Studies
TAMALE

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Energy Drinks: Perception, Consumption and Factors Associated with its Consumption among the Youth in Tamale Metropolis."***

Proposed Site: ***Tamale Metropolis.***

Sponsor: ***Principal Investigator.***

Your submission to the Committee on Human Research, Publications, and Ethics on the above-named protocol refer.

The Committee reviewed the following documents:

- A notification letter of 31st March, 2022 from the Tamale Metropolitan Assembly (study site) indicating the approval for the conduct of the study at the Metropolis.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for a fixed period of one year, beginning **14th June 2022** to **13th June 2023** renewable thereafter. The Committee may, however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you for your application.

Yours faithfully,

Rev. Prof. John Appiah-Poku.
Honorary Secretary
FOR: CHAIRMAN

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