12-2009

The Impact of Knowledge, Attitude, and Peer Influence on Adolescent Energy Drink Consumption

Alyson C. Ward
Utah State University

THE IMPACT OF KNOWLEDGE, ATTITUDES, AND PEER INFLUENCE ON

ADOLESCENT ENERGY DRINK CONSUMPTION

by

Alyson C. Ward

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Health, Physical Education and Recreation

Approved:

Julie Gast, PhD Major Professor	Matthew Flint, PhD Committee Member
Scott Bates, PhD Committee Member	Byron R. Burnham, EdD Dean of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah

2009

ABSTRACT

The Impact of Knowledge, Attitudes, and Peer Influence on Adolescent

Energy Drink Consumption

by

Alyson C. Ward, Master of Science

Utah State University, 2009

Major Professor: Dr. Julie Gast
Department: Health, Physical Education and Recreation

Adolescents are labeled as sensitive to caffeine, though despite this predisposition, consumption is high among this population. Energy drinks are a current trend in soft-drink-like beverages and are marketed to 11-35 year olds. However, unlike soft drinks, energy drinks are not regulated by the Food and Drug Administration, and therefore do not have to limit their caffeine content.

This cross-sectional, correlational study sought to identify the role that knowledge, attitudes, and peers play in adolescent energy drink consumption. Adolescents (n = 199), ages 18 to 21, at a university in the west were surveyed. Descriptive statistics revealed that 25% of the surveyed population reported consuming at least one energy drink in the last 30 days.

Using binary logistic regression, it was determined that having seen warning labels on energy drink cans significantly reduced the odds that the participant would consume energy drinks ($p < .01$). Interestingly, having more negative attitudes toward caffeine increased the odds the individual would consume energy drinks ($p < .01$). Additionally, the more individuals disagreed that they drank energy drinks with friends, the more likely they were to drink energy drinks ($p < .01$). Being male significantly increased the odds that the individual would consume energy drinks ($p < .01$). Moreover, there was a significant interactive effect between having a negative attitude toward caffeine and the fewer friends they had that drank energy drinks, resulting in an increased odds the individual consumed energy drinks ($p < .05$). Hopefully, the results from this study will contribute to the current energy drink research.

(143 pages)

ACKNOWLEDGMENTS

I appreciate the help of all the professors I have had throughout my graduate experience—I have learned and grown exponentially. Thank you especially to my committee chair, Dr. Julie Gast, and to my committee members, Dr. Matt Flint and Dr. Scott Bates. Also, thanks to Elizabeth Dansie and Chad Bohn for helping with my statistics.

This project was also made possible by many family and friends. Namely, my parents, my in-laws, and my ever-committed sister Cami—thank you for at least pretending to be interested in my research. I am also appreciative of the love, support, and tolerance from my daughters Elizabeth and Lillian, which allowed me to be a student and a mother simultaneously. I would also like to acknowledge my dogs Stella and Luna for helping provide psychological solace through exercise and love. Last, but certainly not least, I am so grateful for my best friend and husband, Michael, who gave me love, support, and encouragement and was willing to listen to my dramatic shifts from being excited about this project to loathing it.

I also am thankful for the timely entertainment of radio show hosts Doug Fabrizio of KUER, and Ebay Jamil Hamilton and Bad Brad Wheeler of KRCL. They helped keep my soul fed while my mind and fingers were busy researching and writing.

Alyson Connelly Ward

CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Caffeine, particularly in soft drinks, has become part of mainstream American life as demonstrated by 87% of the general U.S. adult population reporting daily caffeine use (Frary, Johnson, & Wang, 2005). Furthermore, caffeine is often cited as the most widely consumed psychoactive drug in the United States (James, 1998; Rogers & Dernoncourt, 1998; Unemura et al., 2006). Specifically, the psychoactive properties of caffeine have spawned extensive research that demonstrates that caffeine can be both beneficial and detrimental to individuals.

Caffeine has shown positive effects on reaction time (Rogers & Dernoncourt, 1998), acute alertness (Boxtel, Schmitt, Bosma, & Jolles, 2003; James, 1998), and mood (James, 1998). However, caffeine has detrimental effects on sleep quantity (Roehrs & Roth, 2008; Shilo et al., 2002), sleep quality (Roehrs & Roth; Shilo), insulin resistance (MacKenzie et al., 2007; Williams et al., 2008), and glucose metabolism (Lane, Feinglos, & Surwit, 2008; Williams et al.). The results regarding caffeine's affect on fertility (Hakim, Gray, & Zacur, 1998; International Family Planning Perspectives, 2004; Kelly-Weeder & O'Connor, 2006) and blood pressure (Jee, He, Whelton, Suh, & Klag, 1999; Karatzis et al., 2003; Unemura et al., 2006) are inconsistent. Moreover, caffeine has addiction potential that predisposes users, especially those who consume high amounts, to suffer from withdrawal, which is characterized by headache, drowsiness, fatigue, and poor mood (Rogers & Dernoncourt, 1998). The adverse health effects of caffeine are even more apparent in sensitive populations, namely children and adolescents (McCusker, Goldberger, & Cone, 2006; Pollack & Bright, 2003).

Although adolescents are labeled as sensitive to caffeine, its use is highly prevalent among this population with 89% of adolescents in a recent study reporting daily caffeine use (Frary et al., 2005). Although the prevalence of caffeine consumption among adolescents appears to be high, few studies have been conducted that focus on caffeine use among adolescents (Bernstein, Carrol, Thuras, Cosgrove, & Roth, 2002). In the studies that do exist, caffeine has a similar effect on adolescents as it does on adults but may have different health implications. For example, Pollack and Bright (2003) found that the more caffeine that adolescents consumed, the more they were sleep deprived. Disrupted sleep due to caffeine negatively affects school attendance (Giannotti, Cortesi, Sebastiani, & Ottaviano, 2002), school performance (Giannotti et al.; Pollack & Bright), psychological health (Giannotti et al.), and safety (Giannotti et al.). Additionally, adolescents, like adults, can become addicted to caffeine and experience similar withdrawal symptoms (Bernstein et al.; Hughes & Hale, 1998; Oberstar, Bernstein, & Thuras, 2002). Making the matter more complicated, when caffeine is consumed in the form of sugar-sweetened beverages, like soft drinks, there are even more negative health outcomes.

After coffee, soft drinks are the second biggest contributor to caffeine intake in the general U.S. adult population (Frary et al., 2005). In the adolescent population, soft drinks account for 62.9% of caffeine intake (French, Lin, & Guthrie, 2003). Aside from the effects of caffeine, soft drinks are associated with a variety of negative outcomes such as increased energy intake (Cotton, Subar, Friday, & Cook, 2004; Vartanian, Schwartz, & Brownell, 2007), unhealthy body weight (Ludwig, Peterson, & Gortmaker, 2001), decreased milk and calcium intake (French et al.; Vartanian et al.; Vatanparast, Lo, Henry, & Whiting, 2005), and increased dental caries (Tahmassebi, Duggal, Malik-Kotru, & Curzon, 2004). In response to the high prevalence of soft drink consumption and the caffeine content in soft drinks, the Food and Drug Administration (FDA) began investigating the safety of caffeine, and particularly its use in soft drinks.

After reviewing caffeine research, the FDA recognized that caffeine had adverse effects, but concluded that these effects were not sufficient enough to ban it nor was there definitive proof that caffeine was a hazard to the public (FDA, 1987). Based on their conclusion, the FDA, starting in 1987, began regulating the milligrams of caffeine allowed in soft drinks, setting the limit of caffeine in nonalcoholic carbonated beverages at 32.4 mg of caffeine per 6 oz (FDA). Currently, soft drink manufacturers still have to abide by the FDA caffeine recommendation. Energy drinks, like soft drinks, are contemporary, sugar-sweetened, caffeinated beverages. However, unlike soft drinks, the FDA regards energy drinks as functional beverages, a classification that denotes the food may provide some health benefit, and, as such, are not required to limit their caffeine content (McCusker et al., 2006).

There is not an agreed upon definition for energy drinks (Finnegan, 2003). This study will use the definition proposed by McCusker and colleagues (2006) that defined energy drinks as sugar-sweetened, nonalcoholic-carbonated beverages that contain more than 32.4 mg of caffeine per 6 oz. Additionally, this study will expand the definition proposed by McCusker et al. to include Finnegan's, which defines energy drinks as beverages marketed for the purpose of providing real or perceived enhanced physiological performance.

Unfortunately, the safety of energy drinks is unknown due to relatively limited research (Finnegan, 2003; Food Safety Promotion Board [FSPB], 2002). The research that does exist primarily examines energy drinks' caffeine content. For example, McCusker and colleagues (2006) analyzed 10 energy drinks and report that 80% of the tested energy drinks had a much higher amount of caffeine than soft drinks. In fact, energy drinks have between 33.3 to 141.1 mg of caffeine per 8.3 to 16 oz (McCusker et al.). The researchers also noted that 3 of the 10 tested energy drinks were labeled with a warning stating "children, pregnant women, and those sensitive to caffeine should not use this product in large amounts" (McCusker et al., p. 114). Reissig, Strain, and Griffiths (in press) found large amounts of caffeine in some of the energy drinks they evaluated, such as the 505 mg of caffeine per 24 oz in Wired X505 and 500 mg of caffeine in 20 oz of Fixx.

Even though the research focused specifically on energy drinks is limited, their popularity is soaring. Since the introduction of Red Bull in 1987, the energy drink market has doubled every year, making it the fastest growing sector in the soft drink industry (Reissig et al., in press; Thomas, 2007). Among adolescents the trend in energy drink consumption is no different in part because they are specifically marketed to 11 to 35 year olds (FSPB, 2002). A study conducted by O'Dea (2003) revealed that 43% of interviewed adolescents, ages 11-18, reported consuming at least one energy drink in the past two weeks. Another study surveying college-aged students concluded that over half of the students drank more than one energy drink in the last month (Malinauskas, Aeby, Overton, Carpenter-Aeby, & Barber-Heidal, 2007). This body of research collectively shows that energy drinks are effectively marketed as evidenced by their popularity among adolescents.

One reason why young people consume energy drinks is because of the way they are marketed. Specifically, the marketing of energy drinks revolves around their stimulant effects, claiming that they increase cognitive and physical performance (Ministry of Agriculture, Fisheries, and Food [MAFF], 1998; Reissig et al., in press). Interestingly, energy drink marketing emphasizes the inclusion of herbs, vitamins, and minerals in these beverages despite the findings that caffeine is responsible for the stimulant effects of energy drinks (O'Dea, 2003; Smit, Cotton, Hughes, & Rogers, 2004). The stimulant effects of energy drinks are reflected by the responses adolescents give for drinking these beverages such as better sports performance (O'Dea), increased energy (O'Dea, 2003), to perk themselves up when tired (FSPB, 2002, p. V), to perk themselves up when they have too much to drink, (FSPB, p. V), and to compensate for insufficient sleep (Malinauskas et al., 2007). Though adolescents are aware of the beneficial effects of energy drinks, they are less aware of the detrimental effects. O'Dea highlighted the lack of knowledge about the negative effects of energy drinks when none of the adolescents in this study reported any known potential risks of energy drinks, and the participants in the FSPB study acknowledged some risks like panic attacks, but continued drinking them despite known risks. These examples indicate a possible gap of consumer knowledge concerning the negative health consequences of energy drinks.

Energy drinks do, in fact, carry potential risk. High caffeine content, like those found in energy drinks, is associated with decreased sleep (Jay, Petrilli, Ferguson, Dawson, & Lamond, 2006), decreased sleep quality (Jay et al.), new onset seizures

(Iyadurai & Chung, 2006), and relapses in bipolar disorder (Machado-Vieira, Viale, & Kapczinski, 2001). Beyond effective marketing and the stimulant effects of energy drinks, adolescents may overlook the negative impacts of energy drinks for other reasons.

One such reason may be peer influence. Previous research has found that adolescent affiliation with peers that engage in unhealthy behaviors is one of the strongest risk factors in the initiation of unhealthy behaviors (Kinsman, Romer, Furstenberg, & Schwarz, 1998; Marshal & Chassin, 2000). Alcohol use (Marshal & Chassin, 2000), smoking (Hoffman, Monge, Chou, & Valente, 2007; Kobus, 2003), and sexual activity (Kinsman et al.) are some of the unhealthy behaviors that are influenced by peers. However, no research has examined the role of peer influence as it relates to adolescent energy drink consumption.

Theoretical Construct

Theories are commonly used to understand health behavior. Specifically, the social cognitive theory (SCT) is popularly used to help explain the complex dynamics behind behavior. Bandura (1986), the psychologist who pioneered SCT, theorized that individuals neither act only on inner forces nor only on external forces. Instead, human behavior is multicausal. SCT explains behavior as part of a triadic reciprocal causation, known as reciprocal determinism (RD), and it denotes the relationship between personal factors, environmental influences, and behavior (Bandura, 1986).

Personal factors include forms of cognitive functioning such as knowledge, attitudes, intentions, and perceptions (Bandura, 1986, 2001). Environment is comprised of many factors. In particular, social environments, like modeling and social persuasion, create reciprocal effects on behavior (Bandura, 1986). Bandura explained that one person’s behavior could influence the social environment, which in turn can influence the behavior of others in that environment. Expanding on RD, Bandura clarified that there may not be symmetry of strengths between influences. Where the strength lies in the triad may depend on the circumstances and the individual. Meaning that personal influences may be stronger than environmental influences in certain situations, and at other times the environment may be the main contributor to the behavior. Because SCT recognizes that behavior is multidimensional, it is appropriate to use it as a means to understand the influence of an individual’s knowledge and attitudes as well as their social environment on their behavior. In fact, many researchers have used the SCT to understand the motivations behind behavior as well as used the SCT theory to understand ways to avoid negative behaviors (Kobus, 2003).

When applied to the current research study, SCT was used to help understand the behavior of adolescent energy drink consumption, by using the model’s construct of RD. This research study, keeping in check with the SCT theory, investigated how an adolescent’s environment, particularly peer influence, and an adolescent’s knowledge and attitudes about energy drinks affected his or her behavior of energy drink consumption.

Significance of the Study

Because caffeine use, particularly in sugar-sweetened beverages, is potentially harmful to health, there is a need to understand the motivation behind adolescent energy drink consumption. Specifically, understanding an adolescent’s individual factors, such as knowledge, attitudes, and religion, and their environmental factors, such as peer influence, were investigated as reasons why adolescents choose to consume energy drinks.

Purpose of Study

The purpose of this study was to investigate the impact of knowledge, attitudes, and peers on adolescent energy drink consumption. This study also explored the relationship of age, gender, and religion on energy drink consumption.

Research Questions

1. Does adolescent knowledge about energy drinks predict consumption and consumption frequency?
2. Do adolescent attitudes toward energy drinks predict energy drink consumption?
3. Does peer influence predict energy drink consumption among adolescents?
4. Do the demographic variables of age, gender, and religion predict energy drink consumption?
5. How do knowledge, attitudes, peer influence, age, gender, and religion interact to predict energy drink consumption?
6. In terms of reported reasons for energy drink consumption, how does this sample compare to samples in other research studies?

Limitations

Limitations of this study included the following:

1. The community where data were collected is largely a homogenous Caucasian population.
2. The instrument was a self- report questionnaire. Therefore, responses may not have accurately reflected the behaviors being measured.
3. Depending on age or maturity, the respondents may have interpreted the questions differently.

Delimitations

Delimitations of this study included the following:

1. This study used non-random sampling procedures.
2. Adolescents sampled were 18-21 years old.
3. Adolescents sampled were students of Utah State University enrolled in general education courses.
4. Caffeine was the only ingredient of energy drinks researched in this study.
5. Energy drinks that contain alcohol were excluded from this study.

These delimitations may have limited the generalizability of the results to other populations.

Assumptions

Assumptions made in this study included the following:

1. The instrument utilized in this study accurately measured what it intended to measure.
2. The instrument used in this study was valid and reliable.
3. All participants in the sample answered the survey honestly.

Definition of Terms

The following definition was used for this study:

Energy drinks: sugar-sweetened, nonalcoholic-carbonated beverages that contain more than 32.4 mg of caffeine per 6 oz (McCusker et al., 2006) and are marketed for the purpose of providing real or perceived enhanced physiological performance (Finnegan, 2003).

CHAPTER 2

REVIEW OF LITERATURE

Introduction

To understand the reasons behind adolescent consumption of energy drinks, a literature review was conducted. This literature review is a comprehensive analysis of the current research and provides a basis for the need of the proposed study. The facets of literature researched include: (a) prevalence of caffeine consumption; (b) the physiological effects of caffeine on adults; (c) the physiological effects of caffeine on adolescents; (d) the physiological effects of sugar-sweetened beverages; (e) energy drinks; (f) social cognitive theory and unhealthy behaviors.

Information regarding the effects of energy drinks and their consumption patterns is constrained because of limited research in this area (Finnegan, 2003; FSPB, 2002). Currently, the energy drink trend is mainly highlighted in popular press articles. However, because energy drinks have many similarities to soft drinks as seen by their caffeine content, high sugar content, and carbonation this literature review will consider soft drinks as a proxy for studying energy drinks (Frary et al., 2005; “Energy Drinks,” 2006; Vartanian et al., 2007).

Caffeine Content in Beverages

Current regulations of caffeine are derived from a 1987 FDA proposal to delete caffeine from the generally recognized as safe (GRAS) category and move it to the interim food additive category—a category that allows additives to remain as an ingredient pending completion of safety studies (FDA, 1987). Prior to making this shift, the FDA allowed public interest groups and soft drink manufacturers to report caffeine use in their products to help determine their decision. The Soft Drink Association and Coca-Cola Company, among others, responded to the FDA's proposal. A letter written by the commissioner of Coca-Cola was particularly influential. The letter stated that the ingredients in Coca-Cola were safe as established by its history. The FDA recognized this letter as sufficient proof of previously sanctioned use of caffeine and extended this sanction to include the addition of caffeine in all nonalcoholic carbonated beverages, as long as continued studies regarding caffeine use indicated its safety.

Between 1980 and 1987 the FDA investigated the use and safety of caffeine (FDA, 1987). After reviewing caffeine studies, the FDA recognized that caffeine appeared to have adverse effects on fetuses, reproduction, behavior, cardiovascular disease, and carcinogenicity, but that these adverse effects were not sufficient to ban caffeine on the grounds that it was injurious to health nor did they conclude that caffeine demonstrate a hazard to the public. Therefore, the FDA determined the allowable amount of acceptable caffeine for nonalcoholic carbonated beverages to be .02 percent by weight or 32.4 mg per 6 oz (FDA).

Currently, the amount of caffeine in beverages varies considerably depending on the brand of the beverage and if it is bottled or a fountain drink. McCusker and colleagues (2006) determined the caffeine content of 19 soft drinks, 10 energy drinks, and 7 other beverages such as bottled iced tea. The researchers isolated the caffeine from the beverages by using a liquid-liquid extraction and then analyzed the liquid using a gas chromatographic analysis. The researchers found that bottled caffeinated soft drinks contained between 18 and 48.2 mg of caffeine per 12 oz. In addition, caffeinated fountain colas, like those filled at restaurants and gas stations, fluctuated between 41.5 and 48.4 mg of caffeine per 16 oz. Both bottled and fountain caffeinated beverages were within range of the FDA recommendation. However, energy drinks, because they are listed as a functional beverage, which means they may provide some health benefit, are not regulated by the FDA, and do not have to adhere to FDA recommendations for caffeine (McCusker et al.). The energy drinks in this study ranged between 33.3 and 141.1 mg of caffeine per 8.3 to 16 oz. Eighty percent of the energy drinks in this study were significantly higher in caffeine than the FDA maximum allowed in soft drinks. The authors also noted that 3 of the 10 tested energy drinks were labeled with a warning stating "children, pregnant women, and those sensitive to caffeine should not use their product in large amounts" (McCusker et al., p. 114).

The Ministry of Agriculture, Fisheries, and Food (MAFF) recognized the importance of updating caffeine content in beverages because of the influx of high caffeine containing products during the 1990s, particularly the emergence of energy drinks. MAFF revealed that energy drinks market themselves to be "stimulating and revitalizing" an effect achieved by caffeine or guarana, which is an extract from a South American plant that contains caffeine (1998, Background section, paragraph 3).

In order to determine the caffeine content in beverages, MAFF gathered samples of 36 colas, 26 energy drinks, 12 miscellaneous drinks, 26 tea products, 30 coffees, and 32 chocolate products. Details from the ingredients label were recorded and those that required preparation were made according to manufacturer's instructions or standard methods. All samples were tested for the three methylxanthines-caffeine, theobromine, and theophylline using the liquid chromatography with ultraviolet detection (LC-UV). Additionally, confirmation of the caffeine analysis was performed using liquid chromatography-mass spectrometry (LC-MS). Limits of detection were 0.2 mg/l for caffeine, 0.1mg/l for theobromine and theophylline.

Caffeine was detected in all 162 samples. The results relevant for the current study involve the amount of caffeine for soft drink and energy drinks. The caffeine content in cola drinks ranged from 22 to 213 mg/l. Interestingly, colas fit into three sub-ranges of caffeine at or around 35mg/l, 75mg/l, or 100mg/l. The caffeine content in energy drinks was also variable coming in at 0.5 to 349mg/l with a mean of 240mg/l, an amount much higher than that found in cola drinks. Again, the researchers found that the caffeine content in many of the energy drinks were similar to those reported on the can label. Additionally, the amount of guarana, a caffeine-containing plant from South America, was similar to what was listed on the label for those drinks that listed guarana on the ingredients list. Though the results of this study where similar to previously conducted research, MAFF indicated that the results of this study would be used to estimate dietary intakes of caffeine as well as use the data obtained on caffeine in energy drinks to generate discussion on the safety of these drinks.

Reissig and colleagues (in press) conducted a review examining energy drinks. In this review the authors examined the regulatory aspects of caffeine in beverages and specifically in energy drinks. The researchers reported that the marketplace for caffeinated beverages has changed dramatically since the introduction of energy drinks with some of the newer energy drinks containing 505 mg of caffeine per 24 oz In agreement with other authors, Ressig and colleagues stated that energy drinks fall under the supplement category and do not have to adhere to the caffeine restrictions placed on caffeinated soft drinks. Interestingly, the researchers found that energy drinks, unlike caffeinated over-the-counter medications such as NoDoz, do not have to have a warning label that advises proper use or the amount of caffeine in the product. In their review, the researchers collated the caffeine content in 28 energy drinks and 4 soft drinks (see Table 1). The researchers noted that the caffeine content in all the beverages was obtained from the manufacturers' product labels. The top selling energy drinks are listed according to market shares.

As Table 1 shows, the amount of caffeine varies considerably among beverages. The studies presented in the this section demonstrate that energy drinks have considerably more caffeine than their soft drink counterparts—an amount of caffeine that is far above the caffeine level deemed acceptable in soft drinks by the FDA. However, energy drinks bypass the FDA recommendation because they are considered a functional food, but the high level of caffeine should generate discussion about the safety of these beverages, especially for sensitive populations.

Prevalence of Caffeine Consumption

In the United States, caffeine consumption through foods and beverages is commonplace. A study conducted by Frary et al. (2005) identified the food and beverage sources of caffeine and the number of people that consume caffeine in the United States. The researchers used data collected through the United States Department of

Table 1

Caffeine Content in Energy Drinks and Soft Drinks

Top selling energy drinks	Ounces per can	Total caffeine (mg)
Red Bull	8.3	80
Monster	16	160
Rockstar	16	160
Full Throttle	16	144
No Fear	16	174
Amp	8.4	75
SoBe Adrenaline	8.3	79
High caffeine energy drinks	Ounces per can	Total caffeine (mg)
Wired X505	24	505
Fixx	20	500
BooKoo Energy	24	360
Cocaine	8.4	280
Blow	8	240
Concentrated energy drinks	Ounces per can	Total Caffeine (mg)
RedLine Power Rush	2.5	350
Ammo	1	171
Soft Drinks	Ounces per can	Total caffeine (mg)
Coca-Cola Classic	12	34.5
Pepsi Cola	12	38
Dr. Pepper	12	41
Mountain Dew	12	54

Note. From “Caffeinated energy drinks—A growing problem,” by C. J. Reissig, E. C. Strain, and R. R. Griffiths, in press, *Drug and Alcohol Dependence*, 99, p.3. Adapted with permission.

Agriculture's (USDA) Continuing Surveys of Food Intakes by Individuals (CSFII). The researchers noted that the CSFII is the most comprehensive database that identifies food consumption.

The average intake of caffeine was separated by the source of caffeine, age, and gender. By examining the CSFII data from years 1994, 1995, 1996, and 1998, the researchers determined from a sample of 18,081 that 87% of U.S. adults use caffeine daily. Particularly, men and women between 35-64 years consume the highest amount of caffeine, averaging 293 mg daily. According to these data, coffee was the biggest contributor to caffeine comprising 71% of caffeine intake for this age group. These data also showed that soft drinks accounted for 16% of caffeine intake. Comparing the latest CSFII data to the CSFII data collected five years previous, the researchers found that the amount of soft drinks consumed had increased nearly fivefold and had become second major source of caffeine. The major limitation for this study was that it did not address all sources of caffeine excluding items such as supplements and energy drinks, which may underestimate the total caffeine consumed by the U.S. population.

The high consumption of caffeine in the United States has been of recent interest to researchers. For example, Cotton and colleagues (2004) collected data from the USDA's Continuing Survey of Food Intakes by Individuals (CSFII) ages 19 years and older. After the researchers categorized foods into 112 groups based on similarities of nutrient content or use they found that caffeine was the thirtieth biggest contributor to nutrient intake. Additionally they found that carbonated beverages, like soft drinks, only comprised 1% of total caffeine intake, this finding is contrary to other studies that have found a much higher contribution of soft drinks to total caffeine intake. Interesting to note, the researchers found that adults are not the only population in the United States with a high rate of caffeine consumption.

Consumption of caffeine is also widespread among the adolescent population. Frary et al. (2005) explored adolescent caffeine consumption by deriving adolescent data from the Continuing Surveys of Food Intakes by Individuals (CSFII). The adolescents in the survey were ages 12-17 of which 89% reported daily caffeine use with a mean caffeine intake of 69.5 mg daily. Soft drinks constituted 62.9% of caffeine consumption among this group of surveyed adolescents. Again, soft drink consumption is an adequate proxy to understand caffeine consumption patterns.

Specifically, French et al. (2003) found that soft drink consumption among adolescents has increased 51% since 1978. The researchers compiled data collected from the Nationwide Food Consumption Survey, the Continuing Survey of Food Intakes by Individuals, and the Supplemental Children’s Survey to determine the recent trends of soft drink consumption among children ages 2-17. The sources of soft drinks have also shifted with children in this study reporting that they obtain most of their soft drinks from outside the home from fast-food (53%) and vending machines (48%). The researchers indicated that most of the vending machines were on school grounds.

Several studies have shown the high prevalence of caffeine in the diets of most Americans (Cotton et al., 2004; Frary et al., 2005). Moreover, the studies above demonstrate the upward trend in soft drink consumption among the U.S. population and specifically among the adolescent population (French et al., 2003). Caffeine content, particularly in sugar-sweetened beverages, like soft drinks and energy drinks, is crucial to study because of caffeine potentially harmful health effects.

Physiological Effects of Caffeine on Adults

Caffeine is a pharmacologically active substance and as such its short and long-term effects have been researched extensively (Finnegan, 2003). Yet, despite comprehensive research, results of caffeine's health effects are ambiguous and variable (James, 1998; Rogers & Dernoncourt, 1998). James proposed that the variable results might be a consequence of methodological flaws. One such flaw is that most people use caffeine and many are caffeine dependent and because experimental studies require that the participants abstain from caffeine prior to research there may be symptoms of withdrawal (James; Warburton, Bersellini & Sweeney, 2001). Therefore, the results from such research may be faulty because the enhanced performance may be from restoration of performance due to a reduction of withdrawal symptoms and not solely a result of caffeine's influence (James). Moreover, a Roehrs and Roth (2008) questioned if caffeine actually increases cognitive and behavioral performance and mood in its own right or if the effects are merely a result of restorative effects or caffeine withdrawal and Anderson and Horne (2008) proposed that caffeine placebo is actually just as effective in improving performance as caffeine itself.

Performance and Mood

James (1998) sought to reduce methodological flaws and seek more reliable results of the effects of caffeine by alternating phases of caffeine exposure and abstinence with regular caffeine consumers. This research design also allowed the researcher to assess both the acute and chronic effects of caffeine use, which in turn controlled for both withdrawal and tolerance effects. James was specifically investigating the influence of caffeine on performance, mood, headache, and sleep.

The alternating caffeine exposure-abstinence was incorporated into double-blind, placebo-controlled, cross-over design, in which all participants took part. The Symptom Substance Questionnaire was used to assess the effects of caffeine on 36 participants, ages 18-52. The participants were divided into four distinct experimental conditions, a six day placebo followed by one day of placebo, six day placebo followed by one day of caffeine, six day caffeine consumption followed by one day of placebo, and six day of caffeine consumption followed by one day of caffeine. Throughout all phases the participants were asked to abstain from caffeine-containing beverages. Caffeine and the lactose placebo were administered through gelatin capsules and were administered three times a day to mimic typical caffeine consumption.

On the seventh day of each phase the researchers assessed performance of participants by engaging them in character recognition tasks designed to measure performance by incorporating information transfer and short-term memory. Mood, headache, and sleep were assessed daily in a self-report entered into an electronic diary. Headaches were assessed by duration and severity. Mood was reported based on the Profile of Mood States and the Visual Analogue Mood Scales allowing participants to choose from eight different mood states. Sleep was reported as duration and quality from the time the participants turned the lights out to when they awoke.

The researchers found that caffeine consumption contributed to a significant improvement on performance from the first phase to the second phase, but not on the subsequent phases—a result that might be due to initial practice effect. Specifically, performance was superior when the participants were in the condition where the placebo was followed by caffeine. However, it is important to note that the individuals involved in the six days of caffeine consumption followed by one day of placebo performed significantly poorer than individuals in the other conditions. Most significantly, the researchers found no significant interactions between performance and caffeine manipulation irrespective of target length and performance trials. Nor was an adverse effect on caffeine withdrawal and performance observed across all performance trials.

The research regarding caffeine and mood showed that there was a chronic main effect for alertness and an acute main effect for alertness and tiredness. Specifically, concerning acute effects, the participants rated alertness higher and tiredness lower when caffeine was ingested instead of the placebo. Interestingly, the chronic effect of caffeine was a decrease in alertness, essentially the exact opposite of the acute effect.

Regarding headaches, statistical analysis showed that those in the six day caffeine followed by one day placebo condition showed that they suffered significantly longer and significantly more severe headaches than those in the other three conditions. The participant data concerning sleep showed that those in the six-day caffeine followed by one-day placebo condition slept longer and had a higher quality of sleep compared to the other three conditions.

In another study, examining caffeine's role in mood and performance, Rogers and Dernoncourt (1998) reviewed both the adverse and beneficial components of caffeine, acknowledging that research on caffeine provided variable results. Some of the benefits they found in their review increased alertness, improved mood, and enhanced psychomotor and cognitive performance. However, the researchers found flaws in the research they reviewed citing that the participants where too young, they were low to moderate caffeine consumers, there was a restriction on caffeine during the study, and the amount of caffeine administered as part of the treatment was higher than that which is typically consumed.

The adverse effects the researchers reviewed were primarily the withdrawal effects of caffeine, namely increased incidence of headache, drowsiness, fatigue, and poorer mood. The authors noted that because most people consume caffeine, adverse effects of caffeine withdrawal are experienced on a daily basis.

To explore the role of caffeine in mood and performance Rogers and Dernoncourt (1998) recruited 36 individuals and split them into two age groups, 20 to 35 and 55 to 84 for a three-session experiment. Participants recorded their beverage intake for three days prior to the study and were asked to abstain from caffeine the night before the study. The order of caffeine capsules, 1 mg/kg or 2 mg/kg , were counterbalanced against a placebo across gender and age. After the treatment or the placebo, participants were tested on cognitive performance tasks such as, simple reaction time (SRT), memory task, and a two-finger tapping task 45 minutes after ingestion.

Examination of the participants' caffeine records revealed that the younger group averaged 6.4 mg/kg of caffeine daily and the older group averaged 8.9 mg/kg of caffeine daily. Additionally, the researchers found that the younger subjects performed significantly better on the memory task, however, there were no significant caffeine effects for this task. The younger group demonstrated a significantly faster tapping rate—again no significant effects for caffeine were found. There were no significant age-related effects for the simple reaction time, however, caffeine significantly improved

SRT. Unfortunately, this study did not clarify confusion surrounding the effects of caffeine on performance nor did it rectify the identified flaw of enhanced performance as potentially the result of relieved caffeine withdrawal.

As previously stated, one cited beneficial effect of caffeine is its potential to restore cognitive abilities. Boxtel et al. (2003) conducted a unique study to determine if caffeine could be a protective factor against age-related cognitive decline. This longitudinal study of 1,376 participants, ages 24-81, used the Maastrict Aging Study data to determine caffeine's possible effects on cognitive function over a six-year period. In addition, the study collected data that compared caffeine consumption using the following measures: Visual Verbal Learning Test, Motor Choice Reaction Test, Letter-Digit Substitution Test, Fluency, Concept Shifting Test, and the Stroop Color-Word Test.

The results showed that motor reaction tests were significantly maintained throughout the six years of the study. However, the verbal memory test times were not significantly associated with caffeine consumption. Based on the results of the six-year study, the researchers concluded that caffeine had a negligible effect on age-related cognitive function.

Though many researchers have demonstrated beneficial effects of caffeine on performance, Anderson and Horne (2008) found that a placebo had similar effects as caffeine itself. The participants (n = 16) engaged in two counterbalanced conditions one week apart. The night prior to each testing, the participants abstained from caffeine and alcohol and their sleep was limited to five hours for which compliance was monitored by wearing an actiwatch. The day of the study all participants were given one cup of decaffeinated coffee and received one of two sets of instructions. The first set was the control instructions—telling the participants they were receiving a regular cup of decaffeinated coffee. The second set of instructions was the placebo condition that described the decaffeinated coffee as being a super type of coffee that has shown to keep the consumer highly alert for at least 90 minutes. The participants engaged in three psychomotor vigilance tests (PVT) thirty minutes apart that tested reaction time and lapses in response to visual stimuli. Additionally, the participants reported their subjective feelings of sleepiness prior to the trial and 30 minutes after each PVT.

The results of the study found that the participants in the placebo condition responded significantly faster in reaction times at 30 and 60 minutes, but not at 90 minutes after ingestion of the decaffeinated coffee. Additionally, the participants in the placebo condition had a significantly lower number of lapses at 30 and 60 minutes after ingestion in comparison to those in the control condition. In regards to subjective sleepiness, there was a trend for improved sleepiness for those in the placebo group, but this trend was not significant.

Caffeine appears to improve reaction time (Rogers & Dernoncourt, 1998), increase feelings of acute alertness (Boxtel et al., 2003; James, 1998), and improve mood (James). However, it is unclear if the methodology behind these studies lead to the positive results of caffeine on performance or if the effects are due solely to the effects of caffeine. Thus, the question of whether caffeine improves performance absolutely or if it only restores performance degraded by caffeine withdrawal continues to infiltrate caffeine research.

Fertility

Changes in fertility are also physiological effects caffeine may have on the body. Hakim et al. (1998) used data from the Reproductive Health Study to research the effect that alcohol and caffeine have on fertility. This retrospective study involved 124 women over 26 months. The women filled out a daily diary reporting vaginal bleeding, unprotected intercourse, and pregnancy symptoms—this was done to try to predict ovulation. Additionally, the women collected daily urine specimens. Moreover, the women were interviewed monthly regarding their caffeine, alcohol, and smoking consumption.

The results of the study when age, race, pregnancy, infertility history, numbers of intercourse, and smoking were controlled for, showed that caffeine, at levels of less than 26 mg per day, had no effect on fertility. However, when caffeine reached levels of 100 mg or more per day there was a significant decrease in fertility. Moreover, conception rates continued to decline as the rates for caffeine consumption increased after 100 mg per day.

An article published in Internal Family Planning Perspectives (2004) found that along with other lifestyle factors, caffeine consumption could delay conception. The study was conducted with 1,976 women in a British prenatal clinic. The participants were assessed for the risk factors of smoking, coffee and tea intake, underweight and overweight, male partner's alcohol consumption, and low standards of living. From these risk factors the authors found that women who only had one of these risk factors had a 93% chance of becoming pregnant within a years time, but if a woman had four or more of these risk factors the chance of becoming pregnant within the first year dropped to 38% (International Family Planning Perspectives, 2004).

Kelly-Weeder and O'Connor (2006) conducted a literature review examining modifiable risk factors for impaired fertility. Through their literature review, the researchers found variable results regarding caffeine and fertility. Three of the five studies they reviewed resulting in a positive association between caffeine intake and decreased fertility finding that women who drink more than seven cups of coffee per day were 1.5 more likely to have trouble conceiving. Though some of the research claimed a positive association, the other two studies produced conflicting results. One of the five studies reviewed stated that only women who were already at high risk of fertility problems had an additional decrease of fertility due to caffeine consumption and this was only apparent when the women drank more than 300 mg of caffeine per day. The last of the five studies cited many methodological problems with caffeine and fertility studies and found no conclusive results about caffeine's affect on fertility, particularly stating that the causal link between caffeine and spontaneous abortion had not been proven.

Blood Pressure

An acute increase in blood pressure is one of the effects that caffeine has on the body. To try to decipher the mechanism of action that caffeine has on the vascular system in men, Unemura and colleagues (2006) conducted a random, double-blind study with 20 men by directly monitoring their endothelial function under various conditions. Forearm blood flow (FBF) reactions to acetylcholine, an endothelial-independent dilator, and sodium nitroprusside, an endothelium- dependent dilator, were evaluated before and after the participants underwent treatment of 300mg of caffeine or a placebo.

Participants were asked to abstain from caffeine 24 hours prior to the study at which time three baseline FBF's, arterial blood pressure, and heart rate were measured. The participants also received intra-arterial infusions of either acetylcholine or sodium nitroprusside every five minutes. After another 30 minutes the participants were given either caffeine or the placebo. An hour after ingestion of the treatment or placebo, the participants' FBF, blood pressure, and heart rate were again measured and acetylcholine and sodium nitroprusside were again administered. The participants then had a 30-minute rest period where they were given nitric oxide synthase inhibitor while FBF and blood pressure were measured.

The participants that were given the 300mg of caffeine showed a significant increase in both their systolic and diastolic blood pressure, but not in their heart rate—whereas the control group showed no differences in blood pressure or heart rate. The intra-arterial administration of acetylcholine and sodium nitroprusside significantly increased forearm blood flow in both the caffeine group and the placebo group. Moreover, caffeine significantly increased the FBF in response to the acetylcholine. However, neither caffeine nor the placebo altered FBF in response to sodium nitroprusside. The administration of the nitric oxide synthase inhibitor reduced the baseline FBF and eliminated the caffeine-induced increase of FBF to acetylcholine. Blood pressure and heart rate were non-responsive to the delivery of the nitric oxide synthase inhibitor. Based on the results of the study, the researchers stated that the increase in the systolic and diastolic blood pressure help to confirm the vasoconstrictive effects of caffeine in the male population.

To further investigate the pressor effects of caffeine, Jee et al. (1999) conducted a meta-analysis reviewing 11 articles. All the reviewed articles were clinical trials in which coffee consumption was the only difference between the treatment and control groups. The researchers abstracted information such as demographics, hypertensive status, medications, and coffee intake. Additionally, in regards to blood pressure, the researcher used ambulatory blood pressure measurements. For parallel trials, the researchers calculated the mean differences between the coffee minus the control group for the change in blood pressure. For crossover trials, the changes were the mean difference between the coffee treatment and the placebo.

The results of the analysis revealed that coffee administration was associated with an average of 2.4 mm Hg systolic pressure and 1.2 mm Hg for diastolic blood pressure. On average, for each cup of coffee consumed there was a 0.8 mm Hg increase in systolic blood pressure and a 0.5mm Hg rise in diastolic blood pressure. In nine of the eleven reviewed studies, both systolic and diastolic blood pressure rose significantly in the treatment group. For systolic and diastolic blood pressure, the researchers found considerable variation of pressure changes between the treatment and control groups in all of the 11 studies. Using pooled estimates for the 11 studies showed that those in the treatment groups had a highly significant increase in systolic blood pressure and a significant increase in diastolic blood pressure. The researchers noted that the pressor effects of coffee were greater in studies with younger participants, those that administered coffee more often, and those with larger sample sizes. The researchers also reported that the results of the studies did not vary depending on a non-coffee placebo versus a decaffeinated coffee placebo, which indicate that the pressor effects are due to the caffeine content in coffee.

In another study, Karatzis et al. (2003) explored caffeine's effect on both peripheral and central blood pressure. According to the researchers, peripheral blood pressure is typically measured in caffeine studies, but this measurement may not provide sufficient information on caffeine's effect on the cardiovascular system. Therefore, the researchers undertook studying caffeine's affect on central blood pressure, which would accurately demonstrate caffeine's effect on the cardiovascular system. After 12 hours of abstaining from caffeine, the 16 normal blood pressure participants were given one cup of coffee containing 80 mg or one cup of decaffeinated coffee on two different days. The participants' blood pressure was measured in the supine position before consumption and 30, 60, 90, and 120 minutes after consumption. The researchers measured peripheral blood pressure automatic blood pressure cuff placed around the brachial artery. Central blood pressure was noninvasively estimated by measuring aortic pressure waveforms.

The results of the research demonstrated that caffeine did not have a peripheral systolic blood pressure effect in either group, whereas, peripheral diastolic blood pressure increased significantly at 60 and 90 minutes after caffeine consumption. Concerning central blood pressure, both systolic and diastolic blood pressure rose significantly at 60 and 90 minutes after caffeine consumption. Overall, caffeine consumption in the tested participants led to a significant increase in central systolic and diastolic blood pressure, but only rose significantly in peripheral diastolic blood pressure. Meaning that the pressor effects of caffeine on the peripheral blood pressure are short term and due to resistance on vessels and not because of cardiac output. Caffeine's effect on the aorta, as reflected by raised central blood pressure, may be of more importance.

Caffeine is often associated with increased blood pressure, but this claim is controversial as the direct effect of caffeine on the vascular system is unknown (Unemura et al., 2006). Karatzis et al. (2003) argued that research mistakenly focuses on the pressor affects of caffeine on peripheral blood pressure, which may not reflect the more important issue of how caffeine affects central blood pressure, a better measure on the effects of caffeine on primary cardiac organs such as the aorta.

Sleep

One of caffeine's renowned effects is that of increased energy or improvement in performance, and these benefits often can delay sleep, a by-product that can be beneficial or detrimental. Specifically, melatonin, a hormone that manages sleep, can be affected by caffeine (Shilo et al., 2002).

In a critical review examining caffeine's effects on sleep and daytime sleepiness, Roehrs and Roth (2008) stated that the consumption level of caffeine is increasing and that individuals are consuming caffeinated beverages at a younger age. These two factors demonstrate the importance of understanding the impact of caffeine on the general population as well as on youth.

The researchers reviewed the pharmacological properties of caffeine, finding that caffeine's reaches peak levels within 30 to 75 minutes after ingestion with a 3 to 7 hour half-life. Additionally, the researchers found consensus among the articles they reviewed regarding the primary mode of action caffeine has on the body—being that caffeine blocks adenosine receptors, which are responsible for decreasing neural firing and inhibiting neurotransmitters. In other words, adenosine promotes sleep and caffeine blocks its sleep-promoting result.

The authors then turned to the effects of caffeine on sleep in controlled laboratory settings, for which they reviewed six studies. In all studies reviewed the participants received anywhere from 77 to 400 mg of caffeine 30 minutes prior to sleep. Though the results were variable depending on which stage of sleep was most affected, all the articles reviewed reported a significant decrease in overall sleep time and a significant increase in sleep latency, which is how long it takes an individual to fall asleep. Interestingly, the researcher found that caffeine seems to disrupt sleep even at low doses, 77 mg of caffeine, which is comparable to one cup of regular coffee.

Next, Roehrs and Roth (2008) reviewed four articles pertaining to caffeine's effects on daytime alertness and performance. All articles demonstrated a marked increase in one or more areas of performance, which included improvement in attention, reaction time, numeric working memory, sentence verification, semantic memory, logical reasoning, free recall, and recognition recall. To try to understand explain the potential of caffeine as a restorer of performance, the researchers addressed three issues. First, the high rate of basal sleepiness and potentially degraded performance in the typical study participant; second, rebound sleepiness following acute caffeine discontinuation; and third, a withdrawal syndrome associated with caffeine dependence. The researchers reviewed six studies that considered these three issues and found that sleepiness is increased during a caffeine study due to sleep insufficiency relative to the individual's sleep need. The other consideration the researchers found was that increased sleepiness in mid-day may be a function of the accumulated awake time induced by caffeine consumption. The researchers concluded that in the typical caffeine study there could be increased sleepiness and degraded performance among normal participants.

The last area of investigation in this study regarded caffeine's role in sleep and daytime sleepiness in the general population. Roehrs and Roth (2008) stated that this area is particularly difficult to study because of the variety of caffeine sources as well as caffeine content. From the reviewed articles, the researchers averaged that most individuals in the U. S. consume 280 mg of caffeine per day from all sources. One of the studies the researchers reviewed stated that 41% of caffeine consumers reduce their caffeine consumption citing sleep problems as one of the biggest reasons for their cessation. In regards to daytime sleepiness, the authors reviewed two studies that found that high caffeine consumers significantly reported more daytime sleepiness and increased time in bed. Noteworthy to mention, the researchers asserted that the relationship of caffeine to sleep is bi-directional in that disturbed sleep can be a result of caffeine, which leads to sleepiness and sleepiness results in caffeine consumption.

Another study conducted by Shilo et al. (2002) investigated the role caffeine has on melatonin, a hormone that manages sleep cycles. Specifically, Shilo and colleagues explored how coffee consumption affected melatonin secretion, the onset of sleep, and sleep quality. Shilo and colleagues (2002) recruited six regular caffeine consumers.

This double-blind study was comprised of 4 periods, 7 days apart—2 periods where the participants were given 5.3 portions of caffeinated coffee and 2 periods where the participants received 5.3 portions of decaffeinated coffee. During the second period of each treatment regimen urine was collected every 3 hours to determine melatonin secretion. Additionally, the participants were instructed to maintain the same amount of ambient light and to go to bed at the same time each night, both of which are associated with altering melatonin secretion. During sleep the participants wore actigraphs on their wrists to detect levels and quantity of sleep. The participants were also asked to fill out a questionnaire after each study period that inquired about coffee portions, what type of coffee they thought they were consuming, hour of bedtime, and subjective assessment of sleep.

The researchers found that there were significant differences in all areas of sleep parameters. Particularly, the researchers discovered that caffeine decreased the amount of melatonin secretion, especially during 1 and 4 a.m., a time period when melatonin levels should be peaking. A statistically significant difference was found in the amount of sleep with caffeinated-coffee consumers getting on average 19% less sleep than the participants that consumed decaffeinated coffee. Moreover, after consuming caffeinated coffee, the participants took, on average, 58.9% longer to fall asleep. Furthermore, as measured by the actigraphs, those who consumed caffeine were significantly more restless.

Caffeine has the renowned reputation of decreasing fatigue. Even at low doses caffeine decreases overall sleep time (Roehrs & Roth, 2008; Shilo et al., 2002), increases sleep latency (Roehrs & Roth, 2008; Shilo et al., 2002), and even decreases melatonin levels (Shilo et al., 2002).

Metabolism

The research regarding caffeine and metabolism primarily indicates that caffeine negatively affects both insulin resistance (MacKenzie et al., 2007; Williams et al., 2008) and glucose metabolism (Lane et al., 2008; Williams et al.).

MacKenzie and colleagues (2007) investigated caffeine's metabolic effects as well as its effects on melatonin levels and adrenocortical hormones. The 16 participants, ages 18 to 22, were split into two groups, placebo followed by 200 mg of caffeine or 200 mg of caffeine followed by placebo. The participants were asked to abstain from caffeine five days previous to each of the five sessions then asked to take the caffeine or placebo twice a day for seven days. At the end of the seventh day the participants returned for a blood draw to assess blood glucose, adrostenedione, dehydroepiandrosteron, insulin, and cortisol.

McKenzie and colleagues found that 200 mg of caffeine consumed twice daily significantly decreased insulin sensitivity, modestly decreased nighttime melatonin levels, and modestly increased cortisol. However, the researchers did not find effects on androstenedione or dehydroepiandosteron. The researchers noted that the effect of caffeine on insulin levels persisted over the 7-day period, even after the participants went through a period of an overnight fast.

Another study conducted by Williams and colleagues (2008) investigated the affect that caffeine had on adiponectin, a hormone which modulates glucose regulation, in 982 type 2 diabetic women and 1,058 non-diabetic women through the Nurses' Health Study. The researchers collected data about food intake, medications, and diabetes management, and caffeine intake from questionnaires and collected blood samples to assess adiponectin levels.

The results of this study demonstrated that both non-diabetic and diabetic women who drank four or more cups of caffeinated coffee had significantly higher adiponectin concentrations than the women who consumed less or no coffee. Moreover, diabetic women who consumed two or more cups of caffeinated tea per day had a significantly higher concentration of adiponectin albeit the association decreased once adjusted for lifestyle and medical history. No significant interactions were found with food intake or medications. The implications for this study add to the previous research stating that caffeine may decrease insulin resistance by increasing adiponectin concentration.

Another study conducted by Lane and colleagues (2008) found a negative association of caffeine on glucose response in patients with type 2 diabetes. The researchers administered tablets containing 250 mg of caffeine or a placebo twice daily for two days to 10 diabetic participants. Wearing the MiniMed subcutaneous glucose monitor, the participants' blood glucose was measured continuously. The participants recorded what they ate for breakfasts, lunches and dinners.

The results from the glucose monitor showed that caffeine significantly increased average daytime glucose level in comparison to those who received the placebo. In addition, caffeine significantly raised the average glucose concentration in the three hours following breakfast, lunch, and dinner. These finding suggest that caffeine has an adverse affect on glucose management in patients with type 2 diabetes.

Caffeine negatively affects metabolism through decreasing insulin sensitivity (MacKenzie et al., 2007; Williams et al., 2008) and raising glucose levels (Lane et al., 2008; Williams et al.). Both of these negative effects of caffeine may have implications for those with or at risk for type 2 diabetes.

Physiological Effects of Caffeine on Adolescents

Little research has been done on the health effects of caffeine on the adolescent population (Bernstein et al., 2002). The fact that this topic is under researched may be problematic in light of the fact that caffeine consumption is increasing in the adolescent population (Bernstein et al.). The studies that do exist demonstrate that caffeine has similar effects on adolescents as it does on adults (Bernstein et al.; Hughes & Hale, 1998). However, these effects may have different implications (Bernstein et al.; Pollack & Bright, 2003)

Performance

Most research regarding caffeine consumption and adolescents has determined that caffeine negatively affects this population. Hughes and Hale (1998) reviewed 57 articles pertaining to the subject of caffeine's effect on children and adolescents. The researchers divided the review into the effects of caffeine on healthy children, caffeine tolerance and discrimination, and effects of caffeine on children with attention deficit-hyperactivity disorder (ADHD). The researcher further split the categories into subjective and performance effects.

Hughes and Hale (1998) found that caffeine's subjective effects on healthy children were negative, especially when the children typically consumed little or no caffeine. The author noted that positive subjective effects of caffeine on children have not been tested. In regards to caffeine's performance effects on healthy children, the researchers established that acute caffeine intake improved performance on vigilance tasks among caffeine-using children, but no research existed in this area with children who consume little or no caffeine. Interestingly, in researching caffeine tolerance and discrimination, the researchers discovered that some adolescents use soft drink for its pharmacological effects, specifically increased alertness. From the studies reviewed, the researchers stated that caffeine withdrawal effects on children were unclear because of methodological flaws such as lack of follow-up. High caffeine consumption symptoms appeared similar in children and adults, as a 3-10 mg dose of caffeine reportedly produce headaches, stomachaches, and nausea. Examining caffeine's effect on children with ADHD, the subjective effects of caffeine on this group had minimal effects on the ratings of the childrens' behavior. Also, the researchers found that caffeine's effect on performance varied greatly amongst children with ADHD children.

In conclusion, the literature review conducted by Hughes and Hale found varying effects of caffeine. Possibly, the most significant finding in the study was the inconclusive information about children and caffeine dependence as assessed by withdrawal effects. The authors stated that caffeine is not a benign food additive because of its stimulant properties and its addiction potential.

Caffeine can have a positive impact on the physical performance of adolescents. Kristiansen, Levy-Milne, Barr, and Flint (2005) conducted a study examining supplement use among 169 varsity athlete and 214 non-varsity students where caffeine was one of the supplements studied. The researchers used a questionnaire to assess prevalence of supplement use, reasons for using supplements, sports participation, and demographics.

Concerning caffeine, Kristiansen et al. (2005) reported that caffeine is the most frequently used supplement by both groups with 87% of male and 71% of female varsity athletes and 27% of male and 57% of female non-varsity students reporting use—with no significant difference between genders in either group. The majority of caffeine was consumed through soft drinks and coffee. Additionally, the varsity athletes reported several reasons for consuming caffeine such as “counteracts tiredness, provides more energy, and enhances performance (Kristiansen et al., p. 203).

Sleep

Like adults, the sleep patterns of adolescents are affected by the consumption of caffeine. Pollack and Bright (2003) researched caffeine’s effect on the sleep patterns of adolescents. The study administered surveys to 191 seventh, eighth, and ninth graders to determine both the use of caffeine by the students and their sleep patterns. For fourteen consecutive days, the students were asked to record what time they went to bed, if they took naps, and if they woke-up after sleep onset, names of caffeine-containing products they had consumed, and how much caffeine they consumed each day.

The outcome of the research showed the mean intake of caffeine was 53.7 mg per day for the surveyed sample, yet 27% of the respondents reported 50 to 100 mg daily caffeine intake, 12% of the sample averaged 100-150 mg of caffeine use daily, and 6.8% reported consuming more than 150 mg of caffeine a day. Comparing caffeine consumption to sleep patterns, increases in caffeine consumption was significantly correlated with less sleep and more interrupted sleep in the sample. The data also indicated that these associations were correlated with age. Specifically, delayed bedtimes and more interrupted sleep were more significant for those in the eighth and ninth grades. The researchers discussed the possible implication of sleep deprivation on school performance and proposed the caffeine availability to adolescents should be limited.

Orbeta, Overpeck, Ramcharran, Kogan, and Ledsky (2006) echoed the results of Pollack and Bright (2003) stating that caffeine has a profound effect on sleep in adolescents. The researchers used the data from Through the Health Behavior in School-aged Children Study that surveyed 15,686 adolescents, grades sixth through tenth. The participants reported difficulty sleeping and tiredness in the morning for the last six months. Also, the participants were questioned about their coffee and soft drink consumption to determine their caffeine intake.

Coffee consumption was low with 56.3% of the participants reporting that they never drink coffee, while 43% of the participants reported drinking one or more caffeinated soft drinks per day. Fifty-four percent of the participants were classified as high or moderate caffeine consumers and these groups were 1.9 times more likely to report difficulty sleeping and 1.8 times for likely to report being tired in the morning in comparison with the low caffeine consumers. From these results it appears that moderate and high doses of caffeine interrupts the adolescent sleep cycle causing sleep disturbances and morning tiredness.

Another study conducted by Giannotti and colleagues (2002) investigated adolescents and their sleep patterns, sleep problems, daytime sleepiness, and daytime behavior. The 6,631 participants, ages 14 to 18, completed the School Sleep Habits Survey—specifically examining how adolescent behavior and psychology affect their circadian rhythm, the internal clock that regulates sleep. The researchers split the sample into two groups ages 14.1 to 16 and ages 16.1 to 18.6. The data categorized the (*n* = 752) participants as Evening types (E-type) and (*n* = 1005) as Morning types (M-type).

Most relevant to the current study, E-types reported higher consumption of caffeine and caffeine-containing beverages. E-types also reported significantly higher scores on the Sleep/Wake Behavior Scale, which indicates sleep problems in these adolescents. Moreover, E-types in both age groups reported more emotional problems, poorer school performance, more attention problems, more injuries, and an increased tendency to fall asleep during school. The researchers concluded that insufficient sleep has negative implications for adolescent psychological and physical health.

As part of a literature review, Roehrs and Roth (2008) examined caffeine's effect on sleep and daytime sleepiness in youth. Most important for the present study, Roehrs and Roth (2008) affirmed that children and adolescents' sleep problems and daytime sleepiness is strongly associated with caffeine consumption. From their review, the researchers found that caffeine in this age group is most commonly derived from soft drink, chocolate, and tea with a wide range of milligrams reported. Though the consumption levels are lower than adult levels, adolescents are negatively affected by their caffeine consumption. One study reviewed concluded that adolescents who report consuming high amounts of caffeine were 1.9 times more likely to report difficulty sleeping and 1.8 times more likely to report morning-time sleepiness. Other studies reviewed, provided similar results about caffeine's role in adolescent sleep problems.

The research regarding the effect of caffeine on sleep in the adolescent population shows negative consequences. Specifically, the implication of disrupted sleep due to caffeine consumption negatively affects adolescent school attendance (Giannotti et al., 2002), school performance (Giannotti et al.; Pollack & Bright, 2003), and psychological health (Giannotti et al.), and safety (Giannotti et al.).

Dependence

As with adults, the risk of caffeine withdrawal and dependence also applies to children and adolescents. To examine the prospect of caffeine dependence in children and adolescents, Bernstein and colleagues (2002) recruited 36 participants, ages 13-17. The authors discussed that little research had been done with adolescents and caffeine dependence despite the fact that caffeine is the most widely used stimulant among this population. This lack of research is problematic for the reason that caffeine consumption is increasing in the adolescent population, particularly through the consumption of soft drinks, of which 70% contain caffeine (Bernstein et al.).

Through telephone surveys, participants reported demographic information, caffeine use, and parental consent. The participants then underwent an outpatient dietary history to evaluate the amount and sources of caffeine consumption. Additionally, the participants were administered the Diagnostic Interview Schedule for Children-IV (DISC-IV), Personal Experience Screening Questionnaire, Beck Depression Inventory, and Revised Children's Manifest Anxiety Scale.

The results of this in-depth research study showed that the average caffeine consumption of the participants was 244.4 mg per day. In particular, soft drinks accounted for 61.8% of caffeine intake, while coffee accounted for 34.9% and tea 3.3%. Regarding caffeine dependence, the data were analyzed based on the American Psychological Association's DSM-IV criteria for dependence. Based on these criteria, the results were that 41.7% of the participants reported tolerance symptoms, 77.8% reported symptoms of withdrawal, 38.9% of the sample reported unsuccessful quitting attempts, and 16.7% reported caffeine use despite problems. This being stated, 22.2% of the sample qualified, under the DSM-IV criteria, as dependent on caffeine. The surveys investigating anxiety and depression also provided interesting results. The caffeine-dependent group had significantly higher scores on the anxiety and depression scales (Bernstein et al., 2002).

Oberstar and colleagues (2002) conducted a 1-year follow-up study on their previous research examining adolescent dependence on caffeine. Out of the 36 participants in the baseline study, 21 returned to participate in the follow-up. As in the baseline study, the participants in the follow-up recorded a 3-day dietary history of caffeine consumption. Additionally, the participants underwent a structured interview that assessed the DSMV-IV criteria for dependence. The researchers also administered a personal experience screening, an anxiety scale, and a depression scale to each participant.

The results of this follow-up determined that the returning participants were not significantly different than the participants that did not return, other than reporting a higher socioeconomic status. In comparison to baseline data, the participants had lower caffeine consumption with 179.9 mg per day versus 244.4 mg per day. That being stated, the researchers claimed that the participants in the follow-up study still consumed a much higher rate of caffeine than the national average.

Regarding dependence, 66.7% of the participants reported withdrawal symptoms after stopping the use of caffeine with the most common symptoms reported being drowsiness and headache, 38.1% reported caffeine tolerance, 33.3% reported unsuccessful attempts at quitting use, and 4.8% reported use despite physical or psychological problems. Overall, five of the participants meet the DSM-IV criteria for dependence, with only one of the five reporting a previous diagnosis of dependence from the baseline study. Interestingly, there was no significant difference between the mean daily intake of caffeine in the dependent and non-dependent groups—signifying that underlying factors other than amount of caffeine influence dependence. Caffeine dependent adolescents scored higher on both the anxiety and depression scores, but the difference was not significant. Additionally, there was no statistically significant difference on the personal experience screening between the dependent and non-dependent groups.

It appears that adolescents, like adults, are also at risk for becoming dependent on caffeine based on the DSM-IV criteria (Bernstein et al., 2002; Oberstar et al., 2002). Additionally, adolescents that are dependent on caffeine tend to score higher on anxiety and depression scales (Bernstein et al.; Oberstar et al.).

Though there is some research that demonstrates the positive effects of caffeine on adolescent performance (Hughes & Hale, 1998; Kristiansen et al., 2005) the majority highlight negative effects such as sleep disturbances (Giannotti et al., 2002; Orbeta et al., 2006; Pollack & Bright, 2003; Roehrs & Roth, 2008) and dependence potential (Bernstein et al., 2002; Oberstar et al., 2002). Given what is known about caffeine's psychoactive effects, it is imperative that highly-caffeinated energy drinks are researched to determine the health impacts of this recent trend, particularly among the adolescent population.

Physiological Effects of Soft Drinks

Aside from caffeine intake, there are other health implications of soft drinks. Increased energy intake (Cotton et al., 2004; Vartanian et al., 2007), unhealthy body weight (Ludwig et al., 2001) some negative health effects associated with soft drink consumption. Additionally, though the results vary, soft drinks are associated with decreased milk and calcium intake (French et al., 2003; Vartanian et al.; Vatanparast et al., 2005), and an increase in dental caries (Tahmassebi et al., 2004).

Energy Intake and Body Weight

Soft drinks are associated with increased energy intake and unhealthy body weight. Vartanian and colleagues (2007) conducted a meta-analysis of 88 studies to explore the effects of soft drinks on four primary topics: energy intake and body weight, milk intake, and calcium intake. Out of the 88 studies reviewed, the authors noted great variability in the design and therefore split the studies based on strengths of the design. The results of the meta-analysis were variable for energy intake and soft drink consumption. Cross-sectional and longitudinal designs showed a small effect size for energy intake, where experimental designs showed a medium effect size. Two of the cross-sectional studies as well as one of the experimental studies cited that the increased energy intake was more than what could be explained by soft drink consumption alone.

Also, Vartanian and colleagues (2007) revealed that body weight was operationalized in several ways, even within the same study. Effect size varied for the association between soft drink consumption and body weight, with cross-sectional and longitudinal studies having a very small effect size while experimental studies had a medium effect size. The researches also recognized that effect sizes were larger in studies that researched women, adults, studies that focused on sugar-sweetened beverages, and studies not funded by the food industry.

As part of a larger study that examined the dietary sources of nutrients among US adults, Cotton and colleagues (2004) collected data from the USDA's Continuing Survey of Food Intakes by Individuals (CSFII) for ages 19 years and older. The researchers found that soft drinks are the fourth biggest contributor from all the sources of calories consumed, at 25.8%. Additionally, soft drinks account for 23.4% of carbohydrate intake, making it the second leading contributor to carbohydrate intake.

Cotton and colleagues also (2004) addressed the health implications of soft drinks. The researchers found that soft drink consumption contributes to increased energy intake, which may have effects on weight due to soft drink's high sugar content.

Because of the rise in childhood obesity, much of the research regarding increased energy intake and soft drinks focuses on the child and adolescent populations. One such study was conducted by Ludwig et al. (2001), which examined the increased energy intake resulting from sugar-sweetened beverage and its affect on Body Mass Index (BMI). The participants (n = 548), ages 11 and 12, were part of the Planet Health intervention and evaluation project. The BMI of the participants were calculated using the participants' heights and weights. Dietary patterns and activity levels were measured using the youth food-frequency questionnaire and youth activity questionnaire. Data were collected at baseline and again two years later to detect changes in BMI due to the consumption of sugar-sweetened beverages.

From baseline to the follow-up period 57% the participants increased their sugar-sweetened beverage consumption. After adjusting for confounding factors, the data showed that the consumption of sugar-sweetened beverages significantly increased BMI over the 2-year period. Specifically, for each daily serving of a sugar-sweetened beverage, BMI rose .18, a trend that significantly increased the chance of becoming obese in the two-year follow-up.

From examining current research it seems that soft drinks are, in varying degrees, positively associated with increased energy intake (Cotton et al., 2004; Vartanian et al., 2007). Additionally, there is research that links soft drinks with an increase in body weight, particularly among children and adolescents (Ludwig et al., 2001).

Milk and Calcium Intake

One of the primary concerns of sugar-sweetened beverage consumption is the possible displacement of milk. As part of their meta-analysis, Vartanian and colleagues (2007) researched the relationship between soft drink consumption and milk and calcium intake. From the 88 studies the researchers reviewed they found varying effect sizes depending on design type. Cross-sectional studies had a small effect size for both milk and calcium intake while longitudinal studies showed a near medium effect size for milk but a small effect size for calcium. Additionally, the authors found that studies funded by the food industry showed a slight positive association between soft drink consumption and milk and calcium consumption while studies that were not funded by the food industry showed a slight negative association. Overall, the studies the researchers reviewed revealed an overall negative association between soft drinks and milk and calcium intake.

In regards to calcium displacement and its impact on adolescents, Vatanparast and colleagues (2005) used data collected from 218 ninth graders at three points in time over 13 years from the Pediatric Bone Mineral Accrual Study (PBMAS) and the Fluids Used Effectively for Living (FUEL) study. For both the PBMAS and FUEL data were collected via 24-hour dietary recall for which the participants had to name and quantify all food and beverages consumed. Beverages were split into fluid milk, fruit juice, and soft drinks.

The results indicated over the 13 time period that the contribution of milk to total beverage intake decreased significantly in both boys and girls, while fruit juice and soft drinks significantly increased in both groups. There was a significant negative association between milk intake and soft drinks in both the boys and girls. Specifically, overall caloric intake attributable to soft drinks was 50% for boys and 34% in girls. Also, the mean calcium intake decreased significantly from 997 mg in 1997 to 772 mg in 2004 in girls, but not in boys—indicating that girls may be at higher risk for inadequate calcium intake that could detrimental to achieving peak bone mass.

Though many studies found a negative association between soft drinks and milk and calcium displacement, Forshee, Anderson, and Storey (2006) did not find a relationship. By examining data from four years of the Continuing Survey of Food Intake by Individuals (CSFII) and four years of data from National Health and Nutrition Examination Survey (NHANES) the researchers were able to gather information about how age, gender, and beverage consumption are associated with milk and calcium intake.

The participants were split into five groups by age: 6-11, 12-19, 20-39, 40-59, and 60+ for each of these groups the researchers analyzed calcium intake, fluid milk consumption, non-milk beverage consumption, and energy intake.

Though the researchers noted that calcium intake levels were still below recommended levels, they found that calcium intake had actually increased since the previous CSFII studies in some of the groups including 12-19, 20-39, and 40-59 year old females. In comparison to earlier CSFII and NHANES studies, there was an increase in soft drink consumption in all age and gender groups. However, this increase in soft drinks was not at the expense of milk consumption or calcium intake. Not surprisingly, the researchers found that the biggest influence of calcium intake was milk consumption.

Decreased milk consumption has an implication on calcium intake, as milk is the biggest contributor to calcium (Forshee et al., 2006). The impact of soft drinks is a concern for the general population (Vartanian et al., 2007), but is of particular interest in the younger population because childhood and adolescence is marked by rapid bone growth (Vatanparast et al., 2005) and because of the growing trend of soft drink availability in schools (Tahmassebi et al., 2004).

Dental Caries

Sugar-sweetened beverages, such as soft drinks, are frequently associated with poor dental outcomes. Tahmessebi and colleagues (2004) performed a literature review examining the effects that soft drinks have on teeth. Through their review, the researchers found that soft drinks are the largest source of added sugar in the United States and that they damage teeth in one of two ways: through their acidity they erode enamel surface and lead to cavities or the sugars are metabolized by microorganisms in the mouth that lead to cavities.

Through their literature review, Tahmessebi and colleagues (2004) found that there is a positive association between total caries and the frequency of sugar-sweetened carbonated beverages. Additionally, the researchers found that most of the research regarding dental caries is conducted on children because immature enamel is more porous and more easily penetrated by acids. However, they also found that the general population is also at higher risk for tooth decay because of the ability of soft drinks to damage tooth enamel and their ability to foster dental caries. Theses abilities of soft drinks coupled with the prevalence of soft drink consumption is of particular concern. Interestingly, the authors also found that diet soft drinks, though they contain artificial sweeteners, also tend to increase enamel erosion (Tahmessebi et al.).

Another study, conducted by Forshee and Storey (2004), examining the influence of beverages on dental caries found mixed results. Using data from the 24-hour recall and FFQ portions the National Nutrition Examination II 1988-1994, the researchers were able to examine four nationally representative groups ages 17-24, 25-40, 41-60, and over 60. For each age group types of beverages consumed were reported as were the number of decayed, missing, and filled surfaces (DMFS).

The researchers found that the average number of DMFS increased significantly with age, as the 41-60 and over 60 groups had significantly more DMFS than the younger groups. The researchers also found that the 17-24 year olds consumed the largest quantity of soft drinks, an average of 495 g per day. In regards to the two variables together there were few significant results. In the 24-hour recall, regular soft drinks were significantly associated with an increase in DMFS in the 25-40 year olds. Specifically, almost one DMFS was attributed for every 12 oz serving of soft drinks. From the FFQ data, higher soft drink consumption was significantly associated with higher DMFS for the 25-40 and over 60 groups. Those statistics being stated, there are some interesting incongruencies. Though the 17-24 year olds consume the highest amount of soft drinks, they had the lowest reported DMFS. The over 60 group, the least avid soft drink consumers, had the highest DMFS. Because of these discrepancies the researchers concluded that there is no direct correlation between soft drink consumption and DMFS.

Overall, soft drinks have the potential to negatively affect dental health. Tahmessebi and colleagues (2004) found an association between soft drinks and poor dental outcomes such as enamel erosion and dental caries. Though, Forshee and Storey (2004) did not find an association between soft drinks and dental problems for the general population, they did find a significant association for the 25-40 and over 60 groups.

Soft drinks are associated with many negative health outcomes. Though there is some variability among research findings, soft drinks are associated with increased energy intake and unhealthy body weight (Cotton et al., 2004; Ludwig et al., 2001;Vartanian et al., 2007), decreased milk and calcium intake (Vartanian et al.; Vatanparast et al., 2005) and poor dental outcomes (Tahmessebi et al., 2004). These negative outcomes coupled with the high prevalence of soft drink consumption makes them of particular concern for both adults and youth.

Prevalence of Energy Drink Consumption

The consumption pattern of energy drinks has not yet been thoroughly researched (FSPB, 2002). In fact, there are only three full research studies that have been conducted to understand the reasons behind why individuals consume energy drinks. From these studies, some of the reported reasons for consumption range from improved sports performance (FSPB) to drinking as a substitute for soft drinks (O'Dea, 2003) to recovering from a hangover (Malinauskas et al., 2007).

In their research examining energy drink consumption Malinauskas and colleagues (2007) surveyed 496 college students. Specifically, the researchers examined the prevalence and frequency of energy drink consumption for six situations: to compensate for insufficient sleep, to increased energy, when studying, when driving long distances, when drinking with alcohol, and to treat hangover. Additionally, the researchers assessed adverse side effects and dose effects associated with energy drinks.

The results indicated that 51% of the surveyed participants drank more than one energy drink a month. Interestingly, converse to other research, the majority of the energy drink consumers were female. Females were also more likely than males to drink the sugar-free versions of energy drinks. From the six situations inquired about, insufficient sleep was the most common reason that the participants drank energy drinks as indicated by 67% of the participants. Sixty-five percent reported drinking energy drinks while partying, 50% reported use while studying, and 17% drank energy drinks to treat a hangover. Fifty-six percent of the participants drank one energy drink for each of the situations. When drinking with alcohol, 49% reported drinking three or more energy drinks in one episode. To further identify relationships between the six situations and energy drink consumption, the authors combined all the situations together and compared it to the number of energy drinks consumed for any of the situations. These results showed that drinking three or more energy drinks for a situation occurred more frequently among those participants who consumed energy drinks for three or more of the situations assessed. In other words, those participants who consumed more energy drinks tended to be the participants that reported energy drink use in multiple situations.

As part of a larger study about energy drinks, the FSPB conducted a survey and interviews about energy drink, the information appeared in its publication Safefood (FSPB, 2002). The target population for this report was 11 to 35 year olds; the researchers reported that this age range is the group for whom energy drinks are targeted.

The survey was delivered by Lansdowne Market Research on behalf of the FSPB as part of an omnibus study. Therefore, specific methodology was not included in the final report. However, the report did convey that the population was initially surveyed to obtain quantitative information and afterwards the researchers conducted interviews to determine reasons behind why individuals consume energy drinks. In the quantitative portion of the study 1,260 participants, ages 11 to 35, in Northern Ireland and the Republic of Ireland, were surveyed. The participants answered questions about consumption levels of energy drinks, consumer drinking repertoire, time and place of consumption, and average quantity consumed.

The researchers found interesting consumption patterns and attitudes toward energy drinks. Fifty-one percent of surveyed individuals in Northern Ireland and 37% of the individuals surveyed in the Republic of Ireland had drunk an energy drink at least once and 10% of those were regular consumers, with males, ages 19 to 24, consuming the majority. The most common site of consumption was at pubs or clubs, but many also reported consuming energy drinks at home, before and after sports, and while driving. A particularly fascinating finding was that the regular consumers reported drinking an average of three to eight 250 ml cans weekly. Similarly, in a single session, the average amount consumed was three cans or 750 ml, which implies that weekly consumption may take place in a single session. Also, participants reported reasons for consumption were to "perk themselves up when tired, on big nights out, to perk themselves up when they have too much to drink, and with alcohol to enable them to drink more in an evening" (FSPB, 2002, p. V).

The qualitative portion of the study was carried out to address public concerns regarding consumption of energy drinks. This portion of the study included three distinct groups, 15 parents of participants ages 11 to 35, 16 consumers ages 11 to 35, and 15 consumers under the age of 11. The interview questions geared toward the parents inquired about the parental awareness of their childrens' energy drink consumption and if they were aware if their children consumed energy drinks with alcohol. The interviewers asked the 11 to 35 year olds if they had consumed Red Bull in the past, if they mixed energy drinks with alcohol, what they knew about energy drinks, and if they knew any negative outcomes of energy drink consumption. The under 11 interviewees were asked if they were familiar with Red Bull, why they think people drink energy drinks, if and why they drink energy drinks, and if they had any barriers to drinking energy drinks.

Some insights gained through their interviews were that the main concern of the parents was the consumption of energy drinks with alcohol and the uncertainty about the safety of the ingredients in energy drinks. Information reaped from the 11-35 year olds was that the majority of them drank Red Bull and that they typically mix Red Bull with vodka or whiskey. All consumers were aware of health concerns of drinking energy drinks, especially when mixed with alcohol, and all claimed awareness of deaths and adverse reactions associated with energy drinks. Particularly, they were concerned that high levels of caffeine can lead to panic attacks and insomnia, but they drank them anyway. Of course, many of the interviewees reported positive attributes with energy drinks such as reducing fatigue. With the interviewees under age 11, almost all of them had tried Red Bull. Many in this group stated that energy drinks fill the gap between soft drinks and alcohol for children and it claimed that they are easily available. Many had heard bad things that can happen to people when they drink energy drinks. Both the qualitative and quantitative portion of this study provided valuable insights about the consumption patterns, knowledge, and attitudes toward energy drinks.

A qualitative study conducted by O'Dea (2003) investigated reasons why adolescents, ages 11 - 18 consume energy drinks. The 73 adolescents were divided into 16 focus groups and for each of the focus groups the researchers questioned the adolescents about their supplement consumption in the past 2 weeks. Both energy drinks and guarana, a caffeine containing plant, were considered supplements in this study.

The interviews revealed that 43% of the adolescents reported consuming at least one energy drink and 5.2% reported consuming guarana. After identifying the prevalence of supplement consumption the researchers delved into the reasons for consumption. Listed in descending order of importance, the adolescents in the study cited that they drank energy drinks because they believed it gave them increased energy, improved their sports performance, drank as a substitute for soft drinks, peer pressure, and attractive packaging. The reason why adolescents stated they used guarana was for a feeling of increased energy. The researcher stated that what the adolescents perceived as increased energy was a marked stimulant effect of the supplements, namely caffeine (O'Dea, 2003). Additionally, the researcher stated that none of the adolescents discussed the negative consequences of any of the supplements—indicating a possible gap in knowledge about potentially harmful effects of the supplements.

Energy drinks are marketed for 11-35 year olds (FSPB, 2002). From research conducted with this population Malinauskas et al. (2007) found that over half of surveyed college students drank more than one energy drink the last month and O'Dea (2003) found that 43% of 11-18 year olds reported consuming at least one energy drink in the last two weeks. Additionally, many energy drink consumers drink the majority of their energy drinks in a single session (FSPB), which may put these high-caffeine consumers at risk of adverse effects.

Physiological Effects of Caffeine in Energy Drinks

Overall, the high caffeine content of energy drinks account for these drinks positive and negative affects (Smit et al., 2004). Though the caffeine content generally shows improvement in mood (Alford, Cox, & Westcott; Smit & Rogers, 2002; Smit et al.) cognitive performance (Alford et al., 2001; Mucignant-Caretta, 1998; Seidl, Peyrl, Nicham, & Hauser, 2000; Smit et al.; Smit & Rogers), and physical performance (Alford et al.; Forbes, Candow, Little, Magnus, & Chilibeck, 2007), they have also been shown to negatively affect sleep (Jay et al., 2006), sleep quality (Jay et al.), and even incur adverse reactions (Iyadurai & Chung, 2006; Machado-Vieira et al., 2001).

Cognitive Performance

Like in other caffeine-containing beverages, energy drinks are studied in an effort to understand the affect caffeine has on performance. Warburton et al. (2001) sought to reduce methodological flaws by not requiring the 42 participants to abstain from caffeine prior to the study. The participants were randomly given 250 ml of a taurine-containing energy drink with 80 mg of caffeine, 250 ml of a caffeine-free glucose placebo, or 250 ml of a caffeine-free, glucose-free placebo. The participants were then tested for attention, verbal reasoning, verbal memory, spatial memory, and mood assessment.

In both sessions, the caffeinated-taurine drink significantly improved attention as measured by rapid visual information processing in both the number of correct items detected as well as reaction time. Also, reaction time for verbal reasoning was significantly faster in comparison to those in the placebo groups. The participants that consumed the caffeinated-taurine drink significantly reported more positive mood changes such as alert, clearheaded, and attentiveness. However, no significant effects were found for verbal memory or spatial memory. Nor did the researchers find any difference between the placebo groups.

In a three-series study, Smit and colleagues (2004) investigated the effects of carbonation, sugar, and caffeine in energy drinks with 271 adult participants. The first series involved a double-blind distribution of caffeine, sugar containing energy drinks or a placebo. The second series built on the results of the first study and compared the role of the individual ingredients of caffeine and sugar and their interaction by administering drinks to the participants that contained both, one, or none. The third series investigated the glucose-related effects of energy drinks. In each series, the drinks were administered and then the participants performed a sequence of tasks such as simple reaction time, rapid visual information processing, immediate and delayed word recall task, and letter search task.

The results of the first series showed that energy drinks had a statistically significant energizing effect on the participants in comparison to the placebo. Specifically, there was a significant increase in reaction time and information processing. The second series revealed that the energy drinks repeatedly were the biggest contributor to increased reaction time when compared to the various placebos. In the third study, Smit and colleagues (2004) found that carbonation significantly decreased scores on rapid visual information processing. However, contrary to what the researchers expected, the sugar-containing placebo did not demonstrate an improvement in energy or memory.

Another study conducted by Smit and Rogers (2002) examined the effects that energy drinks had on performance and mood. Smit and Rogers hypothesized that the main effects of energy drinks are due to their caffeine. The 23 participants were asked to abstain from caffeine the night before the study until testing where they received one of the treatments a week. The treatments consisted of 150 ml of energy drink A, 150 ml of water, 250 ml of energy drink B, 250 ml of water, or a short break. Both energy drinks contained 75 mg of caffeine. Before being administered the treatment or the placebo, the participants underwent a tiring mental task for the purpose of inducing a state of mild fatigue; a state caffeine is reported to combat. Then the participants underwent cognitive performance tasks such as simple reaction time, rapid visual information processing, memory tasks, and mood assessment.

The researchers found that there was a significant main effect for simple reaction time, but there was not a significant effect treatment by time—indicating that there was an absence of expectancy effects of the drinks on reaction time. There was also a significant effect on rapid visual information processing. The memory tasks showed no main effects.

Another study conducted Kennedy and Scholey (2004) examined the effects of energy drinks on performance by investigating the primary ingredients of caffeine and glucose. Over six study days, the 20 caffeine-deprived participants took part in all five conditions, which consisted of a 250 ml placebo with no glucose, caffeine, or herbs, a 250 ml placebo containing no glucose or caffeine, but flavored with herbs, a 250 ml treatment containing 75 mg of caffeine, a 250 ml treatment of 37.5 mg of glucose, and a 250 ml complete energy drink with 75 mg of caffeine, 37.5 mg of glucose, and flavored with herbs. The participants were tested for heart rate and blood glucose prior to consuming the beverage and 30 minutes after. Also, the participants underwent mood assessments and cognitive assessments 30 minutes after consumption of their beverages.

Based on the data, there were several factors that bore significant results. Heart rate significantly increased after the receiving the glucose only drink, but not in any other condition. Additionally, cognitive memory and speed of attention were significantly improved in the complete energy drink condition. Worthy to note, the caffeine-only drink demonstrated a trend to improve these same cognitive assessments, but failed to reach significance. Surprisingly, there were no significant mood differences in any of the conditions. Therefore, the combination of glucose and caffeine provided more significant results than in any of the other conditions signifying that when taken together performance is further enhance

In a three series study, Alford and colleagues (2001) researched the performance and mood effects of the popular energy drink Red Bull. Each of the three series was conducted over a four-week period. The first series conducted with10 participants, examined pre and post heart rate, blood pressure, subjective mood, and choice reaction time. The second series, with 14 participants, assessed heart rate, blood pressure, subjective alertness, and choice reaction time both pre and post treatment. In the third series, the researchers measured pre and post cognitive tasks that examined concentration and memory as well as anaerobic and aerobic exercise in 12 participants.

Just as the measures varied in all of the three studies so did the treatments. The first series tested the effects of carbonated mineral water against Red Bull. A “no drink” control was added to the second study and a caffeine-free placebo energy drink was added as an additional treatment group for the third study. Participants were asked to abstain from caffeine on study days in the second and third study but not the first. Each of the treatment groups were given 250 ml of their respective beverage with Red Bull containing 80 mg of caffeine. Participants were tested before treatment and 30 minutes after treatment to allow for absorption of the beverage.

Results from the first series showed that reaction time was significantly improved in the treatment group. The second series demonstrated that choice reaction time and subjective alertness showed a significant increase in the Red Bull condition. Interestingly, blood pressure remained relatively stable in all conditions, but heart rate was significantly higher for the participants who consumed Red Bull. The third series showed that memory performance, as assessed through immediate recall, showed a significant increase in the treatment condition—however, concentration showed only marginal improvement in the treatment condition. Again, there were no significant differences in blood pressure in any of the groups.

In another study investigating energy drinks, Mucignant-Caretta (1998) looked at the effects of these drinks on the performance 12 occasional caffeine consumers. The sample was asked to abstain from caffeine 12 hours previous to testing that was done in two sessions a week apart. The participants were given either 150 ml of the energy drink Red Bull containing 32 mg caffeine or 250 ml of a placebo, which simulated the look and taste of Red Bull. Thirty minutes after ingestion the participants were tested on simple reaction time and go-no-go reaction time test.

The results of the testing were analyzed by gender, by drink, and by test type. The research demonstrated that overall, males were faster than females in both types of tests, but only significantly for simple reaction time. As far as type of drink, the treatment significantly increased reaction time for the go-no-go test, but not for the simple reaction time test. When examining type of test, only the interaction between females and the go-no-go test reached significance. Results reached highly statistically significant with the interaction between female, go-no-go test, and the treatment drink.

Also, Seidl and colleagues (2000) investigated energy drinks' influence on cognitive performance and subjective well-being. After abstaining from caffeine overnight, 10 participants were given a placebo capsule or a capsule containing 80 mg caffeine, 600 mg glucuronolactone, and 1.0 g taurine—amounts similar to what is contained in one 250 ml can of an energy drink. The participants were then tested for event-related potential (ERP) via auditory stimuli, for which they were instructed to report the total number of infrequent tones as well as to press a button as quickly as possible. Additionally, the participants filled out a test that measured attention capacity in a stressful situation and a questionnaire to assess subjective mood and well-being.

The results indicated reaction time significantly improved after ingestion of the treatment capsule. Additionally, over time, latency increased in the placebo group whereas latency was preserved in the treatment group. Attention capacity in stressful situation showed improvement in both the treatment and placebo groups, however, the p-values were higher in the treatment groups. Lastly, the placebo group reported significantly lower scores on subjective mood and overall well-being.

The majority of research examining energy drinks' effects on cognitive performance found positive results. However, it is interesting to note that the Alford et al. (2001) and Mucignant-Caretta (1998) studies reported that Red Bull Corporation funded their studies, which may have influenced the results.

Physical Performance

The manufacturers of energy drinks often market these drinks for their ability to improve physical performance (Forbes et al., 2007). Therefore, researchers are now exploring this claim. A study conducted by Forbes and colleagues examined the effects of Red Bull versus a placebo with 16 participants. The treatment consisted of a drink containing 2.0 mg of caffeine per kg of body weight and the placebo was a look-a-like beverage with no caffeine. Participants were tested twice and were required to abstain from caffeine for 48 hours prior to the study sessions. Sixty minutes after ingestion of the treatment or placebo the participants were tested for muscle endurance over three bench-press repetitions at an intensity of 70% of the baseline maximum. Also, cycle performance was measured by three, 30 second Wingate cycling peak and power tests with an intensity of 7.5% of the participants' body mass.

The data collected signified that Red Bull significantly increased bench press repetitions in comparison to the placebo group. However, Red Bull had no effect on either peak or power cycle performance tests.

As part of their study on the performance and mood effects of energy drinks, Alford and colleagues (2001) researched anaerobic and aerobic exercise. After abstaining from caffeine overnight the 12 participants consumed carbonated mineral water, Red Bull, a caffeine-free placebo, or no drinks at all. Each of the treatment groups were given 250 ml of their respective beverage with Red Bull containing 80 mg of caffeine and then tested 30 minutes after ingestion. In regards to physical performance, the researchers found that both anaerobic and aerobic exercise significantly improved with Red Bull.

Another study, conducted by Specterman and colleagues (2005), explored the role of caffeine and glucose on corticospinal excitability as measured by motor-evoked potentials (MEPs). MEPs in muscles typically become engaged during voluntary tasks, however other factors have recently been linked to MEPs. The researchers cited that energy drinks, such as Lucozade, are marketed to improve brain function and athletic performance, the researchers sought to discover what constitutes, specifically glucose and caffeine, of Lucozade are responsible for its effects. The sample of 10 individuals abstained from caffeine the night prior to the study sessions. Four of the participants were controls; the remainder of the participants underwent four conditions 1 week apart. The first condition was consuming 380 ml of carbonated water containing 68 g of glucose. The second condition was consuming 380 ml of carbonated water containing 46 mg of caffeine. The third condition was consuming 380 ml of Lucozade that contained 68 g of glucose and 46 mg of caffeine. The fourth condition was 380 ml of carbonated water alone. Thirty minutes before ingestion and every 30 minutes up to 2 hours after ingestion the participants' blood glucose levels were tested. Additionally, the participants MEPs were tested via the thenar muscles of the right hand and ulnar nerve at the wrists and through transcranial magnetic stimulation.

The results of the study demonstrated that the MEPs of all participants were evoked consistently in the thenar muscles at the intensity of 1.1 in all experimental conditions. However, the MEPs became significantly larger in the participants who consumed Lucozade at 30 and 60 minutes after ingestion. Moreover, MEPs were elevated significantly 30, 60, and 90 minutes after ingestion of Lucozade. Additionally, when plotted against normal blood glucose concentrations, the MEPs rose significantly when blood glucose concentrations were higher—up to 120 minutes after ingestion of the glucose drink and of Lucozade. There was no change in MEPs after ingesting carbonated water alone. The researcher concluded that the MEPs rose significantly with ingestion of Lucozade, the glucose-only drink, and the caffeine only drink. Interestingly, the individual effects of caffeine and glucose were far greater when the two were combined in the Lucozade drink. Though Lucozade has less caffeine than most energy drinks, this research does demonstrate the interactive effects of caffeine and glucose—an effect that may be at play in energy drinks.

Energy drinks positively affect anaerobic and aerobic exercise, bench pressing, and muscle reactions (Alford et al., 2001; Forbes et al., 2007; Specterman et al., 2005). However, they do not improve cycling performance (Forbes et al.). Also, Specterman et al. found that caffeine and sugar in combination have an interactive effect on muscle reaction.

Mood

Mood is another effect that high levels of caffeine, such as in energy drinks, may influence. Smit and colleagues investigated the effects of carbonation, sugar, and caffeine in energy drinks with 271 adult participants. The study was split into three series: the first series consisted of a double-blind distribution of caffeine, sugar-containing energy drinks or a placebo, the second built on the results of the first study and compared the role of the individual ingredients and their interaction, and the third series investigated the glucose-related effects of energy drinks.

In each of the three series the participants were asked to fill out a mood questionnaire that addressed aspects of the participants' physical and psychological well-being. The results of the mood questionnaire demonstrated that the participants in the first series reported significant increases in energy, feelings of pleasantness, and happiness. The participants also reported feeling jittery and tense, but these qualities did not reach significance, suggesting that the positive aspects of energy drinks where more salient to the participants. Smit and colleagues (2004) concluded that the overall effects of energy drinks were due to their caffeine content. As in the first study, the participants in the second study reported a significant increase in energy. Interestingly, in the second study, the researchers reported that carbonation showed a longer-term effect of participants feeling awake. In the third study, participants reported that sugar significantly contributed to the reduction in feeling less tense. Moreover, sugar was associated with the participants feeling less jittery, but this result did not reach significance.

In another study, Smit and Rogers (2002) sought to validate an objective questionnaire to assess mood and performance citing that previous research methods on the topic held potential problems because of the complexity of measuring subjective mood. The 23 participants filled out a mood questionnaire that consisted of several measures for overall mood, with each mood followed by a 100 mm scale anchored at both ends with “not at all” or “extremely.”

The results of the research illustrated that the only reliable construct in the measure was that of Energetic Arousal for which there was a highly significant main effect. Additionally, the participants reported significantly higher (better) mood scores after consumption of energy drinks.

In their three series study, Alford and colleagues (2001) researched the mood and performance effects of Red Bull. The three series study took place over a four-week period with 39 participants. Only in the first series was subjective mood tested by a questionnaire.

The treatments varied for all three series: the first was comprised of carbonated mineral water and Red Bull, the second series a “no drink” control was added, and to the third series added a placebo energy drink. All participants received 250 ml of their respective beverage with Red Bull containing 80 mg of caffeine. Participants were tested before treatment and 30 minutes after treatment to allow for absorption of the beverage.

In regards to mood, subjective mood improved significantly in those participants who consumed Red Bull.

The overall effects of energy drinks are due to their caffeine content (Smit et al., 2004). The caffeine content in energy drinks improves subjective (Alford et al., 2001; Smit et al.; Smit & Rogers, 2002). Additionally, Smit and colleagues found that the sugar content in energy drinks also contribute to positive mood.

Fatigue

As with other caffeine-containing beverages, energy drinks can be used to counteract fatigue, especially when high alertness and performance is necessary. The use of energy drinks to reduce driver fatigue may be especially valuable as falling asleep while driving is a significant cause of car crashes (Reyner & Horne, 2002).

In a study investigating energy drinks' potential to offset fatigue in sleepy drivers, Reyner and Horne (2002) recruited 12 volunteers to participate in the double-blind study. The treatment consisted of a 250 ml can of Red Bull, which contained 80 mg of caffeine. The placebo was a 250 ml can of a beverage with a similar taste, but contained no caffeine.

The design of the study consisted of the participants engaging in a two-hour practice drive in a driving simulator. One week later the participants returned to the laboratory after their sleep was restricted to five hours the previous night, which was monitored by a wrist actimeter to ensure compliance. The sequence of the study began with a 30-minute simulated drive followed by 30-minute break at which time the treatment or control drink was administered. The participants were then required to drive, post-treatment, for 2 hours.

The simulator detected driver sleepiness by lane drifting, which is the typical manifestation of sleepy driving. Additionally, a hidden camera filmed the drivers' faces; the film was then reviewed by two assessors who compared the lane drifting to the look on the drivers' faces to determine if the drifting was due to inattentiveness or to sleepiness. The participants also verbally answered the Karolinska Sleepiness Scale every 200 seconds with answers from "extremely alert" to "very sleepy, great effort to stay awake." The last assessment was EEG measurements that measure eye movements and muscle artefact, with increase EEG meaning increased sleepiness.

The results of the study yielded interesting data. During the pre-treatment period, the rate of lane drifting was similar among both groups. However, post-treatment those in the treatment group had significantly less lane drifting than the control group. Subjective sleepiness was also significantly lower, meaning those who drank the energy drink reported less sleepiness up to 90 minutes after treatment. The researchers claimed that these results demonstrated that energy drinks are effective in reducing fatigue-related incidents—a result that could have remarkable potential to combat fatigued driving.

Jay and colleagues (2006) also conducted a study examining energy drink use in minimizing fatigue. The researchers were especially interested in the fatigue minimizing abilities of energy drinks in night-shift workers, as these workers are often sleep deprived. Additionally, the researchers recognized that caffeine could further disrupt the sleep cycle, increasing the sleep depravity of shift workers. In a simulated night shift work setting, 15 participants were given twice either a 250 ml placebo drink or a 250 ml functional energy drink (FED) containing 1000 mg taurine, 600 mg glucoronolactone, and 80 mg caffeine. Electrodes connected to the participants' jaw monitored the first night-shift protocol followed by 24 hours of wakefulness and an eight-hour recovery sleep period. These electrodes provided information to the researchers about the participants sleep record. Sleepiness was assessed by an objective psychomotor vigilance task that tested reaction time.

The results from the sleep record indicated that total sleep time was 30 minutes less in the treatment group, meaning that those who drank the energy drink slept significantly less. Sleep efficiency also yielded a significant result showing that those in the placebo group had more efficient sleep. Sleep architecture, expressed as total sleep time in each stage of sleep, was significantly greater in the placebo group. Whereas there were no significant results in the sleep record for sleep onset latency. Additionally, assessing sleepiness there were no significant results in reaction time. Therefore, in the case of night-shift workers, energy drinks were detrimental to sleep in that they decreased the participants' ability to sleep and decreased sleep quality while not improving performance as measured by reaction time.

A pilot study conducted by Schmidt (2008) examined the effects of energy drinks on sleepy drivers. The researcher recruited 100 volunteers at a highway rest stop. The participants took a cognitive function test then were given either an energy drink or a placebo and then retested on their cognitive function two hours later.

The results of the study showed that cognitive performance was 23.9% higher from pre to post test in the test group versus the control group. Also, the decline of errors from pre to post test was 59.9% higher in the test group.

Energy drinks effectively reduce fatigue, an effect that positively combats driving fatigue (Reyner & Horne, 2002; Schmidt, 2008). However, the fatigue reducing ability of energy drinks can also be detrimental. Jay and colleagues (2006) found that energy drinks reduce the ability to sleep while also decreasing sleep quality.

Adverse Events

Though much of the research about energy drinks demonstrates the positive effects of these drinks, there are some case studies that document some adverse effects. A case report study conducted by Iyadurai and Chung (2006) linked the consumption of energy drinks to seizures with 4 patients with no known history of a seizure disorder. The researchers recognized that previous research has documented caffeine's potential to induce seizures, but that there is not clear casual link between the two.

The cases consisted of three men ages, 25, 19, and 26 and one female age 28. All patients had no previous history of seizures. Additionally, after examination three of the four patients had high blood pressure and a high heart rate and all other tests were normal. Each of the patients experienced tonic-clonic seizures followed by postictal confusion. The only commonality among all cases was that each of the four patients reported drinking two 24-oz cans of an energy drink within a short period of time. After receiving acute treatment for their seizures, the patients were asked to abstain from energy drinks. At 2 to 6-month follow-ups, they all denied additional seizures.

The researchers acknowledged that it was possible that all four patients could have had undetected idiopathic epilepsy, but the oddity was that when the patients consumed small amounts of energy drinks they did not experience seizures, but when they consumed large quantities they did. This suggests a dose-dependent effect of the caffeine stimulant in energy drinks.

Another case study was reported by Machado-Vieira et al. (2001) and involved a 36-year-old male with a diagnosis of bipolar I disorder who was admitted to a hospital during his second manic episode after not experiencing any episodes for 5 years. One week before hospitalization the patient drank three cans of the energy drink Red Bull and three more cans of Red Bull. After four days he felt more hyperactive, increased libido, and irritability. Seven days after admission, using only his typical lithium dosage and abstaining from energy drinks, the patient's manic episode subsided. The researchers declared that the common ingredients in energy drinks have been shown to affect human mood. Specifically, caffeine exacerbates manic symptoms.

Iyadurai and Chung (2006) followed and documented cases in which new-onset seizures were associated with the intake of energy drinks. Additionally, Machado-Vieira and colleagues (2001) connected the consumption of energy drinks with a manic episode in a male diagnosed with bipolar disorder. There may be dose-dependent effect of the caffeine, meaning that the more caffeine consumed the likelihood that negative outcomes can occur (Iyadurai & Chung).

While the high levels of caffeine are not consistently associated with improved physical performance (Alford et al., 2001; Forbes et al., 2007) or memory (Smit & Rogers, 2002; Warburton et al., 2001), they do appear to positively affect attention (Alford et al.; Kennedy & Scholey, 2004; Warburton et al.) mood (Seidl et al., 2000; Warburton et al., 2001) and reaction time (Alford et al.; Seidl et al.; Smit et al., 2004; Smit & Rogers). Additionally, energy drinks negatively affect sleep time (Jay et al.,

2006) and sleep quality (Jay et al.) as well as their high caffeine content can lead to adverse events like seizures (Iyadurai & Chung, 2006) and manic episodes (Machado-Vieira et al., 2001)

Social Cognitive Theory and Unhealthy Behaviors

Like other studies, the current study uses a theory to help explain human behavior. Specifically, the current study will use the social cognitive theory's (SCT) construct of reciprocal determinism (RD) to help understand why adolescents consume energy drinks. In regards to the current study, the most pertinent constructs of RD are personal factors, such as knowledge and attitudes, and environmental influences such as modeling and social persuasion, and their affects on an individual's behavior. Environmental influences impact adolescents' engagement in unhealthy behaviors such as drinking alcohol (Marshal & Chassin, 2000), smoking (Hoffman et al., 2007; Kobus, 2003) and engaging in sexual intercourse (Kinsman et al., 1998). Moreover, affiliation with peers that engage in unhealthy behaviors is one of the strongest risk factors in the initiation of unhealthy behaviors (Kinsman et al.; Marshal & Chassin).

No research has examined peer influence's impact on caffeine consumption in general, nor has research been done to look at peer influence's impact on energy drink consumption. Therefore, research was reviewed concerning peer influence on unhealthy behaviors in general.

Alcohol

Alcohol consumption is one behavior that peers may influence. Marshal and Chassin (2000) examined peer influence on alcohol consumption and the possible moderating effects of parental support. The researchers split the study into four data collection methods: a longitudinal design to predict alcohol use in relation to peer influence, a multi-reporter data to increase the validity of participants' reports of peer use, parental alcoholism, and data concerning the moderating effects of parental support. The 300 participants in this study ranged from 10-15 years old. The participants answered how many friends they had who drank alcohol, used marijuana or any other drugs. The participants also reported how their peers view adolescent substance use. Additionally, participants were asked to report what their friends would think if they used alcohol, marijuana, or other drugs. To determine actual adolescent alcohol use, the participants reported how often they drank beer, wine, or wine coolers in the past year.

The relevant results of the research showed that 48% of the surveyed participants reported using alcohol within the past year. The researchers also noted that older adolescents reported more alcohol use than younger adolescents. Adolescent peers who use alcohol, negatively influenced other adolescents to use alcohol.

Smoking

Smoking has been thoroughly researched as an area that is highly influenced by peers. For example, a recent study by Hoffman and colleagues (2007) researched peer influence on adolescent smoking behavior. Specifically, the researchers explored if there was a correlation between the smoking status of a friend and the participant's smoking status. The researchers speculated that the correlation could be from either peer influence, where adolescents take up the behavior of those around them, or from peer selection, where selection of friends are based on a attribute or behavior, in this case smoking. The sample in this study were derived from two waves of the National Longitudinal Study of Adolescent Health consisting of 20,747 7th through 12th graders. The first wave of the study, asked the participants if they had ever tried smoking and how many of their three best friends smoke. The second wave of data collection was through in-home interviews with participants over a 5-month period.

The results of this study concurred with previous research showing that peer pressure to smoke influenced the likelihood that others would adopt the behavior. The researchers found that peer selection also was occurring, meaning that adolescents who smoke seek out friends who engage in the same behavior.

In another study, Kobus (2003) stated that previous studies regarding peer influence and adolescent smoking were limited in their methodology and provided only a superficial relationship between peer influence and adolescent smoking and thus undertook explaining peer influence on adolescent smoking with existing behavior theories. Kobus thoroughly examined several theories, including Social Cognitive Theory (SCT), to provide a multifaceted perspective of peer influence on smoking. Kobus stated that SCT highlights social influence's role in determining behavior. Kobus determined that SCT when applied to smoking behavior, suggests that when adolescents associate with peers that smoke, they are more likely themselves to smoke.

Smoking is an unhealthy behavior that is often subject to peer smoking status (Hoffman et al., 2007; Kobus, 2003). Kobus found that when adolescents associate with others who smoke that it increases the likelihood that they would smoke themselves—this SCT concept can be applicable to other behaviors, namely energy drink consumption.

Sexual Activity

Adolescent sexual activity is another behavior that peers may influence. Kinsman and colleagues (1998) undertook studying a group of 1,389 sixth graders. The purpose of the study was two fold. First, the researchers wanted to explore the relationship between the intention to initiate intercourse and subsequent behavior of initiation. Second, Kinsman and colleagues wanted to investigate the components of peer influence that are most strongly associated with sex initiation. Assessing the components of peer influence involved several survey questions that addressed the prevalence of sexual intercourse among peers, social gains or stigmas revolving around sex, and the normative age for someone to have sex or to have a baby. Additionally, the researchers added questions that addressed other unhealthy behaviors such as cigarette smoking and alcohol consumption.

The results of the study yielded interesting information. Of the surveyed population, 30% responded that they have engaged in sexual intercourse, of whom the majority were male, African-American, attended a poor school, and lived in single-parent home. Also, those who had engaged in sexual intercourse reported perceiving a high prevalence of peers who engaged in sexual intercourse and surprisingly reported that they had higher perceptions of social stigmas pertaining to sex. Finally, the sex-initiated group reported a lower age that it was acceptable for adolescents to be sexually active, which is particularly interesting because the sex-initiated group had already engaged in sexual activity long before their reported acceptable age. Most significant to the current study is that the researchers stated that perception about the prevalence of sexual activity among peers was the biggest predictor of having intentions to have sex. In regards to the questions about other unhealthy behaviors, participation in one risk behavior was predictive of other risk behaviors throughout the sample (Kinsman et al., 1998). Sexual activity is another unhealthy behavior that peers negatively affect.

Peer influence is associated with many negative health behaviors such as alcohol consumption (Marshal & Chassin 2000), smoking (Hoffman et al., 2007; Kobus, 2003), and sexual behavior (Kinsman et al., 1998). Engagement in unhealthy behavior in regards to influence from peers is purported to come from one of three ways: by peer pressure, by modeling, or by peer selection. Just as peers influence other unhealthy behaviors, it may also motivate energy drink consumption.

Summary

Chapter 2 reviewed current literature on the prevalence of caffeine use, the physiological effects of caffeine, the physiological effects of sugar-sweetened beverages, energy drinks, and social cognitive theory and unhealthy behaviors. Also, the few studies that examined energy drink consumption were reviewed. However, no literature was found that examined the impact of knowledge, attitudes, and peers on adolescent energy drink consumption. The next chapter discusses the methods used in the current study.

CHAPTER 3

METHODOLOGY

Chapter Overview

Presented in this chapter is a description of the data collection and analysis procedures for this study. Information on the research design, sample, data, instrumentation, pilot testing, and data analysis are also included. Moreover, this chapter discusses how the research in this study addressed the overall research questions presented in chapter one.

Research Design

This study used a cross-sectional, correlational design to investigate how adolescent knowledge and attitudes about energy drinks influence energy drink consumption. Furthermore, this study examined the impact of age, gender, religion, and peer influence on energy drink consumption.

There are advantages and disadvantages of a cross-sectional research design. Some advantages of the design are that it allows the researcher to obtain data at one point in time and the researcher can obtain data from groups that are comprised of different ages or different stages of development (Gall, Gall, & Borg, 2007). Moreover, cross-sectional, correlational designs are often used to collect data regarding negative health behaviors. For example, Hoffman and colleagues (2007) used a cross-sectional study design to collect data about adolescent smoking and peer influence. Additionally, Callas, Flynn, and Worden (2004) used the cross-sectional, correlational study design to collect information from adolescents about alcohol use. However, like other research designs, there are limitations to the cross-sectional design. The major limitation of the cross-sectional design is that it only provides information about the population at one point in time and thus does not take into account the changes that occur over time (Gall et al., 2007). Also, Casey, Tottenham, Liston, and Durston (2005) suggested that the cross-sectional design fails to detect the specificity or magnitude of changes in a sample. Another limitation is that correlational statistics do not allow researchers to find a causal relationship between variables (Gall et al.).

Sampling Procedures

Sample

The population from which the convenience sample was gathered was male and female adolescents 18-21 years old that were enrolled at Utah State University's (USU) main campus in Logan, Utah. The participants were enrolled in general education courses. These particular courses were chosen because it increased the probability that the participants would be in the 18 to 21 year old age range. Additionally, because these courses are required for all students who attend USU, it would increase the probability that the participants would be representative of the general USU student population. Teachers of USU's general education courses were approached and asked if they were willing to allow their students to participate in a brief, in-class, paper and pencil survey about energy drinks.

Sample Justification

The ages of 18 through 21 are part of the adolescent period that is characterized by continuous social and cognitive change (Casey et al., 2005; Steinberg & Monahan, 2007). Steinberg and Monahan deemed this time period late adolescence as demonstrated by the continued influence of peers during these years. In addition to the continued influence of peers, adolescents typically do not purposefully undergo identity development until late adolescence (Steinberg & Monahan). Identity development is often a hallmark for the ending of adolescence and the beginning of adulthood (Steinberg & Monahan). The transition of adolescence into adulthood is distinguished by other characteristics.

Strong evidence demonstrates that the brain system, namely the prefrontal cortex, which is responsible for thoughts and actions, continues to develop throughout and often beyond the first two decades of life (Casey et al., 2005). In other words, individuals are not able to fully process information and act on that information appropriately until approximately age 20 to 25 (Arnett, 2002; Casey et al.). Therefore, the age group of 18 to 21 year olds evaluated in this study was an appropriate group to survey in studying adolescence.

Inclusion Criteria

In order to take part in this study, the participants had to be between the ages of 18 and 21 and be students of USU’s main campus general education courses. The participants had to speak English, as the survey and the letter of information were written in English.

Sample Size

An *a priori* power analysis was conducted to determine the necessary sample size for the current study. The analysis was based upon an alpha level of .05, an estimated power of .8, and a Cohen's δ of .5. These guidelines for the analysis were chosen based on the general acceptance among researchers that an alpha of .05 is a good indicator that the relationship between variables is real relationship and not due to chance factors (Cohen, 2001; Howell, 2002). Moreover, Howell and Cohen suggested that using a statistical power of .8 balances the risk of committing Type I or Type II error. A Cohen's δ of .5 is considered a moderate effect size. The power analysis of this research study was conducted at Utah State University's Office of Methodological and Data Sciences (OMDS). Based on the power analysis, the sample size for this research study was a minimum of 103; however, a minimum sample size of 200 was sought for the current study.

In total, 225 participants were surveyed for this study and all surveys were completed in their entirety. Based on inclusion criteria, 26 surveys were not used in analysis because the participants were over 21. Therefore, 199 surveys were used in data analysis.

Sample Demographics

Of the 199 participants surveyed the majority were female (n=125, 62.8%) and the remainder were male (n = 74, 37.2%) were male. The age groups were quite evenly dispersed 18 through 21 with age 18 comprising 25.6% (n = 51), age 19 accounting for 30.2% (n = 60), age 20 forming 21.1% (n = 42), and age 21 composing 20.1% (n = 46) of the sampled population. The majority of the sampled population reported being white (*n* = 186, 93.5%) followed by Hispanic (*n* = 11, 5.5%), Asian (*n* = 1, .5%), and African American (*n* = 1, .5%). No participants reported being American Indian, Alaskan Native, Native Hawaiian, or Pacific Islander. Religious affiliation data resulted in skewed data. Therefore, religion was collapsed into two categories, Latter-day Saint (LDS) or other. The majority of the population reported being affiliated with the LDS religion (*n* = 160, 80.4%) followed by "other" (*n* = 39, 19.6%). Religious service attendance data showed that the majority of the sampled population attended services weekly (*n* = 161, 80.9%), followed by 0-2 times a year (*n* = 24, 12.1%), 3-6 times a year (*n* = 10, 5%), and monthly (*n* = 4, 2%). A demographic profile of the study participants is presented in Table 2.

Demographic Profile of Energy Drink Consumers

Twenty-five percent (*n* = 50) of the 199 participants surveyed had drunk at least one energy drink in the last thirty days (see Table 2). Of the 50 participants that reported consuming energy drinks the majority were male (*n* = 32, 64%) and the remainder were female (*n* = 17, 34%). The most commonly reported age for consumers was age 21 (*n* = 19. 38%) followed by 19 and 20 (*n* = 10, 20%) and 18 (*n* = 8, 18%). A strong majority of consumers reported being white (*n* = 47, 94%) with other ethnicities accounting for 4% (*n* = 2). Sixty-six percent (*n* = 33) of consumers reported a religious affiliation other than Latter-day Saint (LDS), while 32% (*n* = 16) of consumers were LDS. Religious service attendance data showed that the majority of the consumers attended services weekly (*n* = 32, 64%) followed by 0-2 times a year (*n* = 10, 20%), 3-6 times a year (*n* = 5, 10%), and Monthly (n = 2, 4%).

Table 2

Participants' Demographic Profile (*N* = 199)

Demographic	Group	*n*	Percentage
Gender			
	Female	125	62.8
	Male	74	37.2
Age			
	18	51	25.6
	19	60	30.2
	20	42	21.1
	21	46	23.1
Ethnicity/Race			
	White	186	93.5
	Hispanic	11	5.5
	Asian	1	.5
	African American	1	.5
	Native American	0	0
	Alaskan native	0	0
	Hawaiian Native	0	0
	Pacific Islander	0	0
Religious Affiliation			
	Latter-day Saint	160	80.4
	Other	39	19.6
Religious Attendance			
	0-2 times a year	24	12.1
	3-6 times a year	10	5
	Monthly	4	2
	Weekly	161	80.9

Table 3

Profile of Energy Drink Consumers (*n* = 50)

Demographic	Group	*n*	Consumers (%)	Sample (%)
Gender[a]				
	Female	17	34	13.6
	Male	32	64	43.2
Age[a]				
	18	8	18	15.7
	19	10	20	16.7
	20	10	20	23.8
	21	19	38	82.6
Ethnicity/Race[a]				
	White	47	94	25.3
	Other	2	4	15.4
Religious Affiliation[a]				
	LDS	16	32	10
	Other	33	66	84.6
Religious Service Attendance[a]				
	0-2 times a year	10	20	41.6
	3-6 times a year	5	10	50
	Monthly	2	4	50
	Weekly	32	64	19.9

Note.

[a]Numerical difference is due to missing data

Instrumentation

As stated in chapter two, there was little research about energy drinks, which has resulted in few developed instruments. Malinauskas et al. (2007) developed an instrument for the purpose of understanding energy drink consumption among college students. A revised version of this instrument was used in the current study to measure demographic information and behavior. For the Malinauskas et al. study, a registered dietitian and a health educator developed the instrument by conducting a focus group comprised of 32 college students. The survey instrument was designed for individuals ages 18 to 25 and was comprised of 19 items. Items one and two were demographic questions. Item three was used as a screening question to identify if the individual drinks energy drinks and if not, they need not complete the questionnaire. Item four inquires about the type of energy drinks consumed and items five to seven ask about side effects from energy drinks. Lastly, items eight to nineteen inquire about six situations for which the participants consume energy drinks and how often, in the current semester, have they drank an energy drink for that situation. The questions developed by Malinauskas et al. effectively addressed demographic information and consumption patterns of energy drinks. However, no instrument was found that measured the role of knowledge, attitudes or peers in predicting energy drink consumption.

Due to the inadequacy of reviewed instruments to answer all the research questions in the current study, it was deemed necessary to develop survey items to measure the role of knowledge, attitudes, and peer influence on energy drink consumption. To find models to formulate items for the current study, research was reviewed that investigated how knowledge, attitudes, and peers influence other behaviors. Specifically, White, Webster, and Wakefield (2008) researched adolescent knowledge and attitudes about smoking and subsequent smoking behavior, Kinsman et al. (1998) used peer influence to predict sexual initiation, and Marshall and Chassin (2000) used peer influence to predict alcohol use.

Once the items measuring knowledge, attitudes, and peer influence were developed they were added to items on the Malinauskas et al. (2007) study. The full survey was arranged based on a list of guidelines by Gall et al. (2003). These guidelines included numbering the items in the questionnaire and beginning with non-threatening items. Additionally, the items are organized to reflect the social cognitive theory's construct of reciprocal determinism (RD) with the questions addressing knowledge, attitudes, and peer influence (see Appendix A).

After the survey was composed, Chad Bohn, a student statistician at Utah State University's Office of Methodological and Data Sciences, Dr. Julie Gast, and Dr. Scott Bates critically reviewed the instrument for content validity. Revisions were then made and the survey was prepared for further testing through a pilot study.

Item Description

This survey measured the impact of knowledge, attitudes, and peer influence on adolescent energy drink consumption. The first item asked about frequency of energy consumption and item 2 and 3 inquired about what type of energy drink the participant typically consumes. Items 4, 5, and 28 measured the participant's knowledge about caffeine and energy drinks. Items 6-12 inquired about attitudes toward energy drinks and items thirteen to twenty-four measured energy drink consumption in 6 situations. Items 25-27 measured peer influence and items 29-31 were demographic questions.

Item Scoring

For the current study, the independent variables of knowledge, attitudes, and peer influence were tested for their impact on the dependent variable of energy drink consumption. Items 1-5, twelve, 25, 26, and items 28-33 were categorical questions that were scored by frequency. Items 6-11 and item 27 were scored via a 5-point Likert scale using (1) Strongly agree, (2) Agree, (3) Disagree, (4) Strongly disagree, and (5) I do not drink energy drinks as the answer options. The remainder of the survey, items 13-24 were scored continuously.

Upon completion of the surveys, each item was entered into SPSS version 17.0. The corresponding number circled for each question was entered into the database and coded to identify agreement toward the question or statement. Also, an attitude subscale was formed because this construct had more than three questions. To ensure this subscale had internal consistency, reliability statistics were run that resulted in an appropriate Cronbach's alpha of .856.

Data Collection

Institutional Review Board

The Institutional Review Board (IRB) waived the need for an informed consent due to the minimal risk presented to the participants and because no personal identification was collected. However, the IRB required that each participant be presented with a letter of information explaining the purpose of the study as well as the rights of the participants. Prior to a pilot test of the instrument, a letter of information was written (see Appendix B) and approval for this study was obtained by Utah State Univeristy's IRB (see Appendix C).

Pilot Test

The survey underwent pilot testing by a group of 14 USU students, ages 18 through 21, participating in SOAR, an orientation program designed for incoming freshman. For each survey question there were follow-up questions seeking suggestions of how to improve clarity (see Appendix D). Attached to each survey was a form where the participants could write their name and their teacher's name. The form was placed into a drop box, making the participants eligible to win USU bookstore gifts.

From the pilot test feedback the researcher noted which questions needed clarity and changed them accordingly. For example, the "last month" was changed to the "last 30 days" on question one and an "I do not drink energy drinks" option was added to all likert scale questions. Additionally, the pilot study participants suggested that all participants fill out the survey. Their reasoning for this was that those who did not drink energy drinks would skip several items in the survey and those items could still provide valuable feedback for the researcher. They also suggested that in a small classroom skipping all those questions may stigmatize those who take longer to fill out the survey as being consumers of energy drinks and this would lessen confidentiality. Therefore, the instruction to skip to question 29 if you answered “Never” on question one was eliminated.

Survey Procedures

After obtaining IRB approval, completing pilot testing and gaining permission from general education course instructors, dates and times to administer the surveys were arranged. The student researcher administered the surveys during lab hours or class time in February, 2009. All surveys included the letter of information. After the survey was completed it was returned to the student researcher. The participants were encouraged to fill out the form attached to the survey asking for their name and teacher. These forms were put in a drop box, which made the participants eligible to win USU bookstore gifts, iTunes gift cards, and USU food court gift cards. The participants were thanked for their time and participation in the survey.

Data Analysis

The data collected from the surveys were entered into the statistical software program SPSS version 17.0 to be analyzed. The data were randomly checked for accuracy during the data entry process. Descriptive statistics were calculated on all of the survey items. Logistic regression was used to answer all the research questions because the collapsed dependent variable was dichotomous (see Chapter 4). Table 4 presents the statistical analyses that were conducted to explore and answer the current study’s research questions.

Table 4

Research Questions, Instrument Items, and Data Analysis Procedures

Research questions	Instrument items	Data analysis procedures
1. Does adolescent knowledge about energy drinks predict consumption?	1-5 & 28	Descriptive statistics & Logistic Regression
2. Do adolescent attitudes toward energy drinks predict energy drink consumption?	1-3 & 6-12	Descriptive statistics & Logistic Regression
3. Does peer influence predict energy drink consumption among adolescents?	1-3 & 29-33	Descriptive statistics & Logistic Regression
4. Do the demographic variables of age, gender, and religion predict energy drink consumption?	1-3 & 29-33	Descriptive statistics & Logistic Regression
5. How do knowledge, attitudes, peer influence, age, gender, and religion interact to predict energy drink consumption?	1-31	Descriptive statistics & Logistic Regression
6. In terms of reported reasons for energy drink consumption, how does this sample compare to samples in other research studies?	1-3 & 13-24	Descriptive statistics

Summary

Chapter 3 discussed the methodology for this research study on the impact of knowledge, attitudes, and peer influence on adolescent energy drink consumption. This chapter covered research design, sampling procedures, instrumentation, data collection, and analysis.

CHAPTER 4

RESULTS

This research study was conducted to determine how knowledge, attitudes, and peers influence energy drink consumption among adolescents ages 18 to 21. This chapter reviews the statistical results of the research questions for the present study.

The frequency results indicated that question one, the dependent variable, asking " In the last 30 days, how often have you drank energy drinks" and question thirty-two "What is your religious affiliation" were significantly skewed. To facilitate data analysis and interpretation, the response categories for these two questions were collapsed. For question one the response options changed from "every day, 3 to 4 times a week, 1 to 2 times a week, 1 time a month, and never" to "at least once in the last 30 days" and "never." For question thirty-two the responses changed from "Catholic," "Latter-day Saint," "Episcopal," "Jewish," "Presbyterian," "other," and "none" to "Latter-day Saint" and "other." The shift to a binomial dependent variable enabled all analyses to utilize logistic regression.

The output of logistic regression results in odds ratios. An odds ratio under 1 is a negative association between the independent variable the dependent variable while an odds ratio above one indicates a positive association between the independent variable and the dependent variable.

Research Question 1:

Does adolescent knowledge about energy drinks predict consumption and consumption frequency?

In order to answer this research question, values from participants' responses to survey items four, five, and twenty-eight regarding their knowledge about energy drinks were the independent variables while reported energy drink consumption was the dependent variable (see Table 5). The last knowledge question revealed that when participants responded that they had seen a warning label on energy drink cans they were 4.3 times more likely to refrain from consuming an energy drink. No significant results were obtained for the other knowledge items. Knowledge reflecting Red Bull having more caffeine than coffee indicated a 1.4 ($p > .05$) increase in the odds the individual would not consume energy drinks. Also, the regression model showed that when a participant responded that they thought the FDA regulated energy drinks, there was a 2.144 ($p > .05$) increase in the odds that they would consume energy. Overall, the three knowledge variables accounted for 7.7% of the variance of energy drink consumption (Cox & Snell $r^2(1) = .077$).

Research Question 2:

Do adolescent attitudes toward energy drinks predict energy drink consumption?

Table 5

Logistic Regression Analysis for Knowledge and Energy Drink Consumption (*N* = 199)

Variable	*B*	*SE*	*p*-value	*OR*
More caffeine, coffee or Red Bull	-.361	.483	.46	.697
Regulated by the FDA	.763	.476	.11	2.144
Warning label on cans	-1.451	.487	.00**	.234

**$p < .01$

Participants' responses to items six through eleven reflected their attitudes toward caffeine. The attitude items for this research question were answered in a likert scale with options coded as (1) Strongly Agree, (2) Agree, (3) Disagree, (4) Strongly Disagree, (5) I don't drink energy drinks. Because there were more than three questions measuring attitudes, a subscale was formed to achieve a total attitude score. This total attitude score was the independent variable and again, energy drink consumption was the dependent variable (see Table 6). Interestingly, there was a significant 1.523 ($p <.001$) increase in the odds that a participant consumed energy drinks when they indicated a negative attitude toward caffeine. The attitude sub-scale accounted for 39.4% of the variance of energy drink consumption (Cox & Snell $r^2(1) = .394$).

Table 6

Logistic Regression Analysis for Attitudes and Energy Drink Consumption (*N* = 199)

Variable	*B*	*SE*	*p*-value	*OR*
Sum attitude score	.421	.062	.00***	1.523

***$p <.001$

Research Question 3:

Does peer influence predict energy drink consumption among adolescents?

Responses from participants regarding peer survey items twenty-five through twenty-seven were treated as the independent variables while the dependent variable remained energy drink consumption (see Table 7). The item asking "I drink energy drinks when my friends drink energy drinks" was coded as (1) Strongly Agree, (2) Agree, (3) Disagree, (4) Strongly Disagree, (5) I don't drink energy drinks. The participants' odds of drinking energy drinks significantly increased by 4.659 ($p < .01$) the more strongly they disagreed that they drank energy drinks when their friends drank energy drinks. The other peer survey items did not yield significant results. There was a 1.796 ($p > .05$) increase in the odds that the participant consumed energy drinks the less friends they had who consumed energy drinks. Also, there was a 1.256 ($p > .05$) increase in the odds the participant consumed energy drinks the fewer energy drinks they reported that their friends deemed acceptable. The peer influence items accounted for 39.8% of the variance of energy drink consumption (Cox & Snell $r^2(1)=.398$).

Table 7

Logistic Regression Analysis for Peer Influence and Energy Drink Consumption (*N*=199)

Variable	*B*	*SE*	*p*-value	*OR*
How many of your friends drink	.585	.332	.08	1.796
Frequency friends deem acceptable	.228	.381	.55	1.256
I drink when my friends drink	1.539	.230	.00**	4.659

**p <.01

Research Question 4:

Do the demographic variables of age, gender, and religion predict energy drink consumption?

Table 8 displays the full logistic regression analysis for demographic variables and energy drink consumption. The independent variables in the analysis were the demographic data of age, gender, race/ethnicity, and religious affiliation and energy drink consumption was the dependent variable. The analysis showed that being male significantly increased the odds by 3.950 ($p < .01$) that the individual would consume energy drinks. All other demographic variables did not gain significance. A reported increase in age resulted in a 2.478 ($p > .05$) increase in the odds that the individual would consume energy drinks. Reporting a race/ethnicity of non-white resulted in a 3.8 ($p > .05$) increase in the odds that the participant refrained from consuming energy drinks. In addition, participants reporting a non-LDS religious affiliation indicated a 1.9 ($p > .05$) increase in the odds that they did not consume energy drinks. Lastly, a reported increase in frequency of attending religious services resulted in a 1.9 ($p > .05$) increase in the odds that the individual did not consume energy drinks. The demographic variables accounted for 15.9% of the variance of energy drink consumption (Cox & Snell r^2 (1)=.159).

Table 8

Logistic Regression for Demographics and Energy Drink Consumption (*N*=199)

Variable	*B*	*SE*	*p*-value	*OR*
Age	.907	.547	.09	2.478
Gender	1.374	.422	.00**	3.950
Race/Ethnicity	-1.342	.922	.15	.261
Religious Affiliation	-.633	.781	.42	.531
Religious Attendance	-.658	.875	.45	.518

**p < .01

Research Question 5:

How do knowledge, attitudes, peer influence, age, gender, and religion interact to predict energy drink consumption?

Significant outcomes from knowledge, attitudes, peers, and demographics were taken from the previously run logistic regression analyses for research questions 1-4 and were run again looking at main effects and interactions between the variables (see Table 9). There was a significant main effect ($p < .01$) showing the participants drinking energy drinks significantly increased the more strongly they agreed that they drank energy drinks when their friends drank energy drinks. There were no other significant main effects observed.

Interaction between variables generated a significant interactive effect between the number of friends the participant answered they had who drank energy drinks and agreement that they drink energy drinks when their friends drink energy drinks. In other words, there was a significant interaction effect that resulted in a 4.676 ($p < .05$) increase in the odds the participant drank energy drinks if they answered that they had few friends that drank energy drinks and if they answered they disagreed that they drank energy drinks when their friends drank energy drinks. There were no other significant interactions. Reporting a non-LDS religion and a negative attitude toward caffeine produced a 1.1 (*p* > .05) increase in the odds the individual would abstain from energy drinks. Being male and reporting a negative attitude toward caffeine bore a 1.1 (*p* > .05) increase in the odds the participant would not consume energy drinks. A response of male

Table 9

Main Effects and Interactions for Knowledge, Attitudes, Peers, Demographics, and Energy Drink Consumption (*N* = 199)

Variable	*B*	*SE*	*p*-value	*OR*
Warning label on cans	.000	.833	1.0	1.0
Gender	-1.187	3.077	.70	.305
Religious affiliation	1.116	3.65	.76	3.051
Sum attitudes	.256	.536	.63	3.692
How many of your friends drink	-2.246	1.878	.23	.106
Drink when my friends drink	-5.798	2.173	.00**	.003
Religious affiliation *x* sum attitudes	-.076	.206	.71	.927
Gender *x* sum attitudes	-.064	.174	.71	.938
Gender *x* religion	1.588	1.310	.23	4.896
Friends that drink *x* sum attitudes	-.170	.164	.30	.843
Drink when my friends drink *x*				
Friends that drink	1.542	.6847	.02*	4.676

*$p < .05$, **$p < .01$

and non-LDS produced a 4.896 ($p > .05$) increase that the individual would consume energy drinks. Also, when an individual reported fewer friends that drank energy drinks and having a negative attitude toward energy drinks there was a 1.2 ($p > .05$) increase in the odds that individual did not consume energy drinks.

Research Question 6:

In terms of reported reasons for energy drink consumption, how does this sample compare to samples is other research studies?

Using the continuous variable data for questions one through thirty-three of the survey instrument were analyzed. Questions 13-24 of the survey inquired about the reasons behind why individuals consume energy drinks. Frequencies were run on these items to understand the behaviors of the sample as they relate to energy drink consumption (see Table 10).

Summary

This chapter outlined the study results by research question. The next chapter will discuss the research findings and possible implications.

Table 10

Situations Participants Reported Consuming Energy Drinks and the Frequency, Mean, and Standard Deviations

Situation for an average month	*M*	*SD*	*N*
Haven't gotten enough sleep	2.100	4.37	50
Need more energy	2.310	4.407	50
Studying for an exam or major project	.660	1.007	50
When driving for a long period	1.100	1.421	50
Mixed with alcohol	.090	.280	50
When you have a hangover	0	0	50
Situation for an average day			
Haven't gotten enough sleep	.650	.797	50
Need more energy	.590	.636	50
Studying for an exam or a major project	.380	.567	50
When driving for a long period	.610	.965	50
Mixed with alcohol	.030	.156	50
When you have a hangover	0	0	50

CHAPTER 6

DISCUSSION

This study on the role of knowledge, attitudes, and peer influence on adolescent energy drink consumption was designed to expand the existing research about energy drink consumption. This chapter will discuss the interpretation of findings, theoretical contributions, role of demographics, implications for health education, limitations and future research, and conclusion.

Interpretation of Findings

Overall, knowledge, attitudes, and peer influence significantly contributed to energy drink consumption in the sampled population. In this study, the knowledge of seeing a warning label on energy drink cans significantly increased the odds that participants abstained from consuming energy drinks. This study also revealed that negative attitudes toward caffeine and its consequences significantly increased the odds of drinking energy drinks. Interestingly, the results reported that the more participants disagreed that they drank energy drinks with friends, their odds of drinking energy drinks significantly increased. Additionally, there was a significant interaction showing that, when a participant disagreed with drinking energy drinks with his or her friends and reported fewer friends who drink energy drinks, his or her odds of consuming energy drinks significantly increased. These results add to the little existing research on energy drink consumption. In fact, examining the role of knowledge, attitudes, and peer influence is new to energy drink research. However, consistent with other research, this study found that males are more likely to be consumers of energy drinks. Additionally, participants in this study report similar reasons for consuming energy drinks. Table 11 compares the results of this study with other energy drink research.

Theoretical Implications

To review, reciprocal determinism (RD) denotes a relationship between personal factors, environmental influences, and behavior (Bandura, 1986). This research study used RD to investigate how an adolescent’s environment, particularly peer influence, and an adolescent’s personal factors, specifically, knowledge and attitudes about energy drinks affect his or her behavior of energy drink consumption.

Personal Factors

Personal factors contribute to behavior and are part of the RD construct. Personal factors were operationalized in this study as knowledge and attitudes.

Consistent with theoretical construct of RD, this study found that the knowledge of seeing warning labels on energy drink cans decreased the odds that an individual consumed energy drinks. Though this result is consistent with RD, caution must be used with the interpretation. There is not a direct correlation indicating that when an individual sees a warning on an energy drink they make the decision to not drink energy drinks. In fact, using health consequences on warning labels, such as those used on alcohol and tobacco products, as a deterrent from the behavior may be too narrow a focus, meaning that, as they are now, these health warnings cease to be effective (Givel, 2007; Stockley, 2001; Strahan et al., 2002). Therefore, the result demonstrating the effectiveness of

Table 11

Research Questions and Findings Compared to Previous Research

Research question	Findings	Previous research
1. Does adolescent knowledge about energy drinks predict consumption and consumption frequency?	Participants that responded that they had seen warning labels had a significant decrease in odds for consumption.	None existing
2. Do adolescent attitudes toward energy drinks predict energy drink consumption?	Participants who had negative attitudes toward caffeine had significantly increased odds for consumption.	None existing
3. Does peer influence predict energy drink consumption among adolescents?	Participants who disagreed that they drank when their friends drank had a significant increase in odds that they drank energy drinks.	None existing
4. Do the demographic variables of age, gender, and religion predict energy drink consumption?	Being male significantly increased the odds that the participant would consume energy drinks	Agree: FSPB, 2002; Miller, 2008
5. How do knowledge, attitudes, peer influence, age, gender, and religion interact to predict energy drink consumption?	There was a significant interaction between disagreeing that they consumed energy drinks with their friends and the fewer friends they had who consumed, resulting in a significant increase in the odds that they consumed energy drinks	None existing
6. In terms of reported reasons for energy drink consumption, how does this sample compare to samples in other research studies?	Insufficient sleep and needing more energy were the most prevalent reasons participants consumed energy drinks	Agreed: FAPB, 2002; Malinaskas at al., 2007

warning labels as a preventative of energy drink consumption may be a unique finding for the sampled population. The other knowledge questions did not yield significant results.

This may be because there is not widespread knowledge about the amount of caffeine or its regulation in energy drinks. This lack of knowledge about caffeine content was demonstrated by the responses given by participants. Eighty-five percent of the participants responded that Red Bull contains more caffeine ounce per ounce when compared to coffee. In actuality, Red Bull has a lower caffeine content than many energy drinks resulting in an often lower amount of caffeine than coffee (MAFF, 1998; McCusker et al., 2006). However, other energy drinks do contain significantly more caffeine than coffee so participants may have assumed all energy drinks contain equal amounts of caffeine. Additionally, 75.9% of participants responded “yes” or “I don’t know” to the FDA regulation of energy drinks when in actuality the FDA does not regulate energy drinks because they categorize them as functional beverages (McCusker et al.). Individuals may be more likely to drink energy drinks if they hold the belief that FDA regulation means the product is safe.

The attitude information reaped from this study reported results contrary to the RD construct. It would seem that if an individual held a positive attitude toward caffeine, the more likely he or she would consume energy drinks. However, this research study found the opposite—negative attitudes toward caffeine increased the odds of consuming energy drinks. This could be due to a number of reasons. One reason may be that the lack of knowledge about the caffeine content and the lack of regulation of energy drinks may affect individuals overall attitude toward energy drinks.

There is also the possibility of caffeine dependence reinforcing energy drink consumption despite negative attitudes toward caffeine. Therefore, individuals may hold negative attitudes toward caffeine for a variety of reasons but are dependent on it for increasing their energy and alertness. Arguably, the stimulant effects of caffeine from energy drinks may override any negative attitude an individual holds against caffeine.

Another plausible explanation for the contrary attitude finding, is the effectiveness of energy drink marketing. Currently, energy drinks constitute the fastest growing sector of the beverage market (Bainbridge; Zegler, 2006). Energy drinks are marketed for both their physical and mental stimulant effects and are targeted toward male and female stereotypes with testosterone-infused brand names like Daredevil, Monster, and Bawls, and their female counterparts sporting names like Vixen, Go Girl, and Rip it Chic (Bainbridge; Miller, 2008; Ressig et al., in press; Zegler). Energy drink producers have found that strategic marketing is worth it. At $2-3 per can the energy drink industry, with big players like Coca Cola and PepsiCo., was prospected to bring in an additional $540 million between 2005 through 2008 (Warner, 2005). When examining personal factors and energy drink consumption, it seems that, despite negative attitudes toward caffeine, lack of knowledge coupled with extremely effective marketing may drive energy drink consumption.

Environmental Influences

Environment is comprised of many factors. In this study environmental influences were operationalized as peer influence. During adolescence, peers, as part of a larger environment, often have influence on the behavior of their counterparts (Kobus, 2003).

However, this premise did not hold true in this study. It would seem that if individuals agreed that they drank energy drinks with their friends, they would be more likely to drink energy drinks. However, the results showed that when individuals disagreed that they drank energy drinks with their friends their odds of consuming energy drinks actually increased. The age of the sampled population may have affected the influence their peers had over their energy drink consumption.

The sample targeted in this study was between the ages of 18 and 21, as noted earlier this age group is still considered adolescence as deemed by identity formation, full development of the brain, and the continued influence of peers (Casey et al., 2005; Steinberg & Monahan, 2007). Adolescents become progressively more susceptible to peers, peaking at age 14, and then become more resistant to peer influence gradually after age 14 (Steinberg & Monahan). Moreover, risk taking and risky decision-making decline as adolescents age. Therefore, sampling an older adolescent population, such as the participants in this study, may be why peers did not seem to influence the behavior of energy drink consumption. In addition, caffeine consumption, unlike alcohol and tobacco use, may be more of a solitary behavior than a group behavior.

Role of Demographics

This study's finding that males have increased odds of consuming energy drinks mirrors other energy drink research. This finding may be another result of effective marketing. Though energy drinks are starting to target females and other market segments, males, ages 11-35, are the primary target group of energy drink manufactures (FSPB, 2002; Miller, 2008; Reissig et al., in press). Another possible reason behind this result is that energy drink consumption may be considered a high-risk behavior and males engage in more risk-taking behavior than females (Courtenay, 2003; Courtenay & Keeling, 2000). Moreover, Miller (2008) found that when mediated by high-risk behavior, energy drink consumption was highly correlated to male jock identity. Other demographic variables may have also influenced the results of this study.

Though the demographic variable of religion did not yield statistically significant results, it most likely affected the overall prevalence of energy drink consumption, and may have affected other variables such as attitudes. In comparison to the study by Malinaskaus et al. (2007), which reported a 51% prevalence rate and the FSPB (2002) study that revealed a prevalence of 51% in Northern Ireland and 37% in the Republic of Ireland, this study yielded only a 25% prevalence rate of energy drink consumption. This low prevalence rate may be due to the religious affiliation reported by the majority of the sample. The data collection for this study took place in Utah, and 80% of the sampled population reported a religious affiliation of Latter-day Saint (LDS). The LDS religion speaks out against caffeine consumption and has recently made proclamations to its members about the harm of energy drinks and urges its members to abstain from drinking them (Boud, 2008; Wilcox, 2008).

Implications for Health Education

As stated earlier, there is no current FDA regulation of caffeine content or its labeling on energy drink cans. The results from this study demonstrated that the presence of warning labels on energy drink cans may be an effective deterrent to drinking energy drinks. Health education advocates could use this information as a spring board to petition for mandatory warning labels, similar to those that exist on over-the-counter stimulant medications, alcohol, and tobacco products.

As with any negative health behavior, knowledge is a key part to preventing and treating a problem. A school-based intervention that includes caffeine as part of a drug or healthy lifestyles unit may be an effective and practical way to reach most adolescents. The intervention should include what foods and beverages contain caffeine, focusing on beverages that contain the most caffeine, like energy drinks. Also, the physical and mental consequences of high caffeine ingestion should be taught—especially the most salient side effects for the adolescent population such as nervousness and irritability.

Another education intervention that may prove effective is teaching about the manipulative marketing of energy drinks, this concept could easily be included in a media literacy unit. The intervention would also need to address the fact that energy drinks are not regulated and therefore have not undergone safety testing. This intervention should be introduced before age 11, as energy drinks are targeted to children as young as 11 (FSPB, 2002). This intervention could also include the role of peers in energy drink consumption, just as peer influence is discussed with other unhealthy behaviors. Again, introducing this concept at a younger age would be more beneficial as the influence of peers declines after age fourteen (Steinberg & Monahan, 2007).

Limitations and Future Research

The lessons learned from the limitations of this study can be used to improve future research. Use of a convenience sample rather than a true experimental design with random selection is a limitation of the present study. In future research, it is suggested that random selection be employed as it would ensure a more diverse population, which increases the generalizability of study results. Moreover, increasing the ages of the sampled population from 18-21 to 11-21 would allow researchers the opportunity to detect changes in peer influence and changes in behavior in a broader age group. As mentioned earlier, the sample in this study was largely a homogeneous Caucasian population. Sampling a more urban population, outside of Utah, may provide a more diverse and accurate picture of energy drink consumption and its predictors inside the U.S.

As in any self-report study there is the drawback of social desirability. This phenomenon may have been stronger in this study due to the small classroom environment coupled with the stigma of caffeine in the surveyed population. Future energy drink researchers should continue to encourage their participants to answer honestly and try to provide them a setting that supports confidentiality.

Because little research has been conducted on energy drink consumption, there are few instruments designed to measure this behavior. In the future, it would be helpful if more instruments were created and validated to better assess energy drink consumption and the role of knowledge, attitudes, and peers on consumption. Once well-established instruments are created, the information yielded from these instruments could aide in improving interventions to prevent energy drink consumption among adolescents.

As discussed previously 80% of the sample population reported a religious affiliation of LDS. In researching the LDS church’s stance on caffeine and energy drinks, it was found that the proclamations against energy drinks were published in church magazines two months prior to data collection for this study. The untimeliness of these magazine articles may have been a threat to the internal validity of this study. LDS participants in this study who consumed energy drinks may have been reluctant to admit that they were consumers due to the recently increased stigma of energy drinks in their religion.

The personal and environmental factors of the participants in this study did not consistently predict the behavior of energy drink consumption. This inconsistency incurs speculation that the social cognitive theory's construct of reciprocal determinism may not have been an appropriate construct in studying energy drink consumption. Other theories, such as the diffusion of innovation or the theory of reasoned action, may be more applicable to studying energy drink consumption and its influences.

Conclusion

The full impact of energy drinks on individuals has yet to be determined as they are relatively new on the market and there is little research examining them. According to Bandura (1986), RD might explain and describe how adolescents operate cognitively on their social experiences and how these cognitions influence the subsequent behavior. Though the results were not consistent, using RD as the framework in this study made conjectural implications that the personal factors and environmental influences were contributory variables leading to energy drink consumption.

REFERENCES

Alford, C., Cox, H., & Westcott, R. (2001). The effects of Red Bull energy drink on human performance and mood. *Amino Acids, 21*, 139-150.

Anderson, C., & Horne, J. A. (2008). Placebo response to caffeine improves reaction time performance in sleepy people. *Human Psychopharmacology and Clinical Experience, 23*, 333-336.

Arnett, J. (2000). Emerging adulthood. *American Psychologist, 55*, 469-480.

Bainbridge, J. (2007, September 19). Sports, energy and stimulant drinks - functionality extends reach. *Marketing*, 34-37.

Bandura, A. (1986). *Social foundations of thought and action.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*. *52*, 1-26.

Berstein, G. A., Carroll, M. E., Thuras, P. D., Cosgrove, K. P., & Roth, M.E. (2002). Caffeine dependence in teenagers. *Drug and Alcohol Dependence, 66*, 1-6.

Boud, T. J. (2008). *The energy drink epidemic*. Retrieved February 2, 2009, from http://www.lds.org/ldsorg/v/index.jsp?vgnextoid=e419fb40e21cef00VgnVCM1000001f5e340aRCRD

Boxtel, M. P., Schmitt, J. A., Bosma, H., & Jolles, J. (2003). The effects of habitual caffeine use on cognitive change: A longitudinal perspective. *Pharmacology, Biochemistry, and Behavior, 75*, 921-927.

Callas, P.W., Flynn, B. S., & Worden, J. K. (2004). Potentially modifiable psychological factors associated with alcohol use during early adolescence. *Addictive Behaviors, 29*, 1503-1515.

Casey, B., Tottenham, N., Liston, C., & Durston, S. (2005). Imaging the developing brain: what have we learned about cognitive development [Electronic version]. *Trends in Cognitive Sciences, 9*, 104-110.

Cohen, B. H. (2001). *Explaining psychological statistics* (2nd ed.). New York: Wiley.

Cotton, P. A., Subar, A. F., Friday, J. E., & Cook A. (2004). Dietary sources of nutrients among US adults, 1994-1996. *Journal of the American Dietetic Association, 104*, 921-930.

Courtenay, W. (2003). Key determinants of the health and well-being of men and boys [Electronic version]. *International Journal of Men's Health, 2*.

Courtenay, W., & Keeling, R. (2000). Men, gender, and health: Toward an interdisciplinary approach [Electronic version]. *American Journal of College Health, 48,* 243-246.

Energy drinks and food bars often deliver significant sugar and caffeine. (2006, December 8). *Drug Week,* 184-185.

Finnegan, D. (2003). The health effects of stimulant drinks. *British Nutrition Foundation Nutrition Bulletin, 28,* 147-155.

Food and Drug Administration. (1987). Caffeine in nonalcoholic carbonated beverages (DHHS publication FR 18923 Docket No. 82N-0218). Washington, DC: U.S. Government Printing Office.

Food Safety Promotion Board. (2002). A review of the health effects of stimulant drinks (final report). *Safefood.* Retrieved June 6, 2008, from http://www.safefoodonline.com/safefood/Uploads/health_effects.pdf

Forbes, S. C., Candow, D. G., Little, J. P., Magnus, C., & Chilibeck, P. D. (2007). Effect of Red Bull energy drink on repeated wingate cycle performance and bench-press muscle endurance. *International Journal of Sport Nutrition and Exercise Metabolism, 17*, 433-444.

Forshee, R. A., & Storey, M. L. (2004). Evaluation of the association of demographics and beverage consumption with dental caries. *Food and Chemical Toxicology, 42,* 1805-1816.

Forshee, R. A., Anderson, P. A., & Storey, M. L. (2006). Changes in calcium intake and association with beverage consumption and demographics: comparing data from CSFII 1994-1996, 1998 and NHANES 1999-2002. *Journal of the American College of Nutrition, 25*, 108-116.

Frary, C. D., Johnson, R. K., &Wang, M. Q. (2005). Food sources and intakes of caffeine in the diets of persons in the United States. *Journal of the American Dietetic Association, 105,* 110-113.

French, S.A., Lin, B., & Guthrie, J.F. (2003). National trends in soft drink consumption among children and adolescents age 6 to 17 years: Prevalence, amounts, and sources, 1977/1978 to 1994/1998. *Journal of the American Dietetic Association, 103*, 1326-1331.

Gall, M. D., Gall, J. P., & Borg, W. R. (2007). *Educational research* (8th ed.). Boston: Pearson.

Giannotti, F., Cortesi, F., Sebastiani, T., & Ottaviano, S. (2002). Circadian preference, sleep, and daytime behavior in adolescence. *Journal Sleep Research, 11*, 191-199.

Givel, M. (2007). A comparison of the impact of U.S. and Canadian cigarette pack warning label requirements on tobacco industry profitability and public health [Electronic version]. *Health Policy, 83*, 343-352.

Hakim, R. B., Gray, R. H., & Zacur, H. (1998). Alcohol and caffeine consumption and decreased fertility. *Fertility and Sterility, 70*, 6320-6370.

Hoffman, B. R., Monge, P. R., Chou, C., & Valente, T. W. (2007). Perceived peer influence and peer selection on adolescent smoking behavior. *Addiction Behaviors, 32*, 1546-1554.

Howell, D. C. (2002). *Statistical methods for psychology* (5th ed.). Pacific Grove, CA: Duxbury.

Hughes, J. R., & Hale, K. L. (1998). Behavioral effects of caffeine and other methylxanthines on children. *American Psychological Association, 6*, 87-95.

International Family Planning Perspectives. (2004). Heavy use of tobacco and caffeine are among factors that may reduce a woman's chance of conceiving, *30*, 147-148.

Iyadurai, S. J., & Chung, S. S. (2006). New-onset seizures in adults: Possible association with consumption of popular energy drinks. *Epilepsy and Behavior*, *10*, 504-508.

James, J. E. (1998). Acute and chronic effects of caffeine on performance, mood, headache, and sleep. *Neuropsychobiology, 38*, 32-41.

Jay, S.M., Petrilli, R. M., Ferguson, S. A., Dawson, D., & Lamond, N. (2006). The suitability of a caffeinated energy drink for night-shift workers. *Physiology and Behavior, 87*, 925-931.

Jee, S. H., He, J., Whelton, P. K., Suh, I., & Klag, M. J. (1999). The effect of chronic coffee drinking on blood pressure; A meta-analysis of controlled clinical trials. *Hypertension, 33*, 647-652.

Karatzis, E., Papaioannou, T. G., Aznaouridis, K., Karatzi, K., Stamatelopoulos, K., Zampelas, A., et al. (2003). Acute effects of caffeine on blood pressure and wave reflections in healthy subjects: Should we consider monitoring central blood pressure? *International Journal of Cardiology, 98*, 425-430.

Kelly-Weeder, S., & O'Connor, A. (2006). Modifiable risk factors for impaired fertility in women: what nurse practitioners need to know [Electronic version]. *Journal of the American Academy of Nurse Practitioners*, *18*, 268-276.

Kennedy, D., & Scholey, A. (2004). A glucose-caffeine 'energy drink' ameliorates subjective and performance deficits during prolonged cognitive demand. *Appetite, 42*, 331-333.

Kinsman, S. B., Romer, D., Furstenberg, F. F., & Schwartz, D. F. (1998). Early sexual initiation: The role of peer norms. *Pediatrics*, *102*, 1185-1192.

Kobus, K. (2003). Peers and adolescent smoking. *Addiction, 98,* 37-55.

Kristiansen, M., Levy-Milne, R., Barr, S., & Flint, A. (2005). Dietary supplement use by varsity athletes at a Canadian university. *International Journal of Sport Nutrition and Exercise Metabolism, 15*, 195-210.

Lane, J. D., Feinglos, M N., & Surwit, R. S. (2008). Caffeine increases ambulatory glucose and postprandial responses in coffee drinkers with type 2 diabetes. *Diabetes Care, 31*, 221-222.

Ludwig, D. S., Peterson, K. E., & Gortmaker, S. L. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: A prospective, observational analysis. *The Lancet*, *357*, 505-508.

Machado-Vieira, R., Viale, C. I., & Kapczinski, F. (2001). Mania associated with an energy drink: The possible role of caffeine, taurine, and inositol. *Canadian Journal of Psychiatry*, *46*, 454-455.

MacKenzie, T., Comi, R., Sluss, P., Keisar, R., Manwar, S., Kim, J., et al. (2007). Metabolic and hormonal effects of caffeine: Randomized, double-blind, placebo-controlled crossover trial. *Metabolism Clinical and Experimental, 56,* 1694-1698.

Malinauskas, B. M., Aeby, V. G., Overton, R. F., Carpenter-Aeby, T., & Barber-Heidal, K. (2007). A survey of energy drink consumption patterns among college students. *Nutrition Journal*, *6*, 1-7.

Marshal, M. P., & Chassin, L. (2000). Peer influence on adolescent alcohol use: The moderating role of parental support and discipline. *Applied Developmental Science, 4*, 80-88.

McCusker, R. R., Goldberger, B. A., & Cone, E. J. (2006). Caffeine content of energy drinks, carbonated sodas, and other beverages. *Journal of Analytical Toxicology, 30*, 112-114.

Miller, K. (2008). Wired: Energy drinks, jock identity, masculine norms, and risk taking. *Journal of American College Health*, *56*, 481-489.

Ministry of Agriculture, Fisheries, and Food. (1998). *Survey of caffeine and other methylxanthines in energy drinks and other caffeine-containing products* (Department of Health and Scottish Executive Publication No. 144). Retrieved May 21, 2008, from http://archive.food.gov.uk/maff/archive/food/infsheet/1998/no144/144caff.htm

Mucignant-Caretta, C. (1998). Changes in female cognitive performance after energetic drink consumptions, a preliminary study. *Progress in Neuropsycopharmacology & Biological Psychiatry, 22*, 1035-1042.

Oberstar, J. V., Bernstein, G. A., & Thuras, P. D. (2002). Caffeine use and dependence in adolescents: one-year follow-up. *Journal of Child and Adolescent Psychopharmacology*, *12*,127-135.

O’Dea, J. (2003) Consumption of nutritional supplements among adolescents: Usage and perceived benefits. *Health Education Research*, *18*, 98-107.

Orbeta, R. L., Overpeck, M. D., Ramcharran, D., Kogan, M. D., & Ledsky, R. (2006). High caffeine intake in adolescents: Associations with difficulty sleeping and feeling tired in the morning. *Journal of Adolescent Health, 38*, 451-453.

Pollack, P. P., & Bright, D. (2003) Caffeine consumption and weekly sleep patterns in US seventh-, eighth-, and ninth-graders. *Pediatrics, 111*, 42-46.

Reissig, C. J., Strain, E. C., & Griffiths, R. R. (in press). Caffeinated energy drinks—a growing problem. *Drug and Alcohol Dependence.*

Reyner, L. A., & Horne, J. A. (2002). Efficacy of a functional energy drink in counteracting driver sleepiness. *Physiology and Behavior, 75*, 331-335.

Roehrs, T., & Roth, T. (2008) Caffeine: Sleep and daytime sleepiness. *Sleep Medicine Reviews*, *12*, 153-162.

Rogers, P. J., & Dernoncourt, C. (1998). Regular caffeine consumption: A balance of adverse and beneficial effects for mood and psychomotor performance. *Pharmacology Biochemistry and Behavior, 59*, 1039-1045.

Schmidt, K. (2008). On the effect of intake of an “energy drink” on cognitive functions of car drivers. *Amino Acids, 17*, 94-95.

Seidl, R., Peyrl, A., Nicham, R., & Hauser, E. (2000). A taurine and caffeine-containing drink stimulates cognitive performance and well-being. *Amino Acids, 19*, 635-642.

Shilo, L., Sabbah, H., Hadari, R., Kovatz, S., Weinberg, U., Dolev, S., et al. (2002). The effects of coffee consumption on sleep and melatonin secretion. *Sleep Medicine, 3*, 271-273.

Smit, H. J., & Rogers, P. J. (2002). Effects of ‘energy’ drinks on mood and mental performance: Critical methodology. *Food Quality and Preference, 13*, 317-326.

Smit, H. J., Cotton, S. C., Hughes, S. C., & Rogers, P. J. (2004). Mood and cognitive performance effects of “energy” drink constituents: Caffeine, glucose, and carbonation. *Nutritional Neuroscience, 7*, 127-139.

Specterman, M., Bhuiya, A., Kuppuswamy, A., Strutton, P. H., Catley, M., & Davey, N. J. (2005). The effect of an energy drink containing glucose and caffeine on human corticospinal excitability. *Physiology and Behavior, 83,* 723-728.

Steinberg, L., & Monahan, K. C. (2007). Age differences in resistance to peer influence [Electronic version]. *Developmental Psychology , 43*, 1531-1543. Retrieved June 16, 2008, from Science Direct database.

Stockley, C. (2001). The effectiveness of strategies such as health warning labels to reduce alcohol-related harms—An Australian perspective [Electronic version]. *International Journal of Drug Policy, 12, 153-166.*

Strahan, E., White, K., Fong, G., Fabrigar, L., Zanna, M., & Cameron, R. (2002). Enhancing the effectiveness of tobacco package warning labels: A social psychological perspective [Electronic version]. *Tobacco Control, 11*, 183-190.

Tahmessebi, J. F., Duggal, M. S., Malik-Kotru, G., & Curzon, M. E. (2004). Soft drinks and dental health: A review of the current literature. *Journal of Dentistry, 34*, 2-11.

Thomas, P. (2007). Red Bull. *The Ecologist 37*, 14-15.

Unemura, T., Ueda, K., Nishioka, K., Hidaka, T., Takemoto, H., Nakamura S., et al. (2006). Effects of acute administration of caffeine on vascular function. *American Journal of Cardiology, 98*, 1538-1541.

Vartanian, L. R., Schwartz, M. B., & Brownell, K. D. (2007). Effects of soft drink consumption on nutrition and health: A systematic review and meta-analysis. *American Journal of Public Health, 97*, 667-675.

Vatanparast, H., Lo, E., Henry, C. J., & Whiting, S. J. (2005). A negative trend in calcium intake was accompanied by a substitution of milk by noncarbonated soft drinks in Canadian female students. *Nutrition Research*, *26*, 325-329.

Warburton, D. M., Bersellini, E., & Sweeney, E. (2001). An evaluation of a caffeinated taurine drink on mood, memory and information processing in healthy volunteers without caffeine abstinence. *Psychopharmacology*, *158*, 322-328.

Warner, M. (2005, November 23). Caution: Energy drink profits may be addictive [Electronic version]. *The New York Times*.

White, V., Webster, B., & Wakefield, M. (2008). Do graphic health warning labels have an impact on adolescents' smoking-related beliefs and behaviours [Electronic version]. *Addiction, 103*, 1562-1571.

Williams, C. J., Fargnoli, J. L., Hwang, J. J., Van Dam, R. M., Blackburn, G. L., Hu, F. B., et al. (2008). Coffee consumption is associated with higher plasma adiponectin concentrations in women with or without type 2 diabetes. *Diabetes Care, 31*, 504-507.

Wilcox, R. (2008). *Energy drinks: the lift that lets you down*. Retrieved February 5, 2009, from http://www.lds.org/ldsorg/v/index.jsp?vgnextoid=e419fb40e21cef00VgnVCM1000001f5e340aRCRD

Zegler, J. (2006). What's your niche? *Beverage Industry*, *97*, 8-12.

APPENDICES

APPENDIX A: Study Instrument

Energy Drinks on USU Campus

We are interested in finding out about energy drink consumption among college students at Utah State University. Energy drinks refer to drinks like **Red Bull, Rockstar, Monster, and Full Throttle.**

Instructions: Circle the correct answer for questions 1-12 and 25-33. For questions 13-24, fill out the blank (If you have not drank energy drinks for the situations asked, answer zero).When you have completed the survey return the survey to the researcher or your instructor.

1) In the last <u>30 days</u>, how often have you drank energy drinks?
   a. Every day
   b. 3 to 4 times a week
   c. 1 to 2 times a week
   d. 2 to 3 times a month
   e. 1 time a month
   f. Never

2) What brand of energy drink do you typically drink?
   a. Red Bull (8 oz)
   b. Rockstar (16oz)
   c. Other (8oz)
   d. Other (16oz)
   e. I do not drink energy drinks

3) When you drink energy drinks, do you usually drink regular or sugar free energy drinks?
   a. Regular
   b. Sugar free
   c. I do not drink energy drinks

4) Ounce for ounce, what has more caffeine, coffee or Red Bull?
   a. Coffee
   b. Red Bull

5) Is the caffeine content in energy drinks, like soft drinks, regulated by the Food and Drug Administration (FDA)?
   a. Yes
   b. No
   c. I don't know

6) Drinking caffeine has mental and physical benefits.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree

7) Drinking caffeine has mental and physical consequences.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree

8) I feel more alert when I drink energy drinks.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree
    e. I do not drink energy drinks

9) I perform better physically when I drink energy drinks.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree
    e. I do not drink energy drinks

10) My heart pounds when I drink energy drinks.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree
    e. I do not drink energy drinks

11) I get headaches after I drink energy drinks.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree
    e. I do not drink energy drinks

12) At what age do you think it is okay to drink energy drinks?
    a. Under 12
    b. 12 -13
    c. 14-15
    d. 16-17
    e. Over 18
    f. Never

13) In an **average month**, how many times do you drink energy drinks to compensate for insufficient sleep? _____ per month

14) In the **last month**, on an average day, <u>when you haven't gotten enough sleep</u>, how many energy drinks do you have? _____ per day

15) In an **average month**, how many times do you drink energy drinks when you need more energy? ____ per month

16) In the **last month**, on an average day, <u>when you need more energy</u>, how many energy drinks do you have? _____ per day

17) In an **average month**, how many times do you drink energy drinks to help study for an exam or major project? _____ per month

18) In the **last month**, on the average day, <u>when you are studying for an exam or a major project</u>, how many energy drinks do you have? _____ per day

19) In an **average month**, how many times do you drink energy drinks when you are driving for a long period? _____ per month

20) In the **last month**, on the average day, <u>when you are driving for a long period</u>, how many energy drinks do you have?_____ per day

21) In an **average month**, how many times do you drink energy drinks with alcohol?
_____ per month

22) In the **last month**, on an average night of partying, how many energy drinks do you mix with alcohol (example: Red Bull with vodka)? _____ per day

23) In an **average month**, how many times do you drink energy drinks when you have a hangover? ____ per month

24) In the **last month**, on an average day, when you have a hangover, how many energy drinks do you have? _____ per day

25) How many of your friends drink energy drinks?
    a. All
    b. Most
    c. Some
    d. Few
    e. None

26) In terms of frequency of energy drink consumption, indicate what your friends would state as acceptable.
    a. Never
    b. Once a month
    c. Once a week
    d. Every day

27) I drink energy drinks when my friends are drinking energy drinks.
    a. Strongly agree
    b. Agree
    c. Disagree
    d. Strongly disagree
    e. I do not drink energy drinks

28) Have you seen a warning label on energy drink cans?
    a. Yes
    b. No
    c. I don’t know

29) Age

a. under 18
b. 18
c. 19
d. 20
e. 21

30) Gender

a. Female
b. Male

31) Race/Ethnicity

a. American Indian or Alaskan Native
b. White
c. Asian
d. Native Hawaiian or other Pacific Islander
e. African American or Black
f. Hispanic
g. Other

32) What is your religious affiliation?

c. Catholic
d. Latter day Saint
e. Episcopal
f. Jewish
g. Presbyterian
h. Other
i. None

33) How often do you attend religious services?

a. 0-2 times a year
b. 3-6 times a year
c. Monthly
d. Weekly

Thank you for your participation!

APPENDIX B: Letter of Information

UtahStateUniversity

Date Created: January 26, 2009; Page 124 of 151
USU IRB Approved: 01/29/2009
Approval terminates: 01/28/2010
Protocol Number: 2224
IRB Password Protected per IRB Administrator

Letter of Information
The impact of knowledge, attitudes, and peer influence on adolescent energy drink consumption

Purpose: Dr. Julie Gast and Alyson Ward, a graduate student, from the Department of Health, Physical Education, and Recreation at Utah State University (USU) are conducting a research study to find out more about the influence of knowledge, attitudes, and peers on drinking energy drinks. You have been asked to participate in this study to help identify patterns of energy drink consumption on USU's campus. There will be approximately 200 participants in this study.

Procedures:. If you agree to be in this research study, you will be asked to fill out an anonymous survey that may take about 5 minutes of your time. Depending on the preference of your instructor, you may fill out the survey during class time or complete the survey outside of class and return it to your instructor. In order to understand the consumption of energy drinks, it is important to complete the survey completely. If you wish to be informed of the results of this research study or are interested in any information regarding energy drinks, please provide your name and email address on the next page and the information will be sent to you by email.

Risks: This study is considered to be minimal risk.

Benefits: There may not be a direct benefit to you at this time in; however, researchers may learn important information about why people chose to drink energy drinks versus those who do not. The results of this study may also provide information to policy makers and the community, to better understand the benefits and drawbacks of energy drink consumption.

Explanation & Offer to Answer Questions: Alyson Ward has explained this research study to you and answered your questions. If you have other questions or research-related problems, you may contact Professor Julie Gast at (435) 797-1490.

Compensation: To compensate you for your time, your name will be entered into a drawing for USU bookstore gift cards, iTunes gift cards, and/or USU food court gift cards in the amount of $5.00 each.

Voluntary nature of participation and right to withdraw without consequence:
Participation in research is entirely voluntary. You may refuse to participate or withdraw at any time without consequence.

Confidentiality: Research records will be kept confidential, consistent with federal and state regulations. The survey is anonymous; please do not put your name or any personal identifiable information, to protect your privacy.

IRB approval statement: The Institutional Review Board (IRB) exists to ensure protection of human participants at USU, it has approved this research study. If you have any pertinent questions or concerns about your rights or think the research may have harmed you, you may contact the IRV Administrator at (435) 797-0567 or email irb@usu.edu. If you have a concern or complaint about the research and you would like to contact someone other than the research team, you may contact the IRB Administrator to obtain information or to offer input.

Investigator Statement: "I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered."

__________________________	__________________________
Julie Gast, PhD, CHES	Alyson C. Ward B.S. CHES
Principal Investigator	Student Researcher
(435) 797-1490	(435) 881-5319

APPENDIX C: IRB Approval Letter

USU Assurance: FWA#00003308
Protocol # 2224

UtahState
UNIVERSITY

INSTITUTIONAL REVIEW BOARD OFFICE
9530 Old Main Hill, Suite 214a
Logan, UT 84322-9530
Telephone: (435) 797-1821
FAX: (435) 797-3769

1/29/2009

SPO #:
AES #: UTA00

MEMORANDUM

TO: Julie Gast
Alyson Ward

FROM: Kim Corbin-Lewis, IRB Chair
True M. Fox, IRB Administrator

SUBJECT: The Impact of Knowledge, Attitudes, and Peer Influence on Adolescent Energy Drink Consumption

Your proposal has been reviewed by the Institutional Review Board and is approved unde expedite procedure #7

X There is no more than minimal risk to the subjects.
There is greater than minimal risk to the subjects.

This approval applies only to the proposal currently on file for the period of one year. If you study extends beyond this approval period, you must contact this office to request an annual review of this research. Any change affecting human subjects must be approved by the Board prior to implementation. Injuries or any unanticipated problems involving risk to subjects or to others mus be reported immediately to the Chair of the Institutional Review Board.

Prior to involving human subjects, properly executed informed consent must be obtained from each subject or from an authorized representative, and documentation of informed consent must be kept on file for at least three years after the project ends. Each subject must be furnished with a copy of the informed consent document for their personal records.

The research activities listed below are expedited from IRB review based on the Departmen of Health and Human Services (DHHS) regulations for the protection of human research subjects. 45 CFR Part 46, as amended to include provisions of the Federal Policy for the Protection of Human Subjects, November 9, 1998.

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

APPENDIX D: Pilot Test Instrument

Energy Drinks on USU Campus

We are interested in finding out about energy drink consumption among college students. Energy drinks refer to drinks like **Red Bull, Rockstar, Monster, and Full Throttle.**

1) Have you drank one or more energy drink cans in the last month?
   a. Yes
   b. No

   *If you answered no, then skip to question 29. If you answered yes, please complete the remainder of the survey

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

2) In the last <u>month</u> how often have you drank energy drinks?
   a. every day
   b. 3 to 4 times a week
   c. 1 to 2 times a week
   d. 2 to 3 times a month
   e. 1 time a month

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

3) What brand of energy drink do you typically drink?
   a. Red Bull (8 oz)
   b. Rockstar (16oz)
   c. Other (8oz)
   d. Other (16oz)

Did you understand this question?
  a. Yes
  b. No

How do you think this question could be made clearer?
____
____
____

4) When you drink energy drinks, do you usually drink regular or sugar free energy drinks?
   a. Regular
   b. Sugar free

Did you understand this question?
  a. Yes
  b. No

How do you think this question could be made clearer?
____
____
____

5) Ounce for ounce, what has more caffeine, coffee or Red Bull?
   a. Coffee
   b. Red Bull

Did you understand this question? a. Yes b. No How do you think this question could be made clearer? ________________________________ ________________________________ ________________________________

6) Is the caffeine content in energy drinks, like soft drinks, regulated by the Food and Drug Administration (FDA)?
   a. Yes
   b. No
   c. I don’t know

Did you understand this question? a. Yes b. No How do you think this question could be made clearer? ________________________________ ________________________________ ________________________________

7) Drinking caffeine has mental and physical benefits
   a. Strongly agree
   b. Agree
   c. Disagree
   d. Strongly disagree

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

8) Drinking caffeine has mental and physical consequences
   a. Strongly agree
   b. Agree
   c. Disagree
   d. Strongly disagree

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

9) When I drink energy drinks I feel more alert
a. Strongly agree
b. Agree
c. Disagree
d. Strongly disagree

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?
___
___
___

10) When I drink energy drinks I feel like I perform better physically
a. Strongly agree
b. Agree
c. Disagree
d. Strongly disagree

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?
___
___
___

11) When I drink energy drinks my heart pounds
  a. Strongly agree
  b. Agree
  c. Disagree
  d. Strongly disagree

Did you understand this question?
  a. Yes
  b. No

How do you think this question could be made clearer?
____
____
____

12) After I drink energy drinks I get headaches
  a. Strongly agree
  b. Agree
  c. Disagree
  d. Strongly disagree

Did you understand this question?
  a. Yes
  b. No

How do you think this question could be made clearer?
____
____
____

13) At what age do you think it is okay to drink energy drinks
   a. under 12
   b. 12 -13
   c. 14-15
   d. 16-17
   e. over 18

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

14) In an average **month**, how many times do you drink energy drinks to compensate for insufficient sleep? _____ per month

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

15) In the last **month**, on an average day <u>when you haven't gotten enough sleep</u>, how many energy drinks do you have? _____ per day

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?
____
____
____

16) In an average **month**, how many times do you drink energy drinks when you need more energy? ____ per month

Did you understand this question?
a. Yes
b. No
How do you think this question could be made clearer?
____
____
____

17) In the last **month**, on an average day <u>when you need more energy</u>, how many energy drinks do you have? _____ per day

Did you understand this question?
a. Yes
b. No
How do you think this question could be made clearer?
____
____
____

18) In an average **month**, how many times do you drink energy drinks to help study for an exam or major project? _____ per month

Did you understand this question?
a. Yes
b. No
How do you think this question could be made clearer?
____
____
____

19) In the last **month**, on the average day, when you are studying for an exam or a major project, how many energy drinks do you have? _____ per day

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____
____
____

20) In an average **month**, how many times do you drink energy drinks when you are driving for a long period? _____ per month

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____
____
____

21) In the last **month**, on the average day, when you are driving for a long period, how many energy drinks do you have?_____ per day

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____
____
____

22) In an average **month**, how many times do you drink energy drinks with alcohol? _____ per month

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?
____
____
____

23) In the last **month**, on an average night of partying, how many energy drinks do you mix with alcohol (example: Red Bull with vodka)? _____ per day

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?
____
____
____

24) In an average **month**, how many times do you drink energy drinks when you have a hangover? ____ per month

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?
____
____
____

25) In the last **month**, on an average day when you have a hangover, how many energy drinks do you have? _____ per day

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____
____
____

26) How many of your friends drink energy drinks?

a. All
b. Most
c. Some
d. Few
e. None

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____
____
____

27) In terms of frequency of energy drink consumption, indicate what your <u>friends</u> would state as acceptable
   a. Never
   b. Once a month
   c. Once a week
   d. Every day

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?

28) I drink energy when my friends are drinking energy drinks
   a. Strongly agree
   b. Agree
   c. Disagree
   d. Strongly disagree

Did you understand this question?
   a. Yes
   b. No

How do you think this question could be made clearer?

29) Have you seen a warning label on energy drinks cans?

a. Yes
b. No
c. I don't know

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____

____

____

30) Age

a. under 18
b. 18
c. 19
d. 20
e. 21
f. over 21

Did you understand this question?

a. Yes
b. No

How do you think this question could be made clearer?

____

____

____

31) Gender
- a. Female
- b. Male

Did you understand this question?
- a. Yes
- b. No

How do you think this question could be made clearer?

____

____

____

32) Race/Ethnicity
- a. American Indian or Alaskan Native
- b. White
- c. Asian
- d. Native Hawaiian or other Pacific Islander
- e. African American or Black

Did you understand this question?
- a. Yes
- b. No

How do you think this question could be made clearer?

____

____

____

33) What is your religious affiliation?
a. Catholic
b. Latter day Saint
c. Episcopal
d. Jewish
e. Presbyterian
f. Other
g. None

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?
____

34) How often do you attend religious services?
0-2 times a year
3-6 times a year
Monthly
Weekly

Did you understand this question?
a. Yes
b. No

How do you think this question could be made clearer?

Thank you for your participation!