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Alcohol and Dietary Choices Among College Students

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University of Tennessee, Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Melanie Moyers entitled "Alcohol and Dietary Choices Among College Students." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Dileep Sachan, Major Professor

We have read this thesis and recommend its acceptance:

Jean Skinner, James W. Bailey

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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Interim Vice Provost and
Dean of The Graduate School

ALCOHOL AND DIETARY CHOICES AMONG COLLEGE STUDENTS

A Thesis
Presented for the
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Degree
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Melanie Moyers
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ABSTRACT

A descriptive survey was distributed to a cross-sectional sample of undergraduate students during the time period of April 1998 to May 1998 at the University of Tennessee in Knoxville. The purpose of the research was to compare prevalence of binge drinking with the national average, and to explore and identify relationships between alcohol consumption and nutritional risks.

The student population had significantly lower prevalence of binge drinking (31.9%) than the national average (41%). However, binge drinking among women in the population was lower than the national studies (22%) while binge drinking among men was higher (53%). The members of fraternities were more likely to be binge drinkers (85% vs. 24%), while sorority members had a similar prevalence of binge drinking as non-members (24% vs. 24%). Energy intake was higher among non-binge men, women, and binge men compared to the abstainers. The binge drinking men consumed more protein, less carbohydrate, and less fat than abstainers. The binge drinking women consumed less protein, more carbohydrate, and less fat than abstainers.

Nutrition supplements were taken by 71% of binge drinkers, 54% of non-binge drinkers, and 38% of abstainers.

The most popular supplements were vitamin C, vitamin E, and multivitamins.

More binge drinking men than women ate food before drinking alcohol. Group and individual counseling is recommended to increase awareness to food-alcohol effects, especially among women.

This research provided a basis for further research aimed to identify prevalence of alcohol misuse and nutritional risks among college students with particular focus on energy intake, body mass index, and macronutrient composition of the diet.

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CHAPTER 1

INTRODUCTION

Students' heavy episodic alcohol use is by far the single most serious public health problem confronting American colleges (1). This heavy episodic alcohol use, also referred to as binge drinking, is defined as the consumption of 5 or more drinks in a row on one occasion within the last two weeks (2). According to national studies, the prevalence of collegiate binge drinking exceeds 40%. This pattern of drinking continues to remain identical to the results from a decade ago, despite efforts that have been undertaken to prevent drinking among college students (2). With this increasingly heavy drinking in college populations, there is an urgent need for a better understanding of the implications that various drinking patterns may have for future morbidity and mortality (3). Most research has focused on societal and psychological consequences of alcohol and given little attention to medical and nutritional issues. However, the increased prevalence of about 75% of all medical deaths attributable to cirrhosis of the liver due to alcoholism has increased

public health concerns related to medical and nutritional consequences of alcohol (4). Not only does drinking cause social problems, it also induces nutritional imbalances in various ways.

One area that has not been described in the literature is that of collegiate drinking and its relationship with malnutrition. Alcohol itself is a drug, has caloric value (7.1 kcal/g), and is low in nutrients (5). There is evidence that alcohol may displace other more nutritious foods in the diet, or the dietary composition and nutritional status of the alcoholic may modify the toxicity of alcohol (5).

It now appears relevant and appropriate to intervene at early stages of alcoholism, using a public health approach that is based on identification of individuals at risk (i.e. heavy drinkers identified not only through questionnaires, but also by biological markers) and early detection of the various associated medical disorders (6,7). Even a small decrease in the frequency or duration of associated medical and social complications would largely offset the costs of early intervention and of the research effort still needed in the field, not to mention the benefit of a significant reduction in human suffering (6).

Alcohol use is increasingly being taken into

consideration as a risk factor in other diseases such as cardiovascular disease, hypertension, and certain cancers (cancer of the oral cavity, esophagus, and breast) (3,8). On the other hand, the benefit of low doses of alcohol has been implicated in prevention of cardiovascular disease, but remains controversial in the literature (9). Lieber (6) suggests that we must emphasize that the introduction to moderate drinking in the life of a nondrinker involves the unpredictable risk of a loss of control with the potential for social and medical disintegration.

This study proposes to assess the prevalence of binge drinking and potential malnutrition resulting from consumption of alcohol among college students at the University of Tennessee in Knoxville. The primary focus will be nutritional risks resulting from alcohol misuse among college students. Particular attention will be paid to associations among calorie intake, body mass index, macronutrients and the amount of alcohol consumption.

CHAPTER 2

LITERATURE REVIEW

When the word "alcohol" is mentioned we often first think of it as a drug that causes intoxication and other adverse health consequences. We must also recognize that alcohol is regarded as a nutrient that provides calories (7.1 calories/g) and interacts with other nutrients in our diet. Alcohol abuse is a complex subject involving social, psychological, economical, nutritional, and medical complications that directly or indirectly impact our lives. The majority of the literature available today focuses on alcoholism and its impact on all of the above-mentioned complications. One area that has not been adequately addressed is that of the consequences of binge drinking. This review begins with alcohol metabolism, followed by a discussion of alcohol consumption and diet, and ending with the prevalence of college binge drinking and related areas of concern.

Alcohol Metabolism

Following consumption, a portion of the alcohol is absorbed from the stomach, and the remaining alcohol is

rapidly absorbed by the upper small intestine (10,11). The rate of absorption from the stomach can be influenced by the presence of food or water in the stomach and by the stomach emptying time (12). Alcohol that is absorbed into the bloodstream enters the portal vein and is transported to the liver. The liver cells metabolize alcohol by producing alcohol dehyrogenase (ADH) that oxidizes alcohol and converts it to acetaldehyde, or through the microsomal ethanol oxidizing system (MEOS)(Figure 1).

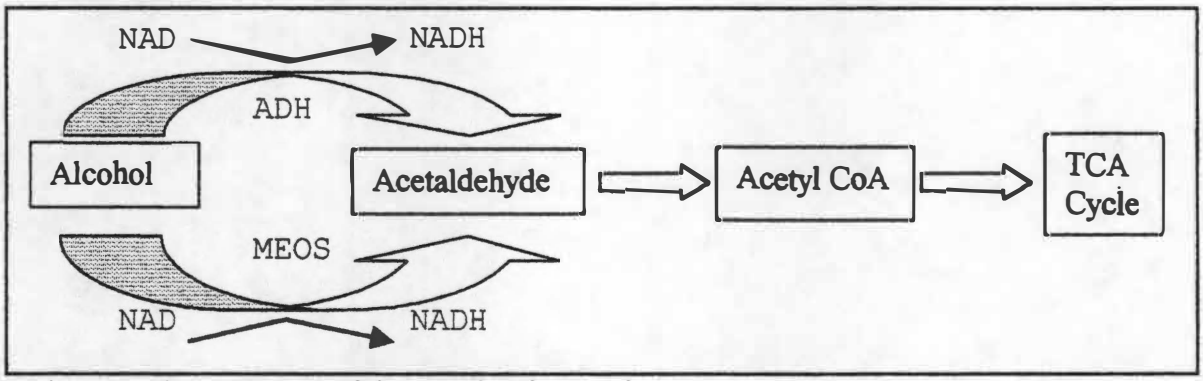

Figure 1 - Metabolism of Alcohol

The MEOS system increases in activity in the presence of large amounts of alcohol (6). Any alcohol that has not been eliminated by this first-pass metabolism will enter the systemic circulation and be distributed in the body water, circulating until enough liver enzymes are available to convert it to acetaldehyde (10,12-14). Acetaldehyde is a toxic substance that contributes to many of alcohol's adverse effects. Alcohol dehydrogenase (ADH) oxidizes alcohol to acetaldehyde, then aldehyde dehydrogenase (ALDH)

oxidizes acetaldehyde to acetyl CoA.

Acetyl CoA can enter the tricarboxylic acid (TCA) cycle to generate energy. These oxidation reactions during alcohol metabolism produce hydrogen ions that nicotinamide adenine dinucleotide (NAD^+) picks up and becomes NADH (reduced form). The accumulation of hydrogen ions results in a shift in the body's acid-base balance toward acid (10). NADH accumulation depresses the TCA cycle, so acetyl CoA builds up and induces fatty acid synthesis. As a result fat deposits in the liver. Fat accumulation can be seen in the liver after a single night of heavy drinking (10).

Gastric emptying is one of the factors that determines the time of exposure of alcohol to gastric ADH metabolism, as well as the speed of intestinal absorption (6,13,14). Sharma (15) examined the total time of alcohol absorption and elimination under fasting and full-stomach conditions and found that food consumption before drinking alcohol does lower the peak blood alcohol concentration (BAC) due to a decreased rate of absorption of alcohol from the stomach and intestines. In one study, sixteen healthy male volunteers drank a moderate dose of alcohol (0.51, 0.68, or 0.85 g/kg) as whiskey after an overnight fast (12). A substantial meal was served exactly five hours after the drinking started, and it was shown that the mean rate of disappearance of

alcohol increased to between 36 and 50%. In another study ten healthy men were given a moderate dose of ethanol (0.80 g/kg) in the morning after an overnight fast versus immediately after breakfast. The breakfast consisted of orange juice (150 ml), fruit yogurt (250 ml), two cheese sandwiches, one boiled egg, and one cup of coffee with milk and sugar. Ethanol was determined in venous blood at various times after the start of drinking by headspace gas chromatography. All subjects felt less intoxicated when alcohol was ingested after breakfast compared with drinking on an empty stomach, and the time required to metabolize the dose of ethanol was approximately two hours shorter after the subjects had eaten breakfast (12).

Gender Differences

Women generally have more body fat and about 12% less body water than men, which causes women to be more susceptible to higher blood alcohol levels (BAL) than men when consuming the same amount of alcohol over the same time period (6,17-19). Also, less of the alcohol is broken down in the stomach and more reaches the blood because women, below the age of 50, also have a lower gastric ADH activity than men (6). This effect is much more striking in alcoholic than in nonalcoholic women (6,20).

Peripheral blood concentrations of alcohol represent

the difference between the amount of alcohol that reaches the circulation and the amount metabolized (6). If the rate of entry is close to the rate of oxidation, even moderate differences in the bioavailability of ethanol may result in striking blood concentration changes, with substantial effects on the brain and other tissues (6). The lower rate of first-pass metabolism in women as compared to men, is due to inhibition of gastric ADH by alcohol (6). This effect has now been confirmed for a low alcohol dose of 0.15 g/kg, and is particularly striking after repetitive consumption of small doses, which is common in social drinkers (6). For a 75 kg person, the low alcohol dose of 0.15 g/kg is equivalent to a total of 11.25 g alcohol, or almost one drink. Thus a moderate dose for men may not be a moderate dose for women.

Moderate drinking is defined as not more than 2 drinks per day for men, and only one drink per day for women (21). A drink is defined as 12 ounces of regular beer, 5 ounces of wine, and 1.5 ounces of distilled spirits (80 proof). Although women are more susceptible to the effects of alcohol, the amount of alcohol offered to women in social settings is the same amount as that offered to men. Increasing women's awareness of greater vulnerability to the effects of alcohol may help women make decisions about how

much alcohol they will consume in social settings, and allow better control of their drinking. Further, the literature shows that the incidence of chronic advanced liver disease is higher among women than among men with a similar history of alcohol misuse (6,22). A daily alcohol intake of 40 g in men (3 drinks), but only 20 g in women resulted in a statistically significant increase in the incidence of cirrhosis in a well-nourished population (6). This is of increasing importance because male/female differences in drinking are less than they were a generation ago, especially in terms of drinking by young women, and women are more vulnerable to the effects of alcohol (6).

The Harvard Alcohol Study addressed differences in binge drinking for women compared to men (23). This study measured female binge drinking as ≥4 drinks in a row at least once in the past two weeks, while for men it remained at the ≥5 drinks in a row definition. The study found that binge drinking was at a rate of 50% for men and 39% for women when using those definitions. Our data also were analyzed by this definition to compare with the Harvard Alcohol Study definition of binge drinking.

It has been proposed that men and women who regularly consume alcohol may also have different dietary preferences than nondrinkers (24). One study available that is directly

related to this area is an Australian study in which 201 young adults kept diaries of their drinking events over a two-week period (25). In that study, across all types of beverage drinking occasions, food was just as likely to be present for men as for women (46% of occasions)(25). In absence of more research, it is impossible to judge whether women and men differ in their tendencies to consume food when drinking (17). Furthermore, cultural variation in drinking with meals, and variation in the types of food eaten while drinking complicate the question of whether gender differences in consuming alcohol with food need to be considered in adjusting alcohol measures for biological gender differences (17). The lack of research regarding the potential moderating role of gender differences in behavioral factors related to alcohol consumption reflects a surprising lack of knowledge generally about patterns and prevalence of behaviors (such as concurrent consumption of food, or pace of drinking) that can modify the effects of alcohol (17). Therefore, we pose the question, are there gender differences in drinking practices in college students?

Alcohol, Diet, & Disease

Alcoholics often eat poorly, as much as 50% of their total calories from alcohol, limiting their supply of

essential nutrients and affecting both energy supply and maintenance of body structure and function (4). Even when food intake is adequate, alcohol interferes with nutritional status by affecting digestion, storage, utilization, and excretion of nutrients. In addition, alcohol use may contribute to or exacerbate certain medical conditions such as diabetes, hyperlipidemia and hypertension increasing the risk for cardiovascular disease, cancer, and hepatitis C infection (11,26). For example, in people with diabetes, chronic alcohol consumption may lead to hyperglycemia, and may induce hypoglycemia if the person is in the fasted state (27). Alcohol metabolism in the liver generates NADH and reduces gluconeogenesis, which contributes to a further drop in blood sugar levels, causing hypoglycemia if the person began drinking in the fasted state. In addition, persons with diabetes who consume alcohol must also be alert to the fact that the symptoms of mild intoxication also resemble those of hypoglycemia (27). Alcohol consumption may exacerbate hyperlipidemia because alcohol inhibits gluconeogenesis that in turn inhibits fat metabolism, and results in the production of Very Low Density Lipoproteins (VLDL) particles that increases to contribute to elevated lipid levels (27). Alcohol has also been shown to cause a dose-dependent elevation in blood pressure (28). Also,

infection with the hepatitis C virus, which can result in serious and even fatal liver damage, is becoming more common in the United States (11). Heavy alcohol use in patients infected with hepatitis C accelerates the rate of liver damage and increases the risk of cirrhosis.

Although epidemiological evidence supports a correlation between poor diet and chronic diseases, most college students' diets are high in fat and sodium content, and many students report skipping meals (29). One study indicated that 69% of college students did not eat fruit, and 48% did not eat vegetables at least once a day (30). In addition to poor eating habits, many students also consume alcohol, which may further exacerbate adverse health risks. Increased awareness of the magnitude of the problem may prevent or decrease the prevalence of the associated disease risk from alcohol consumption and poor dietary habits.

Literature on alcohol consumption and diet has focused mostly on dietary patterns of alcoholics leading to malnutrition. However, binge drinking patterns are not the same as alcoholic drinking patterns because binge drinking is more sporadic, whereas alcoholism is considered a chronic daily consumption. Some literature is also available on the effects of eating prior to, during, and following drinking. Jones (16) found that food in the stomach before drinking

leads to lower peak blood alcohol concentrations decreasing the feelings of intoxication while also boosting the rate of ethanol metabolism. A food-induced increase in the rate of disposal of ethanol was also shown when subjects ate a meal up to 5 hours after drinking. In addition, some studies have found that skipping meals and eating less food differ across varied levels of drinking (31-33). The NIAAA's Alcohol Epidemiologic Data System (AEDS), analyses of data from the Health Promotion and Disease Prevention Questionnaire of the 1985 National Health Interview Survey (NHIS), indicated that heavier drinkers are more likely than light or moderate drinkers to report that they "rarely or never" eat breakfast or snack (34). The data also suggest that heavier drinkers are less aware of the connection between diet and health and are more likely to report unhealthy dietary behaviors, e.g. eating less than two meals a day on weekdays and consuming foods that are higher in fat.

24 Hour Recall & Self Reported Weight

In the study by Jones (22) 90% of the subjects rated their 24 hour intake as representative of their usual diet. This was also true for alcohol intake where the reported 24 hour alcohol intake, as determined by the dietitian's interview, was correlated ($r = 0.6$) with the reported weekly

alcohol intake obtained in a separate interview by a non-dietitian (32). Most studies that addressed the relationship between alcohol intake and specific components of diet have relied on the 24 hour recall for the assessment of diet and alcohol intake, although some studies have used the 7 day recall for alcohol intake or weighed-diet records (24).

The 24 hour recall was chosen to provide an overall general assessment of food intake within this large population. Most studies that have addressed the relationship between alcohol intake and specific components of diet have relied on the 24 hour recall for the assessment of diet and alcohol intake, although some studies have used the 7 day recall for alcohol intake or weighed-diet records (24). In order to be comparable to most studies, the 24 hour recall was chosen for this thesis project. Other reasons for choosing the 24 hour recall were 1) students' time constraints for completing the questionnaire, therefore, a diet record would not be appropriate for this population, 2) a food frequency questionnaire would mean certain foods were pre-selected and may not have represented the usual food intake of the college age population, and 3) students may not count certain foods appropriately in food frequency questions, i.e., may count macaroni and cheese as

a vegetable serving. This concern with receiving inaccurate data also resulted in choosing the 24 hour recall.

Colditz (24) documented the validity of self-reported weight. Technicians measured weight of the men and women in the study, and compared it to the weight the individuals listed on their questionnaire. The self-reported weight for women was 65.4 ± 13.3 kg, and the technician measured weight was 67.1 ± 12.1 kg (24). In men, the self-reported weight was 79.3 ± 10.8, and the technician measured weight was 80.4 ± 11.7 kg (24). This shows that self-reported weight was not significantly different from the actual weight of the participants.

Changes in Food Choices

When animals consume alcohol, food intake has been shown to decrease in proportion to the caloric content of the alcohol (35). Some studies in humans have shown that alcohol decreased eating in almost the same proportion as the calories obtained from alcohol (31,36) while on the other hand several other human experiments showed that alcohol had little effect on food intake and the alcohol calories were consumed in addition to calories from food (33, 37-39). The reasons for these differences remain unclear.

One experiment mentioned above was that of Barboriak (36) who observed that alcohol depressed calorie intake in elderly men in a Veterans Administration domiciliary. When compared to a group of abstainers from the same institution, those that drank alcohol consumed fewer food calories (2,140 vs. 2,415 calories) per day.

Hillers and Massey (31) also found that alcohol depressed calorie intake in men. It was observed that as alcohol intake increased, the amount of calorie intake decreased.

Several other experiments showed that alcohol had no effect on depressing food intake, and that the alcohol calories were in addition to the calories from the food. One study included men (n=23) and women (n=69) in the age range of 18-54 years (37). This study showed those who consumed alcohol, but who are not alcoholic, added the alcohol calories to their calorie intake consuming more total calories than nondrinkers.

Herbeth (38) studied French men aged 18-44, who were either moderate or heavy drinkers. It was found that total calorie intake was higher in drinkers than in the controls.

Rissanen (39) assessed 26 Finnish men that drank excessively. One limitation of this study was that it did not define how much alcohol would be considered excessive.

Compared with the control group of men, the daily intake of calories of the excessive drinkers was significantly greater (3,315 calories vs. 2,850 calories). However, this difference in calories was entirely accounted for by calories derived from alcohol (39).

Colditz (24) examined the relationships among alcohol intake, body mass index, and diet in two cohorts, men (age 40-75) and women (age 34-59). The study indicated that total calories increased with alcohol consumption, and in women, sucrose intake decreased with higher alcohol intake. A gender difference was found in this study that may indicate alcohol affects food intake differently for women than for men.

Alcohol not only interacts with the intake of calories, but also with the choice of macronutrients (40). The largest change has been shown in the suppression of carbohydrate consumption. It has been observed in studies on rats that the carbohydrate intake can vary between 29% and 57% (calculated relative to the total caloric value of the food) (40). Further, the protein intake can vary between 9% and 35%, and the fat intake between 18% and 64%.

In elderly residents it was found that those consuming alcohol consumed less protein (87 vs. 97 g), less fat (90 vs. 100 g), and less carbohydrate (246 vs. 284 g) than

abstainers from the same institution (36).

Yung (41) gave food with varying compositions to alcoholic patients at their clinic and measured the days the patients could abstain from alcohol. It was found that the patients who consumed the most carbohydrate abstained from drinking for the longest time.

The Alcoholics Anonymous group has recommended that their members carry candies with them to help suppress the urge to drink (42,43). Eddy et al (44) studied sailors on an ocean-going tanker and found those who consumed alcohol used less table sugar.

The Hillers and Massey (31) study also showed that in men, the average amounts of protein, fat, and carbohydrate consumed in meals decreased in those drinking alcohol.

Another study analyzed data from the household and individual segments of the Nationwide Food Consumption Survey (NFCS) to determine levels of alcoholic beverage consumption in the United States (45). The population age range in the study was 14 years and above, and did not include non-household residences, such as college dormitories, military bases, and boarding houses, where alcohol consumption is reported to be prevalent. Nutritional quality of the diet was found by standardizing all of the nutrient intakes to values per 1,000 calories so

the quality of individual diets may be compared equally. This was defined as the Index of Nutritional Quality (INQ), and the data were presented using a nutrient density profile (45). The profile showed differences in dietary intake for the chosen nutrients. It was found that mean daily consumption of macronutrients per 1,000 calories was lower for those who consumed alcohol than for those who abstained (45). The drinkers consumed lower mean protein (40.8 g) versus the abstainers (43.0 g) protein. Mean fat intake was 44.8 g for drinkers, versus 46.0 g for abstainers, and carbohydrate intake was 95.3 g for drinkers, versus 104.9 g for abstainers (45). Carbohydrate and fat intake were both lower for those individuals that drank alcohol.

In analysis of the 1987 NCI Epidemiological Study addressing the relationship between certain dietary beliefs and behaviors, the NIAAA's Alcohol Epidemiologic Data System (AEDS) examined variables that have face validity as positive or negative indicators of respondents awareness of the importance of diet for health (34). Of these variables, two were 1) reporting a diet high in fat, 2) taking any vitamin/mineral supplements in the past 12 months. Heavier drinkers in all age and gender groups were more likely to report diets high in fat (34).

Colditz (24) found that carbohydrate intake decreased

from an average of 152.8 g/d in abstainers to 130.6 g/d in women consuming 25.0-49.9 g alcohol/d, and then rose to 143.6 in women consuming ≥ 50 g of alcohol/d. This reduction in carbohydrate intake was shown to be a decrease in sucrose consumption with increasing alcohol intake. Sucrose intake decreased from 44.6 g/d in abstainer to 24.1 g/d in women consuming ≥ 50 g alcohol/d. In men, carbohydrate intake decreased from 231.3 g/d in abstainers to 213.2 g/d in men consuming 25.0-49.9 g/d, and then rose to 221.7 g/d in men consuming ≥ 50g alcohol/d. As seen for women, sucrose intake decreased with increasing alcohol intake. Sucrose intake decreased from a mean of 24.2 g/d among abstainers to 16.9 g/d among men consuming ≥ 50g alcohol/d. In summary, Colditz (15) found that carbohydrate intake decreased for women who drank alcohol.

The rate of metabolism of ethanol in humans has been assessed by intravenous infusion of ethanol/saline under feedback control to maintain a constant blood alcohol concentration (46). After equilibration, meals consisting predominantly of carbohydrate, fat or protein were eaten and it was found that carbohydrate caused a significant increase in the rate of metabolism of alcohol in fasting human subjects, and fat or protein either have no effect or caused

small (non-significant) decreases (46). Therefore food composition can have an affect on the rate of ethanol metabolism, independently of ethanol effects on the rate of absorption. It is also interesting to note that the carbohydrate effect on ethanol metabolism was the greatest around 1 hour after the meal. The mechanism for this action is unknown. One should not only avoid drinking on an empty stomach because food will slow its absorption, but in addition if the meal contains carbohydrate it may also speed up alcohol metabolism.

Micronutrient Deficiency

Almost any organ of the body may be affected by one or more deficiencies and many interactions occur between nutrients. The early work from Baker's group (in 1969) demonstrated that reduced circulating levels of vitamins frequently occur in alcoholic patients and are usually multiple (47). Since that study many other studies have been conducted that have found varying degrees of depletion, depending upon the particular populations studied and the methodology used (47).

Habitual use of alcohol also alters the functioning of other important digestive organs, including the pancreas and liver (48). Alcohol-induced pancreatitis can lead to insufficiencies in pancreatic enzymes which may contribute

to the malabsorption and steatorrhea commonly observed in alcoholics (48). In addition, pancreatitis may result in disturbances of fluid and electrolyte balance, and decreased nutrient intake. Liver damage, which is common in chronic alcoholics, alters the metabolism of many essential vitamins and minerals, including folic acid; pyridoxine; vitamins A, C, and D; and sodium, potassium, and magnesium (48,49).

Most of the data regarding micronutrient deficiencies were obtained from alcoholics who consume many of their calories as alcohol. Although inadequate dietary intake is a major cause of vitamin deficiencies, alcohol can also affect absorption, storage, and metabolism of nutrients.

Thiamin is most often deficient in alcoholics and can cause Wernicke-Korsakoff syndrome, and dry beriberi (4,49). Wernicke-Korsakoff syndrome is characterized by ataxia, eye movement abnormalities, a confused state, and impairment of short-term memory that may also result in nerve damage (50,51). Reasons for thiamin deficiency are inadequate intake, reduced hepatic storage in a patient with fatty deposits, inhibition of intestinal thiamin transport, and impaired thiamin pyrophosphate (TPP) synthesis and promotion of TPP breakdown (52).

In 64 normally nourished alcoholics with liver disease, 29.7% were found to have low transketolase activity that

indicated thiamin deficiency, and 12.5% had normal transketolase activity but a low thiamin pyrophosphate (TPP) effect (53). It was suggested that the TPP may fail to recombine with transketolase in the presence of normal thiamin stores in alcoholics. In another study, it was shown that decreased transketolase activity correlated with thiamin deficiency in patients with Wernicke's encephalopathy and was more frequently abnormal than the TPP effect in the entire group of alcoholics (54). Because TPP is involved in carbohydrate metabolism, alcoholics with thiamin deficiency given large quantities of carbohydrate risk beriberi heart failure, lactic acidosis, or Wernicke-Korsakoff syndrome (49).

Thiamin treatment should be considered in all alcoholics because deficiency is common, assessing deficiency is difficult, thiamin replacement is easy and safe, and it may help prevent beriberi and Wernicke-Korsakoff syndrome (50). Usually 50 mg/day is the dose used to treat thiamin deficiency (50).

When B vitamin intake is decreased, riboflavin deficiency may also occur (4). Riboflavin deficiency was found in 50% of alcoholic patients with medical complications admitted to a hospital (4). Riboflavin is usually given to alcoholics as part of a standard

multivitamin preparation (4).

Pyridoxine deficiency causes peripheral neuropathy and anemia (49). Pyridoxine deficiency is caused by inadequate intake, or increased destruction and reduced formation of plasma pyridoxal 5' phosphate (PLP) (4). PLP is more rapidly destroyed in erythrocytes in the presence of acetaldehyde, the first product of ethanol oxidation, possibly by displacement of PLP from protein and consequent exposure to phosphatase (4,55). Supplementation to manage pyridoxine deficiency is usually with a multivitamin dosage (4). Doses above 200 mg of pyroxidine/day should be avoided due to studies showing development of ataxia from sensory neuropathy following 200 mg dosages (4).

Folate deficiency results from inadequate intake, and/or alcohol interfering with absorption, decreased hepatic uptake and retention, and increased urinary excretion (49).

In one group of alcoholics, 37.5% had low serum folate levels and 17.6% had low red blood cell folate levels (56). Alcohol was shown to impair intestinal absorption of folate in another study (52). Alcohol consumed acutely was shown to decrease serum folate secondary to increased urinary excretion (52). Further, alcohol given chronically to monkeys showed decreased hepatic folate levels (57).

The minimum daily folate requirement is 3 μg/kg body weight, or about 200 μg/day for adult men, and 180 μg/day for women (51). The lack of dietary folate results in deficiency in about 140 days, and maintenance folate therapy is 0.1mg/day for 1 to 4 months, which can be discontinued only if the diet contains at least one fresh fruit or vegetable daily (49,51). A diet providing adequate folate will replete stores in a matter of weeks.

Deficiency of B_{12} is rarely seen in alcoholics due to large body stores and large reserve capacity for absorption (the ratio of its body pool size, 2-3 mg, to its minimum daily requirement, about 1 μg is much greater) (49,58). However, hepatic stores of vitamin B_{12} have been shown to decrease in relation to severity of alcoholic liver disease, possibly as a result of an inhibitory effect of alcoholism on absorption of the vitamin from the ileum (59). Alcohol has also been shown to decrease vitamin B_{12} absorption after several weeks of intake (59). It may be due to abnormal binding of intrinsic factor and vitamin B complex to ileal sites, but this remains controversial (4).

When alcohol intake exceeds 30% of total calories, vitamin C intake falls below recommended dietary allowance (4,60). Daily supplementation of 175-500 mg may be

necessary for weeks to months to restore plasma and urinary ascorbate levels to normal (61).

A clinical sign of vitamin A deficiency is night blindness (4). Alcohol mediated changes in vitamin A status may be important for the association of vitamin A or carotene levels with malignancies (4). Intake of vitamin A has also been shown to be low for Americans consuming >20% of calories as alcohol (~400calories/day) (31,60). Hepatic vitamin A stores have been shown to be lower whether vitamin A intake is low, normal, or high (51). Alcohol induces the cytochrome P450 system enzymes that increase breakdown of hepatic retinol and promotes vitamin A mobilization from the liver, resulting in an increased excretion of vitamin A (62).

Vitamin A decreases in serum and hepatic levels in alcoholic liver disease. The further the stage of the disease, the more vitamin A is decreased (62). In one study vitamin A absorption was found to be reduced by 17% when given 12 ml of wine (4). However, another study found that acute alcohol ingestion showed no change on vitamin A levels in humans (3). It is difficult to determine the dose of vitamin A needed to counteract the effects of alcohol. Assessment of tissue vitamin A stores is difficult, vitamin A in high dose is toxic, and even usual doses are

potentially toxic with continued intake of alcohol (4). It is suggested that with night blindness and low serum vitamin A (<30 µg/dl or 1.4 µM) provides evidence of deficiency (4). Zinc therapy may also be indicated if vitamin A treatment fails (4). Recommended dose of 10,000 µg/day should only be given for well-documented deficiency and when sure the patient will be abstinent from alcohol to prevent hepatoxicity and hypervitaminosis A (4).

Zinc deficiency may result in growth retardation, male hypogonadism, rough dry skin, disordered taste, poor appetite, and mental lethargy (4). Enzymes that contain zinc include hepatic alcohol dehydrogenase (converts ethanol to acetaldehyde), ocular retinol dehydrogenase (converts retinol to retinal) and hepatic and erythrocyte superoxide dismutases (protect against oxidative damage) (4). Zinc absorption has been shown to be low in the alcoholic cirrhotic but not in patients with cirrhosis of other causes (63). Below normal serum zinc levels are found in about 70% of alcoholic patients with cirrhosis, and in 30-50% of alcoholic patients without cirrhosis (64).

Iron deficiency may result in alcoholics as a result of bleeding from esophagitis, esophageal varices, gastritis or duodentitis (4). Iron overload has also been found. It is suggested that alcohol increases intestinal absorption of

iron or hepatic uptake of iron occurs in alcoholic liver disease and contributes to increased hepatic iron causing iron overload (65). However, if iron deficiency has been diagnosed, it should be replaced with the usual amount orally (4).

Nutritional Supplements

The findings of the National Health Interview Survey study of 1987 found that heavier drinkers in the general population are least likely to use dietary supplements (34). Associations of heavy drinking with possible malnutrition suggest that lower levels of vitamin and mineral supplements are likely to be more of a problem among heavier drinkers than are similar low levels of vitamin and mineral supplements among abstainers (34). Age, gender, drinking level, and diet are all important factors to consider in regard to the need for additional vitamin supplements.

Although heavy drinkers have few detectable nutritional deficiencies, many alcoholics who have been hospitalized for complications of alcoholism do experience severe malnutrition (35,58). Because alcoholics consume a lot of their calories as alcohol and consume less food to provide sufficient nutrients, a major concern is that alcohol intake may cause a mildly malnourished person to become severely malnourished. If this is the case, alcoholics will benefit

from nutritional therapy as an adjunct to other therapy for recovery.

Body Mass Index (BMI)

An epidemiological study by Colditz (24) studied alcohol intake, body mass index, and diet in two cohorts, men (age 40-75) and women (age 34-59). Alcohol levels observed were within the range of 0 g to 50+ g alcohol/day. As alcohol intake increased from 0 g/day to almost 50 g/day, the BMI for women decreased. However, women with the highest level of alcohol intake (50+ g) showed an increase in body mass index (24). In men, body mass index was about the same across all levels of alcohol intake.

Data from the first National Health and Nutrition Examination Survey (NHANES I) were analyzed for differences in nutrient intakes based on the amounts of alcohol consumed by US adults (18-74 yr.), and for relationships among alcohol consumption, calorie intake, and relative body weight (60). Drinkers had significantly higher intakes of total calories because of their alcohol calories. In addition, despite their higher calorie intakes, drinkers were not more obese than nondrinkers.

Food intake and alcohol consumption was also studied in a random sample of a predominantly white upper-middle class suburban community in Southern California (32). The

majority of men and women (age 30-90) in the study population consumed an average of 30 g of alcohol. Although alcohol intake resulted in increased total calories consumed, alcohol drinkers were not more obese than nondrinkers (32). The alcohol calories may not be efficiently utilized in those averaging 30 g alcohol/day.

Consuming alcohol in place of carbohydrates in the diet, or in addition to the usual diet has not been shown to produce the expected weight gain (66). This energy deficit has been attributed to induction of the microsomal ethanol oxidizing system. Lieber (66) suggests that for this reason it may be beneficial to lower the fat content of the diet of alcoholics, and increase the carbohydrate content of the diet to compensate for the "energy wastage" effect of chronic alcohol consumption. An explanation of excess calories from alcohol not resulting in an increase in body weight has been referred to as "energy wastage" (66). This energy wastage is due to the induction of the microsomal ethanol oxidizing system (MEOS) (66,67). MEOS is the metabolic pathway that oxidizes alcohol without associated energy production. The MEOS has a relatively high K_m (about 10 mM), compared to the ADH pathway K_m (about 1 mM), and therefore the MEOS impact can be expected to be greater at high rather than low blood alcohol levels (66,67). Further,

the MEOS pathway is induced by chronic alcohol consumption, which is noted to aggravate energy wastage. It also appears that a relatively high fat diet is required in order to demonstrate the energy wastage of alcohol calories (66,67). It was suggested that a low-fat diet (fat substituted with carbohydrate) may counteract the energy wastage, resulting in weight gain from added alcohol calories (67). The critical issue concerning alcohol and energy homeostasis is whether the alcohol molecules are "captured" by metabolic processes comparable to that of other dietary constituents such as fat, carbohydrate, and protein (68). If the 7.1 calories/g of alcohol is not actually bioavailable to binge drinkers, we may see BMI values within the healthy weight range.

It is important to note that different alcoholic beverages contain different amounts of alcohol, and thus it is necessary to identify the alcoholic beverage most consumed by students to provide an accurate account of the amount of alcohol they are consuming. Of the alcoholic beverage calories consumed by men 48% were derived from beer, 17% from wines, and 35% from distilled spirits, either undiluted or in mixed drinks (45). Women who reported drinking consumed approximately 24% of alcoholic beverage calories from beer, 33% from wines, and 43% from undiluted

spirits and/or mixed drinks (45). However, this study included data from the Nationwide Food Consumption Survey (NFCS) with the population within the age range of 14 years and up, and excluded college dormitories (45).

Collegiate Binge Drinking

Alcohol use is normative on college campuses and student binge drinking is the single most serious public heath problem confronting American colleges (1,2,69-88). Binge drinking is defined in the literature as the consumption of 5 or more drinks in a row on one occasion within the prior two weeks (1,2,64). The overall decline in drinking in the United States has not been reflected on college campuses as indicated by the results of three national studies that reported binge drinking exceeds 40% on college campuses (2,19,72,89). One area that has not received attention is the relationship between college student drinking and malnutrition. Therefore, this research will focus on collegiate binge drinking and the nutritional risks resulting from alcohol misuse including associations between calorie intake, macronutrients, and body mass index.

Alcohol consumption is associated with up to 25% of all deaths in college age students and contributes to almost half of all motor vehicle fatalities (29,89). Alcohol has been related to nearly two thirds of violent behavior, one

half of physical injuries, one third of emotional difficulties, and one third of the academic problems that occur on campus (89). It has also been related to unplanned and unsafe sexual activity, physical violence, sexual assault, unintentional and intentional injuries, and physical and cognitive impairment (29). During 1997 there were seven fatal incidents related to college student binge drinking. During 1998, there were nine accidents, and by September 1999, five tragic accidents were attributed to college student binge drinking (67)(Appendix A). This does not include the other contraindications of binge drinking, as mentioned previously.

The University of Tennessee prevalence of binge drinking results will later be compared to the national studies results. The national studies, which follow, are 1) The Monitoring the Future Project, 2) Harvard School of Public Health College Alcohol Study, and 3) The Core Institute Study (1,2,62).

Monitoring the Future Project

As mentioned previously, research has primarily focused on the prevalence of binge drinking among college students. One of the major studies regarding college student binge drinking prevalence is the Monitoring the Future Project. This project is a long-term research program conducted at

the University of Michigan's Institute for Social Research under a series of research grants from the National Institute on Drug Abuse. It is comprised of an ongoing series of annual national surveys about drug abuse among college students and young adults. The college students targeted in this project were 1-4 years past high school, and therefore, the study decided to use age cut-off range of 19-22 years in order to compare their trend data with prior studies. Data for this project was last compiled in 1998, and constitutes the twelfth national survey of American college students in this series. This study defines drinking five or more drinks in a row on one occasion within the prior two weeks as an episode of heavy drinking (2). This definition of binge drinking is consistent with other research (1,72-74). Therefore, our study also will define binge drinking as drinking five or more drinks in a row on one occasion within the two weeks prior to the questionnaire.

The latest results of the Monitoring the Future Project show that nationally 41% of college students binge drink (2). This figure is only slightly lower than the 43% reported in 1980 and is actually identical to the results from a decade ago despite efforts that have been undertaken to prevent binge drinking among college students (2). The

Monitoring the Future surveys have also found that college students drink more and are more likely to be binge drinkers than non-college students.

The Monitoring the Future study indicated that the age band for college students of 19-22 was a limitation of their study. For trend estimation purposes, they decided to limit the age band to the most typical one for college attendance, i.e. one to four years past high school, which corresponds to the modal ages of 19 to 22 years old (2). According to statistics from the United States Bureau of the Census, this age band should encompass about 74 % of all undergraduate college students enrolled in 1995, down slightly from 79% in 1989 (2). The Monitoring the Future Study researchers make note that extending the age band an additional two years (to make it a 6 year age span) would cover more of the enrolled college students, but it would not correlate with their prior trend data. An analysis conducted in 1985 indicated that the differences in prevalence of use estimates under the two different age definitions were extremely small (2). The annual prevalence of all drugs except cocaine shifted only about one-or two-tenths of a percent, based on comparisons between those made in 1985 and those in 1998 (2). They concluded that for purposes of estimating all prevalence rates except lifetime prevalence, the four-year

and six-year intervals are nearly interchangeable (2). If we analyze the number of students at the University of Tennessee, we find that the age range of 19-22 would target only 48.3% of the undergraduate student population, while 17-23 age range would target 66.2% of the student population. The research results will also be compared to the other two national studies, namely the Core Alcohol Study, and the Harvard Alcohol Study.

Harvard School of Public Health College Alcohol Study

Another major national study, the Harvard School of Public Health College Alcohol Study surveyed students in a nationally representative sample of colleges to explore the extent of binge drinking and identify types of students most involved in this behavior (1). Two sets of surveys have been completed, the first in 1993, and the most recent, which re-surveyed those colleges participating in 1993, was completed in 1997 (1). The findings revealed little change in binge drinking from 1993 to 1997. In 1993, 44% (2 out of 5) of students were classified as binge drinkers. It is of interest that in this study men and women were assigned different definitions of binge drinking. Men were classified as binge drinkers if they drank five or more drinks in a row, while women were classified as binge drinkers if they drank four or more drinks in a row, at

least once within the 2 weeks prior to the survey. The 1997 study results indicated that 42.7% of students were binge drinkers, 19% were abstainers, and 20.7% were frequent binge drinkers (1). As was true in the 1993 study, 81% (4 out of 5) of fraternity or sorority students were binge drinkers. Binge drinking rates also varied extensively among the 140 different colleges, ranging from almost 0 to nearly 70 percent of the students (90). At 44 of the 140 colleges in that study more than half of the responding students were binge drinkers. It was shown that the binge drinkers in both 1993 and 1997 were at increased risk of alcohol-related problems, and abstainers at colleges with high binge drinking rates had increased risks of encountering secondhand effects of binge drinking (1).

The Harvard Alcohol Study defined colleges by binge drinking level (90). In this study middle level binge drinking colleges were defined as those having a range of 36% to 50% of students classified as binge drinkers, and low-level binge drinking colleges were defined as 35% or less of students classified as binge drinkers.

Core Institute Alcohol & Drugs on American College Campuses

The Core Alcohol and Drug survey was first developed in 1989 by a committee of grantees from the Drug Prevention Program in Higher Education of the Fund for Improvement of

Postsecondary Education (FIPSE) of the US Department of Education, it was designed to assess campus wide patterns of substance abuse (72-74). Its purpose was to assist institutions of higher education in obtaining a common "core" of baseline information that can serve as a centerpiece of lengthier studies (72-74). Data on 41,667 students from 77 institutions were analyzed. Demographics of the respondents were reported for both two-year and four-year institutions (72-74). The analysis described substance use according to the student's class year in school, student's gender, and provided an analysis of regional differences. Due to the considerable national interest in the legal versus illegal use of alcohol the study included variables with respect to the age of the respondents. The study found that overall 33% of women, and 48% of men reported binge drinking in the two weeks prior to the survey (72-74). Almost 16% of the students reported three or more binge drinking episodes, including 23% of men and 10.8% of women, a ratio of more than 2 to 1 (72-74). The total percentage of binge drinking for four-year institutions was 40.2%, which was higher when compared to 33.2% at two-year institutions.

The study was also divided into regions for further analysis (72-74)(Appendix B). In terms of quantity of

alcohol consumed, the Northeast region showed a consumption level 50% greater than that of the West (5.5 drinks/week per student compared to 3.7 drinks)(72-74). The North Central region had the second highest consumption level (4.6 drinks) and the South ranked third (4.3 drinks). In the Northeast, one-fifth of the students (19.5%) engaged in binge drinking three or more times during the two weeks prior to the survey (72-74).

The Core study found that students living on campus binged on alcohol more often than students living off campus. In this study, students under the legal drinking age consumed greater quantities of alcohol than those for whom the drug is legal, and they engaged in binge drinking more often (72-74).

Annual prevalence of alcohol use from highest to lowest was as follows: white students (87.1%), Hispanic (84.5%), Native American/Alaskan Native (82.9%), black students (72.4%). The lowest prevalence was among Asian/Pacific Islander descent (70.5%)(72-74).

In terms of the average number of drinks consumed per week, Native American/Alaskan Native consumed 5.5 drinks, white students consumed 4.9 drinks, Hispanic students consumed 3.6 drinks. Both Asian students and black students had 1.8 drinks per week (72-74).

Related Areas of Concern

The following will briefly address other pertinent areas in the collegiate population with reference to alcohol misuse.

Accidents

Alcohol related accidents are a major source of drinking-related mortality and morbidity for teenage youth. Older teenagers (aged 16-21 years) account for only 13% of all licensed drivers, but they are responsible for about 25% of all alcohol-related fatal motor vehicle accidents (92). Teenage drinking has also been shown to increase the risk of suicide, violent behavior, and emotional problems. As already mentioned there have been tragic accidents in the past few years related to alcohol abuse (Appendix A).

Economics

The Surgeon General estimated that college students annually spend $4.2 billion on alcoholic beverages (90). In addition, alcohol abuse and dependence cost the United States an estimated $98 million in health care and productivity losses in 1990 (92).

Sexual Behavior

Surveys of adolescents suggest that alcohol use is associated with increased risky sexual behavior and vulnerability to coercive sexual activity. Among

adolescents surveyed in New Zealand, alcohol misuse was significantly associated with unprotected intercourse and sexual activity before age 16 (93). Forty-four percent of sexually active Massachusetts teenagers said they were more likely to have sexual intercourse if they had been drinking, and 17 percent said they were less likely to use condoms after drinking (94).

Vulnerable age

It is suggested that research needs to focus on episodic patterns of alcohol use (infrequent binge drinking, drinking before or during school or work) that do not necessarily cause problems for adults (92). Differences in body weight, experience with alcohol, and judgment all make teenagers more vulnerable than adults to many predicaments associated with episodic drinking (e.g. engaging in unprotected sex, getting into fights, crashing a car) (92).

Geographic Location

The Harvard Alcohol Study compared 140 colleges using chi-square analysis and determined that several college characteristics were individually associated with binge drinking. Colleges located in the Northeast or North Central regions of the United States (compared with those in the West or South) or those that were residential (compared with commuter schools where 90% or more of the students

lived off campus) tended to have higher rates of binge drinking. Other characteristics, such as whether the college was public or private and its enrollment size were not related to binge drinking rates (90). It was noted that binge drinking is less likely if the institution does not have any alcohol outlets within one mile of campus or if it prohibits alcohol use for all persons (even those older than 21 years) on campus.

Another study of 14 colleges in Massachusetts found that seven out of eight college students drink (95). More than half of the men and one-third of the women were categorized as binge drinkers (95). These data indicated that binge drinking rates vary by the type and location of the college and the ethnic and gender makeup of the student body (90,95).

Age

Binge drinking is also related to age. Developmentally, the ages 18 through 21 represents the period of heaviest alcohol consumption for most drinkers in the United States (96). Generally, students in the predominant college age group (between 17 and 23 years) have much higher binge drinking rates than older students (90). However, within this predominant college age group, it was shown that students who are younger than the legal drinking age of 21

years do not significantly differ in binge drinking rates from students aged 21 to 23 years (90).

Binge drinking, often beginning around age 13, tends to increase during adolescence, peak in young adulthood (ages 18-22), and then gradually decrease (97). It has been shown that individuals who increase their binge drinking from age 18 to 24 and consistently binge drink at least once a week during this period may have problems with the transition from adolescence to young adulthood (transitions such as marriage, educational attainment, employment, and financial independence) (97).

Education Level

Prior studies have shown that the rates of binge drinking are almost identical among students across the years of college attendance (90,95,98). However, other studies have reported that there are increases in alcohol abuse accompanying the transition to college for both genders, with potentially greater changes in women (99). Hill and Bugen (100) showed gradual increases in alcohol use as students advance. Occasional drinking for freshmen through senior year were identified sequentially as: 55.8%, 65.3%, 69.5%, and 75.0%, study of college students (n = 6,115) found significant differences in drinking patterns of students in relation to year in college (70).

Fraternity or Sorority Member

Peers have been cited as sources of extremely strong influence on drug and alcohol use (99). Research studies have shown that college students belonging to fraternities and sororities were more likely to use alcohol (101).

Educational Programs

The pattern of binge drinking continues despite the efforts that have been undertaken to prevent drinking. One program was the federally mandated Drug-Free Schools and Communities Act of 1986, which was amended in 1989 to require institutions to certify that they had adopted and implemented alcohol abuse education and prevention programs (90). The Fund for the Improvement of Post-secondary Education (FIPSE) has provided grants for colleges to develop, improve, and coordinate prevention efforts. In spite of these efforts, rates of binge drinking on college campuses remain virtually identical to those documented over a decade ago (2,90).

What drinking policies and educational programs are in place at the University of Tennessee in Knoxville? According to the Hilltopics Student Handbook Standards of Conduct exclusion from UT may result from the following misconduct:

> Statement #11: Unlawful use, manufacture, possession, distribution, or dispensing of drugs or alcohol on University owned or controlled property or during University activities.

Statement #16: Use, possession, or being under the influence of alcoholic beverages on university owned or controlled property.

The Hilltopics Student Handbook also mentions that any students needing treatment information should contact their campus Student Affairs Office, Student Health Center, or Counseling Center. The University of Tennessee in Knoxville also has an Alcohol Awareness Week that takes place on campus every fall semester to increase awareness of alcohol abuse and treatment programs available.

The literature indicates that alcohol consumption is often associated with poor dietary practices that may lead to malnutrition. This information generated the following new research questions about the collegiate population: Does binge drinking affect dietary patterns among students? Is there a change in BMI with binge drinking? Are binge drinkers more likely to have lower food intake when compared to those who do not drink? Do binge drinkers change their eating patterns by planning what they eat before, during, and after alcohol consumption to control their level of drunkenness? No literature was found regarding these aspects of college binge drinking, which may be valuable in detecting the following: 1) whether one is at risk for malnutrition, 2) if there is an adaptive state by planning

to eat different foods when drinking, and 3) how many binge drinkers actually do plan to eat certain foods and/or actually have a adaptation that is reducing the probability of potential adverse effects of alcohol by slowing the gastric emptying rate and having better control of the metabolism of alcohol.

CHAPTER 3

RATIONALE

We have information from prior human studies and animal studies that show differences in nutritional status related to alcoholism. There is evidence that alcohol may replace other more nutritious foods in the diet, or the dietary composition and nutritional status of the alcoholic may modify the toxicity of alcohol (102). However, we do not find any studies available on the college age binge drinking population and associated nutritional risks. Further, most studies have been on men, or have not focused on gender differences in alcohol intake and relationships with nutrition. Therefore, we propose to identify relationships between alcohol consumption and nutritional risks in the college age population, for both genders.

The prevalence of drinking on college campuses is greater than 40%, and has remained the same over the last decade despite efforts that have been undertaken to prevent drinking among college students. There is a need for an understanding of the implications that binge drinking may have for future morbidity and mortality of college students.

In addition, alcohol use is increasingly being taken into consideration as a risk factor in other diseases such as cardiovascular disease, hypertension, and certain cancers (cancer of the oral cavity, esophagus, and breast) (3,8). Even a small decrease in the frequency or duration of associated medical and social complications would largely offset the costs of early intervention and of the research effort still needed in the field, not to mention the benefit of a significant reduction in human suffering (6).

The benefit of low doses of alcohol has also been implicated in prevention of cardiovascular disease, but remain controversial in the literature. Lieber (6) suggests that we must emphasize that the introduction to moderate drinking into the life of a nondrinker involves the unpredictable risk of a loss of control, with the potential for social and medical disintegration.

It was suggested that different schools need different types of programs geared to their specific needs, and this may be found by assessing the magnitude of the problem prior to developing and implementing intervention programs to the college students (75). This research will provide baseline data to help develop programs specific to the individual characteristics of the college or university.

College health professionals can play a significant

role in preventing a wide variety of health problems (29). Those services, which are designed to reinforce individual and collective behaviors, are especially effective during this critical period before students have an opportunity to develop fully the unhealthy lifestyles that so often extend into adulthood (29). An understanding of the changes in nutrition related to alcohol intake will help 1) clinicians recognize students that may have primary or secondary malnutrition related to alcohol intake and counsel appropriately, 2) to have a better understanding of what is going on so we may develop nutritional interventions to add to those already in place and 3) provide baseline data for further research.

Objectives

The objective of this study was to identify the prevalence of binge drinking among college students attending the University of Tennessee in Knoxville, and compare with the national data, i.e., the Monitoring the Future Project, Core Alcohol Study, and the Harvard School of Public Health study. This will be attained by focusing on the following:

1. Describe characteristics of the student body at the University of Tennessee in Knoxville.
2. Describe the magnitude of binge drinking among

undergraduates on the University of Tennessee campus in comparison with the national studies.

3. Identify the relationships between characteristics of the student sample and prevalence of binge drinking.
4. Identify gender differences with regard to binge drinking.
5. Identify the beverage preferences of men versus women.
6. Identify the relationship between alcohol consumption and caloric intake, macronutrient and micronutrient intakes.
7. Identify the relationship between alcohol intake contributing to weight gain in binge drinkers according to the body mass index calculation.
8. Identify gender differences in food and beverage intake before, while, and after drinking in the college population.
9. Identify adaptations of food or beverage intake with level of drinking, to determine the time-course of these adaptations, and to see if it is specific to any type of macronutrient.
10. Identify the use of nutritional supplements by those who drink versus those who abstain.

Limitations

This study was delimited by the low response rate

resulting in a low sample size. Because of the low sample size, the study population cannot be considered representative of the UT population as a whole. In addition, statistical tests of significance were not accurate for such small numbers in some of the data sets and relationships were reported instead of statistical significance.

Intentional and unintentional over and under-reporting may occur for both food and alcohol consumption and there is no way to completely control for this behavior. Over and under-reporting may have occurred secondary to forgetting, selective reporting, skepticism about confidentiality of data, miscounting, disinterest, or fear of being reported for drinking under the legal drinking age.

Validity is the degree to which a method measures what it claims to measure (102). There are relatively few methods for validating subjects true eating and drinking behavior (45). Studies based upon validation of each individual's drinking would be needed, but practical difficulties are too great for monitoring the intake of every individual to be feasible (45). The 24 hour recall has been shown to have higher validity with groups (102). It is difficult to assess the absolute validity of dietary methods because diet is constantly changing, the very act of observing often

alters intakes, and the reference standard itself may be flawed (51).

Reliability indicates the ability of a procedure to give the same results when used repeatedly in the same situation, indicating the results are repeatable or reproducible (103). The 24 hour recall is considered to be fairly reliable in terms of obtaining information related to mean nutrient intakes for populations, and has been used in prior studies regarding alcohol consumption and energy intake (24,103). This study is limited in that the questionnaire was pilot tested, and then administered one time to the population.

CHAPTER 4

METHODOLOGY

Research Design

The research design is a descriptive survey, distributed to a cross-sectional sample of undergraduate students within the 17-23 year age range at the University of Tennessee in Knoxville. Approximately 25,000 students were enrolled at UT, comprised of about 19,000 undergraduate students at the time of the study. A sample size of 1,250 students was chosen to represent this population. The IRB Committee of the Office of Research for the University of Tennessee approved the study protocol (Appendix D).

Descriptive data were collected by a self-administered questionnaire that contained both closed-ended and open-ended questions developed from a compilation of prior national study questions and additional questions addressed by the literature. The principal investigator and a doctoral student that had completed prior research regarding alcohol and dietary intake reviewed the questionnaire.

Pilot Study

A pilot study was completed with twenty-five

questionnaires presented to students to verify student comprehension of the questions. It was found that the wording for the food and beverage consumption before, during, and after drinking needed to be changed so that students would clearly understand them. After those questions were changed, it was presented to twenty-five students again to verify the changes were adequate.

Questionnaire

Approximate time to complete the questionnaire was 20-30 minutes. The six-page self-administered food and beverage questionnaire began with a statement of informed consent read by the participant prior to answering any of the questions (Appendix C). The research project was presented to students orally by the co-principal investigator, and they were instructed to read the statement of informed consent. Following the statement of informed consent, open-ended and closed-ended questions assessed the quantity-frequency of alcohol-containing beverage intake, trends associated with the combination of food and alcohol-containing beverage intake, and a 24 hour food recall. An additional question was added following the 24 hour recall which asked if this 24 hour food intake represented a typical day? The 24 hour dietary intakes of those students responding with yes to the typical diet question were

included in the final analysis, therefore the dietary intake results were delimited to those respondents indicating their 24 hour recall was typical.

In addition to those questions, a question regarding participation in a telephone interview was included with a post card to be returned through campus mail. This part of the study was added to assess the motivation of drinking by college students. Student response rate was too low (approx 15 students) for this portion of the research to be analyzed.

One thousand questionnaires were sent to students by campus mail during the beginning of spring semester, 1998. Although all responses were to be anonymous, students may have been skeptical due to questions pertaining to alcohol consumption resulting in too low student response to provide data for analysis. Therefore, 1,250 questionnaires were distributed again, face to face during classes and fraternity/sorority chapter meetings at the end of the spring semester, from April 13, 1998, to May 25, 1998. Distribution of questionnaires was modified to take into account spring break, so that students would be responding about their binge drinking during a prior 2-week time while attending classes.

First, the directors of all of the fraternity and

sorority chapters were contacted to schedule an appointment to hand out questionnaires to student members during a chapter meeting. Students were notified by the chapter director that participation in responding to a questionnaire was for a thesis research project by a graduate student in Nutrition at the University of Tennessee in Knoxville. Of all of the chapters, only two fraternity and two sororities were willing to participate in the study. The co-principal investigator and chapter director then distributed 100 questionnaires during the chapter meetings. The chapter names will not be mentioned to protect those participating in the research. Distribution was scheduled during a convenient time during April through May of spring semester 1998, which was not during exam days, or directly following spring break. Participation in the research project was voluntary with no penalty for refusing to participate, or for choosing to withdraw at any time during participation.

The remaining 1,150 questionnaires were distributed to undergraduate classes to provide data to compare the results with those of the more structured environment of fraternities and sororities. This also helped to make the study broader in scope, and finally to reduce bias. Undergraduate courses were randomly chosen from the University of Tennessee's 1998 spring semester timetable to

provide a variety of disciplines participating in the research. Professors were contacted to elect to allow their class to participate in the research. For those agreeing to participate, a meeting time was arranged, the study was presented to each class by the co-principal investigator, and the self-administered questionnaire was distributed to all attending class. If any students had already participated through their fraternity or sorority, they were asked not to participate a second time. Students willing to participate returned the questionnaire when the class period ended. Participation was voluntary with no penalty for refusing to participate, or for choosing to withdraw at any time during participation.

Response Rate

Although the research was explained to students while in the classroom or chapter meeting, student participation was difficult to achieve. All students in the class had the choice to participate, but response rate remained minimal. Questionnaires were distributed to 1,250 undergraduate students on the University of Tennessee campus. A total of 357 students returned the questionnaire, yielding a 29% overall response rate. Thirty-four questionnaires were omitted because responders were above the cut-off age of 23, and two others were omitted due to incomplete

questionnaires. The final analysis is based on data from 321 undergraduate students within the 17 to 23 age range.

Part two of the study, the request for telephone survey, was omitted due to poor response rate. A different approach, perhaps using an incentive, may be helpful in future research to achieve a higher response rate.

Data Analysis

Descriptive statistics including frequencies, means, and standard deviations were completed using the SAS version 6.11 (104) program. A paired t test was used to find statistical significance of the difference in prevalence of binge drinking between the student population and the Monitoring the Future Project results. Macronutrient intakes were calculated using a two-factor ANOVA. A statistician was consulted to provide guidance in performing appropriate statistical procedures using the SAS program (104). Statistical results will be considered significant if the probability of observing a result is less than or equal to one chance in twenty ($p \leq 0.05$). Nutritionist IV, version 4.0 (105) was used for analysis of the dietary data. Data were analyzed for differences in nutrient intakes based on amounts of alcohol consumed, and for a relationship between alcohol consumption, calorie intake, and relative body weight (BMI).

Students were classified into age and gender groups and into three drinking categories based upon whether or not they consumed alcoholic beverages. Drinking categories for this population were binge drinkers, non-binge drinkers, and abstainers. Binge drinkers were defined as drinking 5 or more drinks in a row during one occasion within the past two weeks (2). Non-binge drinkers were defined as students that chose to drink, but did not fit the binge drinking classification. Abstainers were defined as students that did not consume alcohol. These drinking categories were further divided by gender because it has been shown that there are gender differences in drinking and eating patterns (2,6,13).

Binge Drinking

The student sample prevalence of binge drinking was compared to the Monitoring the Future Project national data last compiled in 1998. When comparing our results to the Monitoring the Future Project we analyzed both our total sample and a subset of respondents within the age range of 19-22. The subset is the age distribution that the Monitoring the Future Project used for their studies and provided consistency in comparing their trend data (2). In addition, an analysis of female binge drinkers using the Harvard Alcohol Study definition of ≥4 drinks will be analyzed to identify significant differences in alcohol

intake.

Energy Intake

To identify the energy intake of students, the questionnaire included a 24 hour recall form. Students were asked to list all foods and beverages consumed, and the corresponding amounts, within the last 24 hours. Following completion of the 24 hour recall, students were then asked if this 24 hour recall represented a typical day of food consumption. Respondents with completed data for their 24 hour recall answered yes to the typical diet question. Those without data, or very little data were not included in the analysis. The 24 hour recall data was analyzed using the Nutritionist IV (105) program to compare the diets for males and females within the different drinking levels (binge, non-binge, and abstainer). In addition, all of the questionnaires were administered on a Tuesday, Wednesday, Thursday, or Friday to avoid weekend days.

Because beer was the most popular beverage, it was used for the addition of energy from alcohol. The energy provided by the average number of drinks consumed by non-binge drinkers, and energy for 5 drinks for binge drinkers, were added to the energy intakes to compare differences in estimated dietary intake and estimated intakes with additional alcohol among the groups. One beer is equal to

146.4 calories, and 12.8 g of alcohol. This means that alcohol content of one beer is (12.8g x 7.1 calories/g = 90.8 calories) 90.8 calories.

The average drink consumption of non-binge females was 2.3 drinks (341.6 calories), and for non-binge males 2 drinks (292.8 calories). Therefore, we added 2.3 beer to females calorie intake, and 2 beer to males calorie intake to make our adjustments for the non-binge groups alcohol consumption.

For binge drinkers we add 5 beer (732 calories) to the calorie consumption, because in order to fit the binge drinking category, students had to consume no less than 5 drinks in one occasion.

Ethanol Content of Beverages

The amount of ethanol found in 5 beer would be 2.7 oz., or 64 g of ethanol. Beer contains 4.5% ethanol, wine contains 12.9% ethanol, and distilled spirits contains 41% ethanol (3). One 12 fl oz (356 g) beer contains 12.8 g of alcohol (106). (Appendix E)

Macronutrients

The macronutrient intake of students in the research sample was identified using the 24 hour recall form. Students were asked to list all foods and beverages consumed, and the corresponding amounts, within the last 24

hours. The 24 hour recall data were analyzed using the Nutritionist IV program to compare macronutrient intake for males and females within the different drinking levels (binge, non-binge, and abstainer). Following the procedure by Windham (45) the data compiled from the Nutritionist IV analysis was standardized by expressing it as the amount of nutrients per 1,000 calories. This standardized data will allow us to find the nutrient density ratio, called the "Index of Nutritional Quality" (45,107).

Further, the carbohydrate content of beer was added to the carbohydrate intake to examine the contribution of drinking to the diet. We added 2.3 drinks for female non-binge drinkers, 2 drinks for male non-binge drinkers, and 5 drinks for binge drinkers. The content of beer is mostly carbohydrate, therefore, it was added only to the carbohydrate content of the diet.

Expression of Macronutrient Allowances per 1,000 Calories

Expressing the nutrient composition of the diet and the recommended dietary allowances (RDA) for individual nutrients on the same basis, i.e. nutrients per 1,000 calories, allowed a direct comparison between the two parameters, and quality judgements to be derived (108). To obtain a single-value allowance for each nutrient, its RDA must first be converted into an allowance per 1,000 calories

(108). Following the method used in Hansen's study (108), this was calculated by dividing each RDA by the average calorie allowance and multiplying by 1,000 (108). The RDA for protein was calculated as 20 g of the 1,000 calorie allowance for males and 21 g of the 1,000 calorie allowance for females within the 19-24 year age range (Appendix F). No RDA exists for fat and carbohydrate, but may be estimated (108). The Dietary Guidelines for Americans recommend 30% of kilocalories as fat, and through process of elimination, that leaves carbohydrate intake at 62%. Therefore, we can calculate the nutrient density of the macronutrients in the students' diets per 1,000 calories, by standardizing the values and providing an "equal playing field" for comparison.

Calculations for RDA Conversion to Amount per 1,000 Calories

The 1989 RDA values are used to calculate the amount of protein, carbohydrate, and fat intake per 1,000 calories. The calculation to convert the RDA (and recommended intakes) into an allowance per 1,000 calories by dividing each RDA by the average calorie allowance and then multiply by 1,000 (Appendix F).

Now that we have the approximate recommended intake of macronutrients (g) per 1,000 calories, we can compare the results of the mean values of actual students' food and

beverage intake per 1,000 calories to see if students are meeting the recommended macronutrient intakes relative to the calories provided.

Calculations for Student Nutrient Intake Conversion to Amount per 1,000 Calories

The next calculation is the macronutrients consumed by the student sample found by taking the estimated amount of nutrients consumed by each student, dividing that number by the estimated calories consumed by each student, then multiplying by 1,000. The result is the amount of macronutrients consumed per 1,000 calories.

All participants in the study who gave us data that represented their typical diet were analyzed in the Nutritionist IV program. The data from the Nutritionist IV program were then used for the calculations. Each student intake of macronutrients per 1,000 calories is calculated, and then the mean of all of the intakes in each group will be the macronutrient intake per 1,000 calories for that group (for example, female binge drinking group, female non-binge drinking group, etc). The calculations were performed by the SAS program using a two factor ANOVA, and resulted in the amount of macronutrient intake per 1,000 calories.

Index of Nutritional Quality

Now that we have calculated the mean daily intake of

macronutrients per 1,000 calories for the student sample, the next step is to find the Index of Nutritional Quality (INQ) (Appendix G). The INQ will assess if the nutrient intake is meeting the RDA or recommended intakes. This ratio permits foods to be examined (and compared) with respect to the ability to meet dietary allowances relative to the calories provided (108).

BMI, Gender, & Drinking Level

According to the literature body mass index (BMI) ranges are <19 = underweight, 19 to 24.9 = healthy weight, 25 to 29.9 = overweight, and >30 = obese. The demographic data section of the questionnaire asked respondents for their height and weight. The body mass index calculation (Quetelet's Index) is weight (in kg) divided by height (in m^2). The BMI values were calculated and the data were categorized according to gender and drinking level.

Drinking and Food Choices

The questionnaire asked students if they planned to consume certain food or beverages before, during, or after alcohol consumption, and if so, the approximate amount and time the food or beverage may be consumed.

The data were categorized by differences in drinking level and gender. Thus, there were four groups, i.e., binge drinking women, non-binge drinking women, binge drinking

men, and non-binge drinking men, for the section regarding gender differences and alcohol consumption.

Foods and beverages chosen by the respondents were assessed in the Nutritionist IV program to find the percentage of protein, carbohydrate, and fat in each of the food/beverages chosen. These percentages were used to identify the higher carbohydrate, fat, and protein foods chosen for consumption before, after, and during alcohol consumption.

Nutritional Supplements

Nutritional supplement use was also identified across the drinking levels, i.e., binge drinker, non-binge, and abstainer.

CHAPTER 5

RESULTS

Demographics

The student sample included more women (68.5%) than men (31.5%)(Table 1). The sample was predominantly Caucasian (91.5%). The remainder included African American (4.0%), Hispanic (0.3%), Asian Indian (1.2%), Oriental (1.2%), and other (mixed race) (0.9%). Among the respondents, 44.6% were employed, 54.2% were unemployed, and 1.2% responded in the other category. The majority (97.8%) of the students were single. Of the seven remaining students, only 5 were married, 1 widowed, and 1 chose the other category.

The majority of the students were either of the freshman (23.6%), sophomore (39.0%), or junior class (28.6%), altogether accounting for 91.2% of the student sample. The remaining 8.8% were seniors. The sample consisted of 40% fraternity and sorority members; therefore the remaining 60% were non-members. Over half of the sample lived on campus (59%), while 41% lived off campus. All students were in the predominant college age of 17 to 23 years.

Table 1 - Demographic Distribution of the Student Sample

Student Sample	N	(%)
Gender		
Men	101	(31.5%)
Women	220	(68.5%)
Total	321	(100.0%)
Ethnicity		
Caucasian	294	(91.5%)
African American	15	(4.0%)
Hispanic	01	(0.3%)
Asian Indian	04	(1.2%)
Oriental	04	(1.2%)
Other(mixed)	03	(0.9%)
Total	321	(100.0%)
Employment		
Employed	143	(44.6%)
Unemployed	174	(54.2%)
Other	04	(01.2%)
Total	321	(100.0%)
Marital Status		
Single	314	(97.8%)
Married	05	(01.6%)
Widowed	01	(00.3%)
Other	01	(00.3%)
Total	321	(100.0%)
Education Level		
Freshman	76	(23.6%)
Sophomore	125	(39.0%)
Junior	92	(28.6%)
Senior	28	(08.8%)
Total	321	(100.0%)
Frat/Sorority		
Member	129	(40%)
Non-member	192	(60%)
Total	321	(100%)
Location		
On-campus	190	(59%)
Off-campus	131	(41%)

Beverage Preference

The majority of students (69%) indicated that they consumed alcohol-containing beverages. We found that 73.3% of men, and 67.3% of women drank alcohol-containing beverages. Beer was the most popular alcoholic beverage in the sample population, with 81 women (n=220) and 65 men (n=101) choosing to drink beer (Table 2). The next popular beverage was liquor, and then wine, followed by wine coolers, and the least consumed was distilled spirits.

Table 2 - Distribution of Beverage Preference Among Men and Women that Consumed Alcohol-Containing Beverages

Alcoholic Beverage	Drank this Beverage?	Student Sample that Drank the Corresponding Beverage*		
		Men N=101	Women N=220	Total N=321
Beer	YES	65	81	146(45%)
	NO	37	138	175(55%)
	Total	101	220	321(100%)
Liquor	YES	45	80	125(39%)
	NO	57	149	196(61%)
	Total	101	220	321(100%)
Wine	YES	19	40	59(18%)
	NO	83	179	262(82%)
	Total	101	220	321(100%)
Wine Cooler	YES	5	19	24(8%)
	NO	97	200	297(92%)
	Total	101	220	321(100%)
Distilled Spirits	YES	3	1	4(1%)
	NO	99	218	317(99%)
	Total	101	220	321(100%)

*Number of students that chose to drink corresponding beverage; one subject may have chosen to drink more than one beverage

Binge Drinking Prevalence

The prevalence of binge drinking for this sample was 31.9%. This means 31.9% of the students in this sample drank at least five drinks in a row on at least one occasion within the two weeks prior to answering the questionnaire. When we use the age range of 19-22 years, as used by the Monitoring the Future study, the prevalence of binge drinking was 31.0% for the student sample. No significant difference was found between the student sample that was 17-23 years old, and the sub-sample that was 19-22 years old.

Gender Differences

No significant difference was found in amount of drinking for ages above and below the legal drinking age of 21 years ($p \leq 0.05$). Overall, 22.3% of women were binge drinkers, 45% were non-binge drinkers, and 32.7% were abstainers (Table 3). In men, 53.4% were binge drinkers, 19.9% were non-binge drinkers, and 26.7% were abstainers.

Table 3 - Distribution of Drinking Level and Gender

	N	Binge Drinker	Non-Binge Drinker	Abstainer
Gender				
Men	101	54(53.4%)	20(19.9%)	27(26.7%)
Women	220	49(22.3%)	99(45.0%)	72(32.7%)
Total	321	103(31.9%)	119(37.3%)	99(30.8%)

When we analyzed the data using ≥4 drinks in a row definition of binge drinking for women we found the prevalence of binge drinking among women increases to 35.0%, as compared to 22.3% with the ≥5 drink definition (Table 4). The amount of binge drinking for women at the ≥ 4 drink definition was significantly higher than the amount at the ≥5 drink definition (P value ≤ 0.05).

Binge Drinking Men

Fifty-three percent of the men were binge drinkers, and among those 98% were Caucasian (Table 5). Twenty-one percent were freshmen, 21% were sophomores, 40% were juniors, and 18% were seniors. Sixty-six percent were fraternity members, and 64% lived on campus. Sixty percent were unemployed, and 98% were single.

Table 4 - Comparison of binge drinking among women with definition used by the Harvard Alcohol Study of ≥4 drinks compared in a row compared to the definition of ≥5 drinks in a row

Student Sample	N	Binge Drinker	Non-Binge Drinker	Abstainer
Women ≥5 drinks	220	49(22.3%)[a]	99(45.0%)	72(32.7%)
Women ≥4 drinks	220	77(35.0%)[b]	71(32.0%)	72(32.7%)

Means within a column with different superscripts (a,b) are significantly different at p ≤0.05

Table 5 - Demographic characteristics of men by drinking level

	N	Binge Drinker N (%)	Non-Binge Drinker N (%)	Abstainer N (%)
Gender				
Men	101	54 (53)	20 (20)	27 (27)
Ethnicity				
Caucasian	95	52 (98)	19 (95)	24 (89)
African Amer	1	0 (0)	0 (0)	1 (0)
Hispanic	0	0 (0)	0 (0)	0 (0)
Asian Indian	2	0 (0)	1 (5)	1 (4)
Oriental	1	1 (1)	0 (0)	0 (0)
Other	2	1 (1)	0 (0)	1 (4)
Education Level				
Freshman	23	11 (21)	3 (15)	9 (33)
Sophomore	31	11 (21)	8 (40)	12 (44)
Junior	35	22 (40)	8 (40)	5 (19)
Senior	12	10 (18)	1 (5)	1 (4)
Fraternity				
Member	41	35 (66)	4 (20)	2 (7)
Non-member	60	19 (34)	16 (80)	25 (93)
Location				
On-campus	62	34 (64)	16 (80)	12 (44)
Off-campus	39	20 (37)	4 (20)	15 (56)
Employment				
Employed	44	19 (36)	9 (40)	16 (59)
Unemployed	55	33 (60)	11 (60)	11 (41)
Other	2	2 (4)	0 (0)	0 (0)
Marital Status				
Single	98	52 (98)	20 (100)	26 (96)
Married	1	0 (0)	0 (0)	(4)
Widowed	1	1 (2)	0 (0)	0 (0)
Other		(0)	0 (0)	0 (0)

Non-Binge Drinking Men

Twenty percent of the men were non-binge drinkers, and among those 95% were Caucasian (Table 5). Fifteen percent were freshmen, 40% were sophomores, 40% were juniors, and 5% were seniors. Only 20% were fraternity members, while 80% were not fraternity members. Only 20% lived off campus, leaving 80% as living on campus. Forty percent were employed, and all of the non-binge men were single.

Abstainers

Twenty-seven percent of the men were abstainers, and among those 89% were Caucasian. Thirty-three percent were freshmen, 44% were sophomores, 19% were juniors, and 4% were seniors. Only 7% were fraternity members, while 93% were non-members. Less than half (44%) lived on campus, and 59% were employed. Ninety-six percent were single, and 4% were married.

Binge Drinking Women

Only 22% of women were binge drinkers, and among those 94% were Caucasian (Table 6). Twenty-two percent were freshmen, 39% were sophomores, 33% were juniors, and 4% were seniors. Forty- three percent were sorority members, while the other 57% were non-members. Fifty-five percent lived on campus, and 51% were employed. All of the binge drinkers were single.

Table 6 - Demographic characteristics of women by drinking level

	N	Binge Drinker N (%)	Non-Binge Drinker N (%)	Abstainer N (%)
Gender				
Women	220	49 (22.3)	99 (45.0)	72 (32.7)
Ethnicity				
Caucasian	199	46 (94)	91 (92)	62 (86)
African Amer	14	2 (4)	6 (6)	6 (9)
Hispanic	1	1 (2)	0 (0)	0 (0)
Asian Indian	2	0 (0)	1 (1)	1 (1)
Oriental	3	0 (0)	1 (1)	2 (3)
Other	1	0 (0)	0 (0)	1 (1)
Education Level				
Freshman	53	11 (22)	22 (22)	20 (28)
Sophomore	94	19 (39)	45 (45)	30 (42)
Junior	57	16 (33)	25 (25)	16 (22)
Senior	16	2 (4)	7 (7)	6 (8)
Sorority				
Member	87	21 (43)	46 (46)	20 (28)
Non-member	133	28 (57)	53 (54)	52 (72)
Location				
On-campus	129	27 (55)	66 (67)	36 (50)
Off-campus	91	22 (45)	33 (33)	36 (50)
Employment				
Employed	99	25 (51)	39 (39)	35 (49)
Unemployed	119	23 (47)	59 (60)	37 (51)
Other	2	1 (2)	1 (1)	0 (0)
Marital Status				
Single	215	49 (100)	95 (96)	71 (99)
Married	4	0 (0)	3 (3)	1 (1)
Widowed	1	0 (0)	1 (1)	0 (0)
Other	0	0 (0)	0 (0)	0 (0)

Non-Binge Drinking Women

Forty-five percent of the women were non-binge drinkers, and among those 92% were Caucasian. Twenty-two percent were freshmen, 45% were sophomores, 25% juniors, and 7% seniors. Fifty-four percent were not members of sororities, while the other 46% were members. The majority (67%) lived on campus, and 60% were unemployed. Ninety-six percent were single, 3% married, and 1% widowed.

Abstainers

Thirty-three percent of women were abstainers, and among those 86% were Caucasian. Twenty-eight percent were freshmen, 42% sophomores, 22% juniors, and 8% seniors. Only 28% were sorority members, while 72% were non-members. Half of the abstainers lived on campus, and 51% were unemployed. Ninety-nine percent were single.

Energy Intake

Men

When we examined energy intake for men, we observed with higher alcohol intake, energy intake is higher (Table 7). Non-binge men had a mean energy intake 5% (129 calories) higher than that of abstainers. The energy intake for binge drinkers was only 1% (27 calories) higher than that of non-binge drinkers. However, when we compared the binge to the abstainer, the energy intake is 7% (156

Table 7 - Estimated Energy intake from 24 hour recall data for men and women with the addition of kcal from mean number of beer consumed, and the addition of number of beer consumed over the past two weeks.

Gender & Drinking Level	N	(1) Kcal intake mean ± SEM	(2) #Drinks mean	(3) Kcal from beer	(4) Beer kcal + kcal/ 1 occasion*	(5) #Times/2wks mean (range)	(6) Beer kcal/ 2 wks	(7) Total Kcal consumed/ 2 wks**
Men								
Binge	20	2510 ± 145	5	732	3242 ± 145	3.6 (1-12)	2635	5145 ± 145
Non-Binge	10	2483 ± 206	2	292	2775 ± 206	1.6 (1-6)	468	2951 ± 206
Abstainer	11	2354 ± 184	0	0	---------	0	0	---------
Women								
Binge	23	2072 ± 126	5	732	2804 ± 126	3.0 (1-12)	2196	4268 ± 126
Non-Binge	45	1889 ± 81	2.3	341	2145 ± 81	1.2 (1-9)	409	2298 ± 81
Abstainer	40	2092 ± 107	0	0	---------	0	0	---------

*Total kcal including mean # beer consumed on one occasion (1+3)
** Total kcal including mean # beer consumed over prior 2 weeks (1+6)

calories) higher.

The mean number of drinks for non-binge men was two drinks per occasion. The addition of two beer (292.8 calories) to male non-binge group raises the mean energy intake to 2,775 energy per drinking occasion. The range of times of non-binge drinking by men was 1-6 (mean = 1.6) in the past 2 weeks, and 1-6 times (mean = 2.2) in the past month. This implies that if a male drank two beer 1.6 times over the past two weeks, an extra 468 calories would be consumed.

The addition of 732 calories (5 beer) to men binge drinkers group will raise the mean energy intake for a binge drinking occasion to 3,242. The average times of binge drinking reported by men was 3.6 times (range = 1-12) in the past 2 weeks, and 9.5 times (range = 1-25) in the past month. This implies that if a male binge drinker binged 3.6 times in the past two weeks, and extra 2,635 calories would be consumed.

Women

Women abstainers mean energy intake was 2,092 calories (Table 7). We observed a 10% lower energy intake, (203 calories) for non-binge compared to abstainers. The energy intake was 10% (183 calories) higher in binge drinkers than non-binge drinkers.

The mean number of drinks for non-binge women was 2.3 drinks per occasion. The addition of 2.3 beer (341.6 calories) to non-binge women raised the mean energy intake to 2,145 calories per drinking occasion. The range number of times of non-binge drinking for women was 1-9 (mean = 1.2) in the past 2 weeks, and 1-30 (mean = 7.6) in the past month. This implies that if non-binge women drank 1.2 times in the past two weeks, an extra 409 calories would be consumed in addition to the diet.

The addition of 732 calories (5 beer) to the binge drinking women raised the mean energy intake to 2,804 calories for a binge drinking occasion. If the binge drinking is often, this is a significant amount of extra energy in addition to their diet, as compared to the female abstainer group (2,804 vs. 2,092). The average number of times of binge drinking reported by women was 3 times (range 0-12) in the past 2 weeks, and 7 times (range 0-23) in the past month. This implies that if binge drinking occurred three times in the past two weeks, an extra 2,196 calories would be consumed in addition to the diet.

The distribution of energy intake for each group of men is plotted for further illustration (Figure 2). The overall distribution of non-binge drinker energy tended to be higher than abstainers, and the binge drinkers mean

energy intake was higher than abstainers and non-binge drinkers. With additional energy from alcohol, these intakes became significantly higher for male binge drinkers. This further illustrates that the mean energy intake increased with drinking in men, therefore the alcohol energy are consumed in addition to the diet.

The distribution of energy intake for each group of women was also plotted for further illustration (Figure 3). The abstainer group will serve as the control group. For comparison, the energy intake plus energy from average intake of beer for non-binge (2.3 beer) and binge (5 beer) drinkers are also shown in the figure. The overall non-binge group energy intake was lower than the abstainer and binge group. When we add the energy from mean intake of beer, we find that the energy intake for non-binge drinkers was closer to the intakes of abstainers, and for binge drinkers, energy intake was higher than abstainers. This illustrates the range of energy intake for the different groups, and shows that the female non-binge energy intake was lower than abstainers. This again implies that the non-binge energy consumed as alcohol may be replacing food energy.

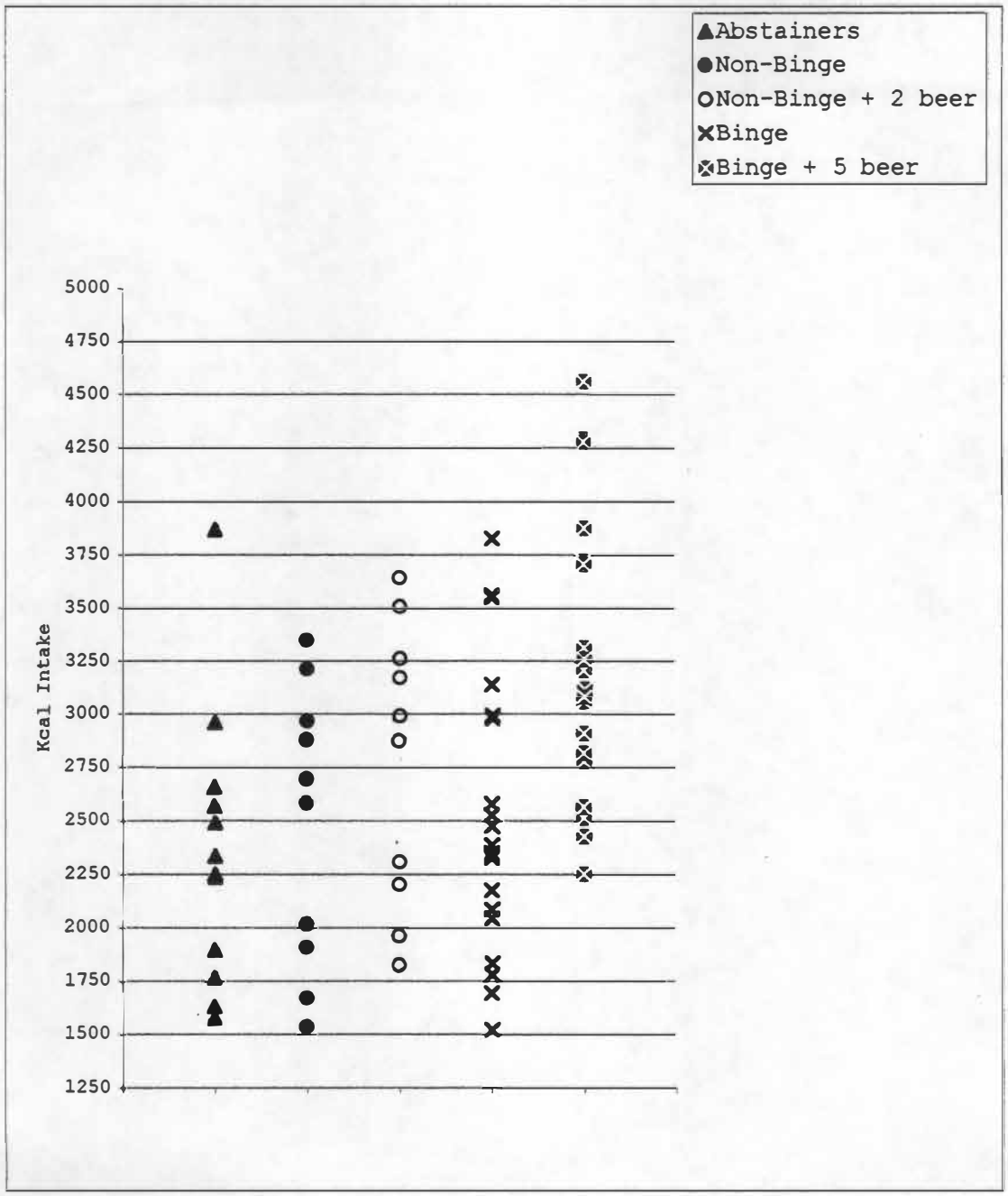

Figure 2. Distribution of energy intake over one day for men with and without the addition of calories from beer intake

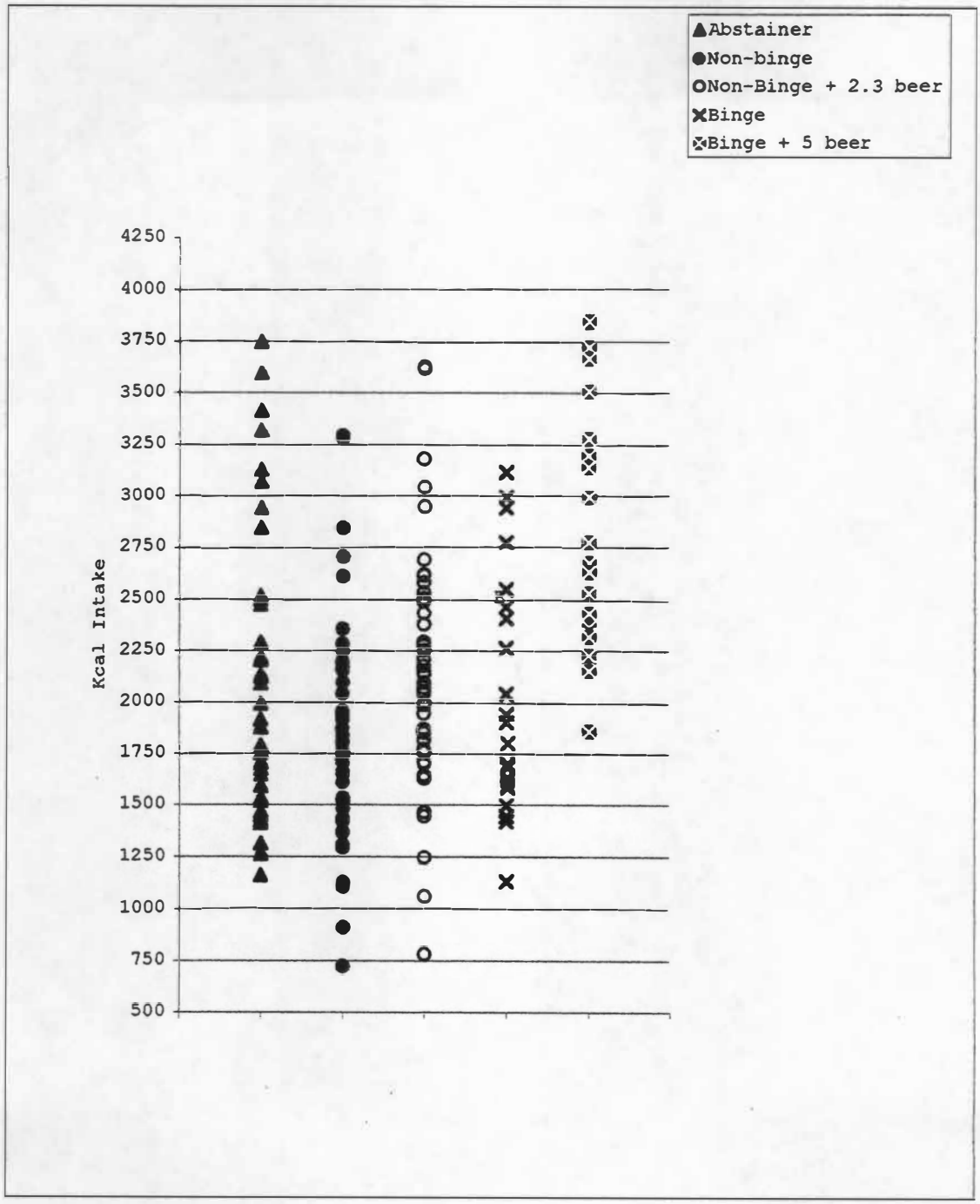

Figure 3. Distribution of energy intake over one day for women with and without the addition of calories from beer intake

Macronutrients

A comparison of mean nutrient consumption per 1,000 energy relative to the total energy provided by the respondent's diet is shown in Figure 4. The nutrient density data shown in table 8 and 9 are presented in a nutrient density profile (Figure 4) in which the lengths of the lines reflect the percent of the RDA (or recommended allowance) of the nutrients provided in diets. The symbols used for of abstainers (A), non-binge drinkers (N), and binge drinkers (B) to the nutrient allowance per 1,000 energy provided the Index of Nutritional Quality (INQ) for each group. The nutrient density profile illustrates that male binge drinkers consumed significantly more protein than abstainers, less carbohydrate and less fat than abstainers (Figure 4). Female binge drinkers consumed less protein, more carbohydrate, and significantly less fat than abstainers.

Macronutrient Density of Dietary Intake

All groups exceeded the RDA for protein, and were close to the recommended ranges for carbohydrate and fat. The changes in macronutrient intake were not significantly different, but we did observe some fluctuations in intake.

When we examined the intake of macronutrients for men, the mean intake of fat was lower (3%), protein intake

Table 8 - Protein, carbohydrate, and fat intake per 1,000 calories for men and women

Gender & Group	N	Protein (g) per 1,000 calories Mean ± SEM	Carbohydrate (g) per 1,000 calories Mean ± SEM	Fat (g) per 1,000 calories Mean ± SEM
Men				
Abstainer	11	34.9 ± 3.6[b]	133.9 ± 7.5[a,b]	38.1 ± 2.6[a]
Non-binge	10	37.3 ± 3.9[a,b]	144.2 ± 8.2[a,b]	33.2 ± 2.9[a,b,c]
Binge	20	45.9 ± 2.8[a]	127.3 ± 5.8[b]	34.7 ± 2.1[a,b]
Women				
Abstainer	40	39.0 ± 1.9[b]	140.6 ± 4.1[a,b]	33.6 ± 1.4[a,b]
Non-binge	45	40.9 ± 1.8[a,b]	148.8 ± 3.9[a]	29.4 ± 1.4[c]
Binge	23	38.1 ± 2.6[b]	145.7 ± 5.4[a]	31.1 ± 1.9[b,c]

*a,b,c represents significant differences among the groups for each column of numbers

Table 9 - Index of Nutrient Quality ratios for macronutrient intake in men and women

Gender & Group	N	INQ for FAT	INQ for CHO	INQ for PRO
Men				
Abstainer	11	1.15	0.86	1.75
Non-Binge	10	1.01	0.93	1.87
Binge	20	1.05	0.82	2.30
Women				
Abstainer	40	1.02	0.91	1.86
Non-Binge	45	0.89	0.96	1.95
Binge	23	0.94	0.94	1.81

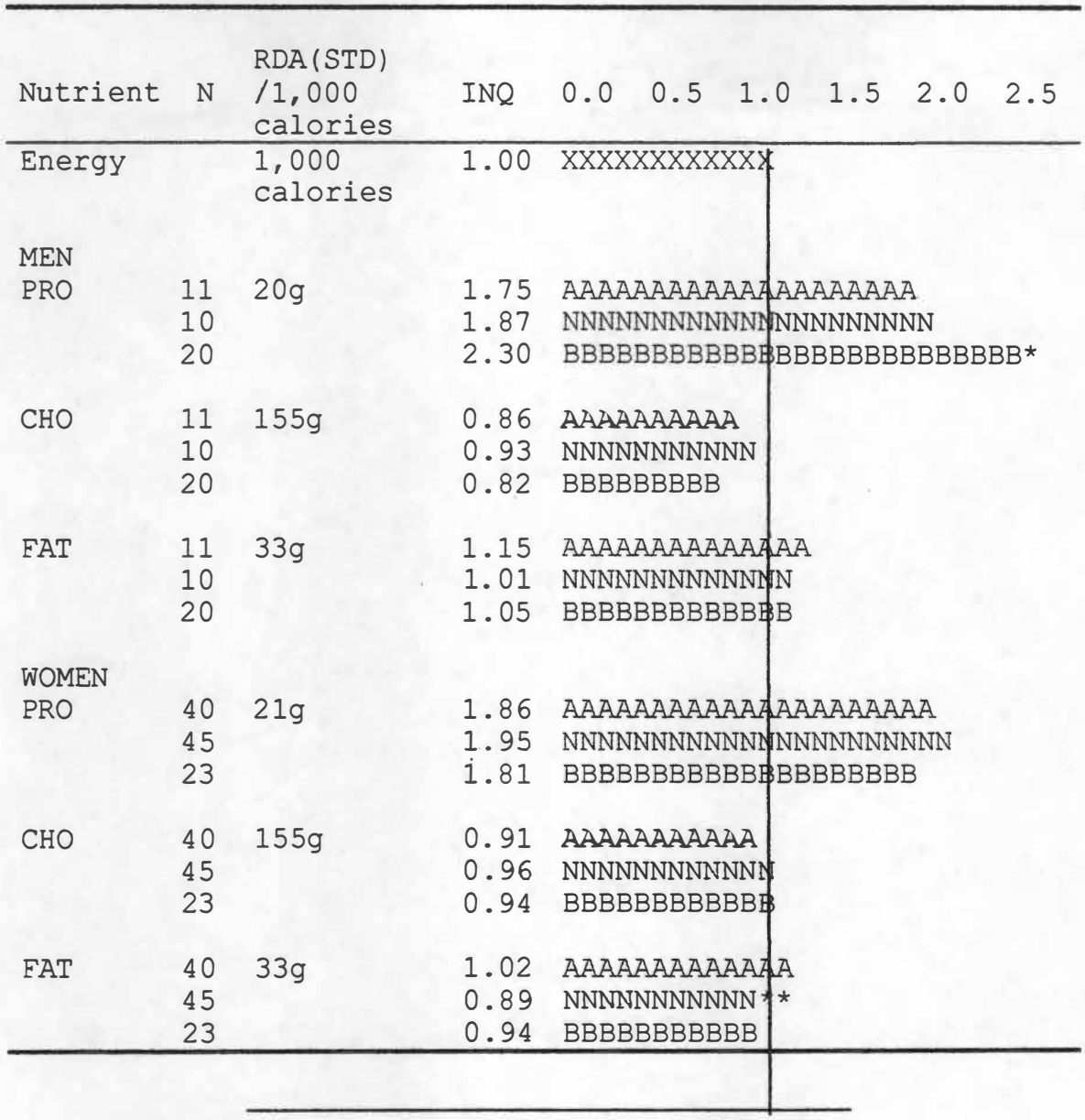

Figure 4 - Nutrient profile of average daily dietary intake for abstainers (A), non-binge drinkers (N), and binge drinkers (B) based upon standard allowances per 1,000 calories***

*male binge drinkers consume statistically significant more protein than the abstainer group

**female non-binge drinkers is significantly different than abstainers for fat intake

***this presentation is patterned after Windham et al., 1983 (see Appendix H)

was higher (4%), and of carbohydrate was lower (3%) for male binge drinkers compared to the abstainers (Table 10).

In women, we observed that the mean intake of fat was lowered with intake of alcohol. Mean intake of fat was 4% lower for non-binge drinkers, but only 2% lower for binge drinkers. Mean carbohydrate intake was higher, by 4%, between abstainers and non-binge drinkers. Carbohydrate was 2% lower for binge drinkers when compared to non-binge drinkers.

Mean fat intake was lower for both non-binge and binge drinking men, by 3-4% (Table 10). Mean protein intake was higher as men drank more alcohol. Change in protein intake was only slightly (1%) higher for non-binge drinkers compared to abstainers. The binge drinking men protein intake was 18% of the diet, as compared to only 14% in abstainers. Mean carbohydrate intake was 3% lower for binge

Table 10 - Adjusted fat, protein, and carbohydrate intake per 1,000 calories (mean) from foods and beverages

Drinking Level	N	Fat (%)	Protein (%)	Carbohydrate(%)
Men				
Binge	20	31%	18%	51%
Non-Binge	10	30%	15%	58%
Abstainer	11	34%	14%	54%
Women				
Binge	23	28%	15%	58%
Non-Binge	45	26%	16%	60%
Abstainer	40	30%	16%	56%

drinkers versus abstainers.

Addition of Alcohol to Carbohydrate Intake

The percentage of carbohydrate contributed from alcohol intake was added to mean carbohydrate intake to provide a general idea of the total carbohydrate intake on a drinking occasion. Women non-binge drinker carbohydrate intake increased from 60% to approximately 72% of the diet on a drinking occasion (Figure 5). For men, this increased from 58% to approximately 68% (Figure 6). Women binge drinker carbohydrate intake was increase from 56% to approximately 85% of the diet on a binge drinking occasion. For men, this was increased from 54% to 77%.

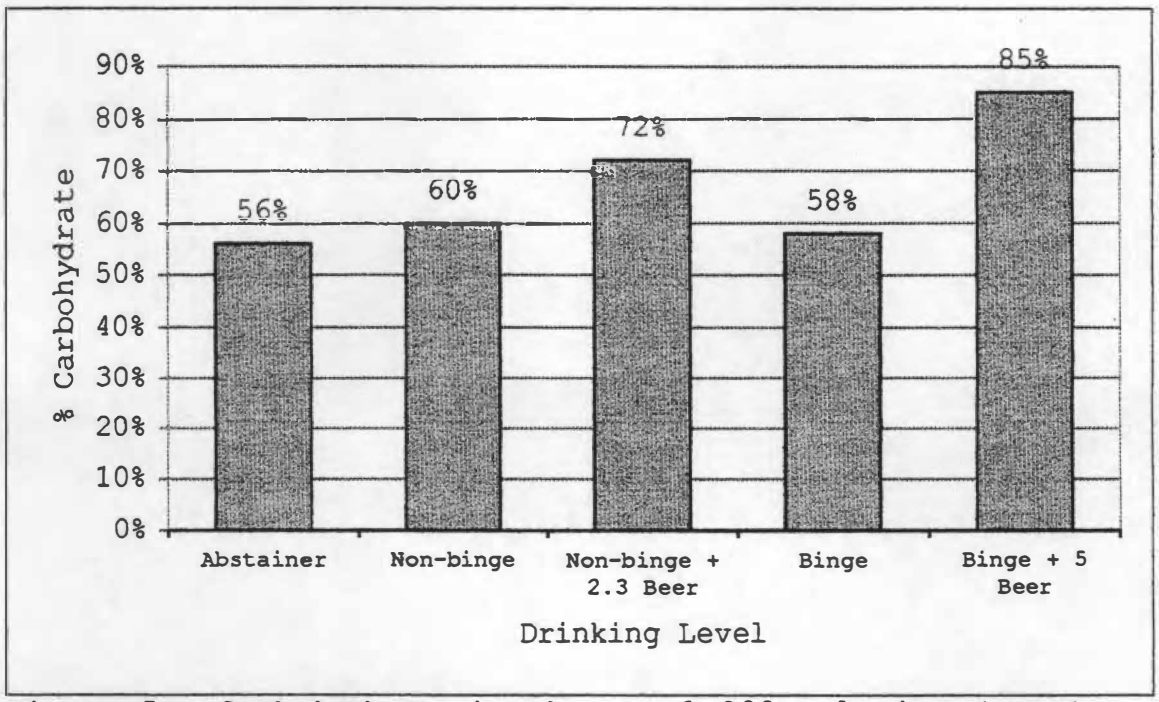

Figure 5 - Carbohydrate intake per 1,000 calories (mean) from food and beverage intake among women according to level of alcohol intake (including alcohol intake)

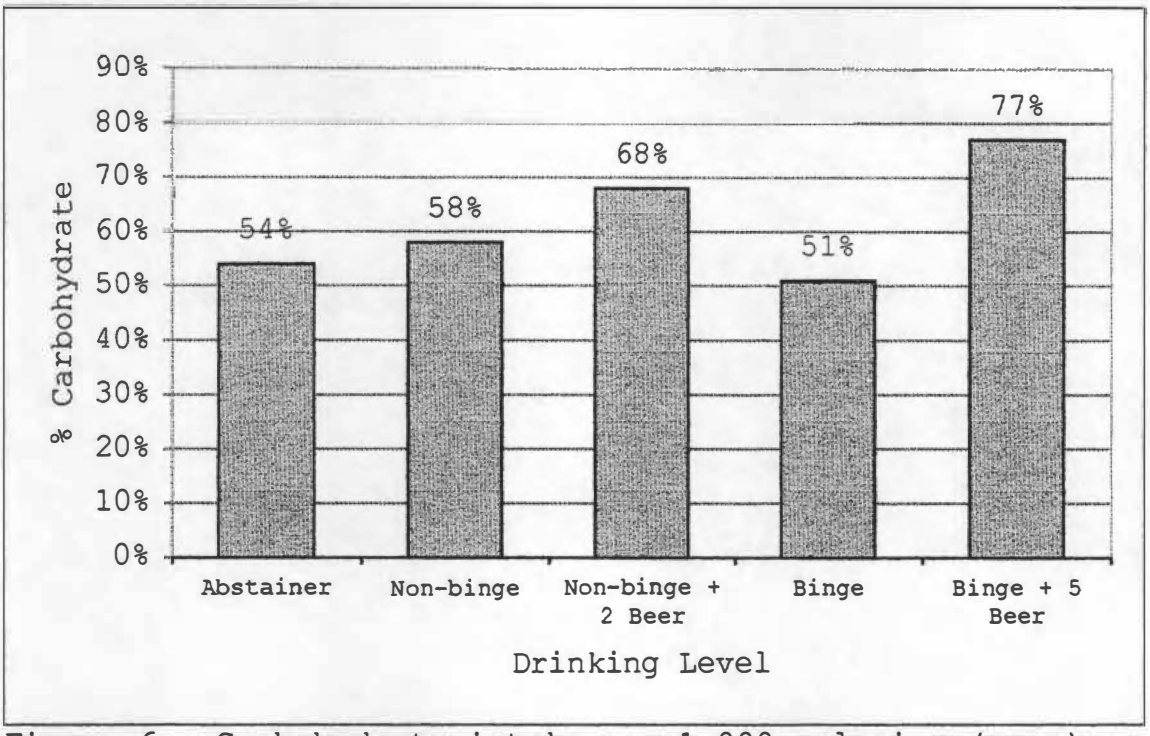

Figure 6 - Carbohydrate intake per 1,000 calories (mean) from food and beverage other than alcohol among men according to level of alcohol intake (including alcohol intake)

BMI

The mean BMI values for the groups were not significantly different (Table 11). However, the distribution of BMI for the groups show a difference in BMI for women. Figure 7 shows the distribution of body mass index values for women. As amount of drinking became higher, the BMI appears to close in more toward the mid-range or "healthy weight" category of BMI values. This suggests that the higher amount of alcohol consumed, the closer the BMI was in the healthy weight range. Figure 8 shows the distribution of body mass index values for men.

Table 11. Body Mass Index (BMI) and fat intake per 1,000 calories for men and women

Gender	N	BMI value (mean)	Fat intake % (mean)
Men			
Abstainer	27	24.1	34
Non-binge	20	25.2	30
Binge	54	23.7	31
Women			
Abstainer	72	22.2	30
Non-binge	99	21.4	26
Binge	49	21.4	28

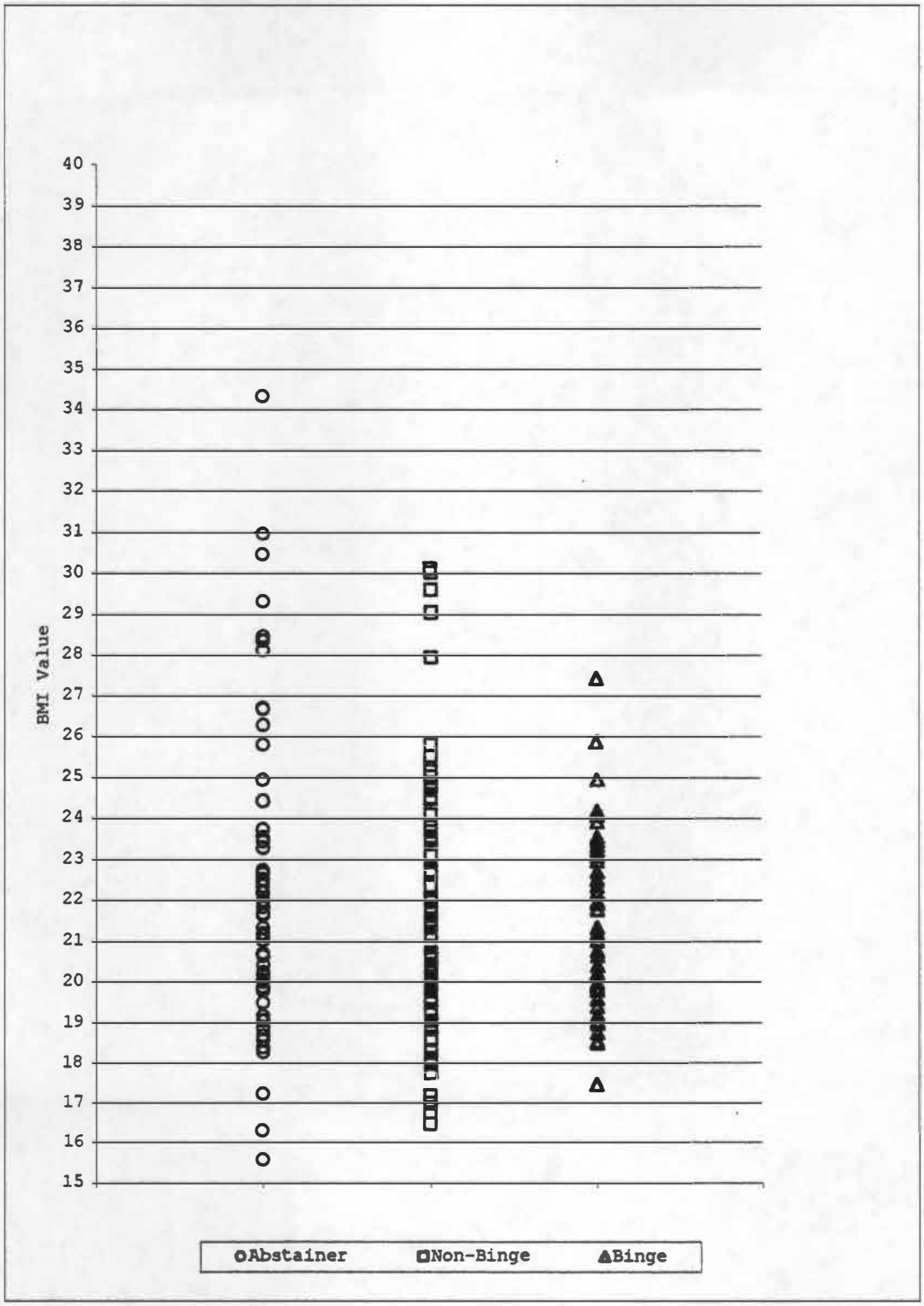

Figure 7 - Distribution of Body Mass Index (BMI) by drinking level for women

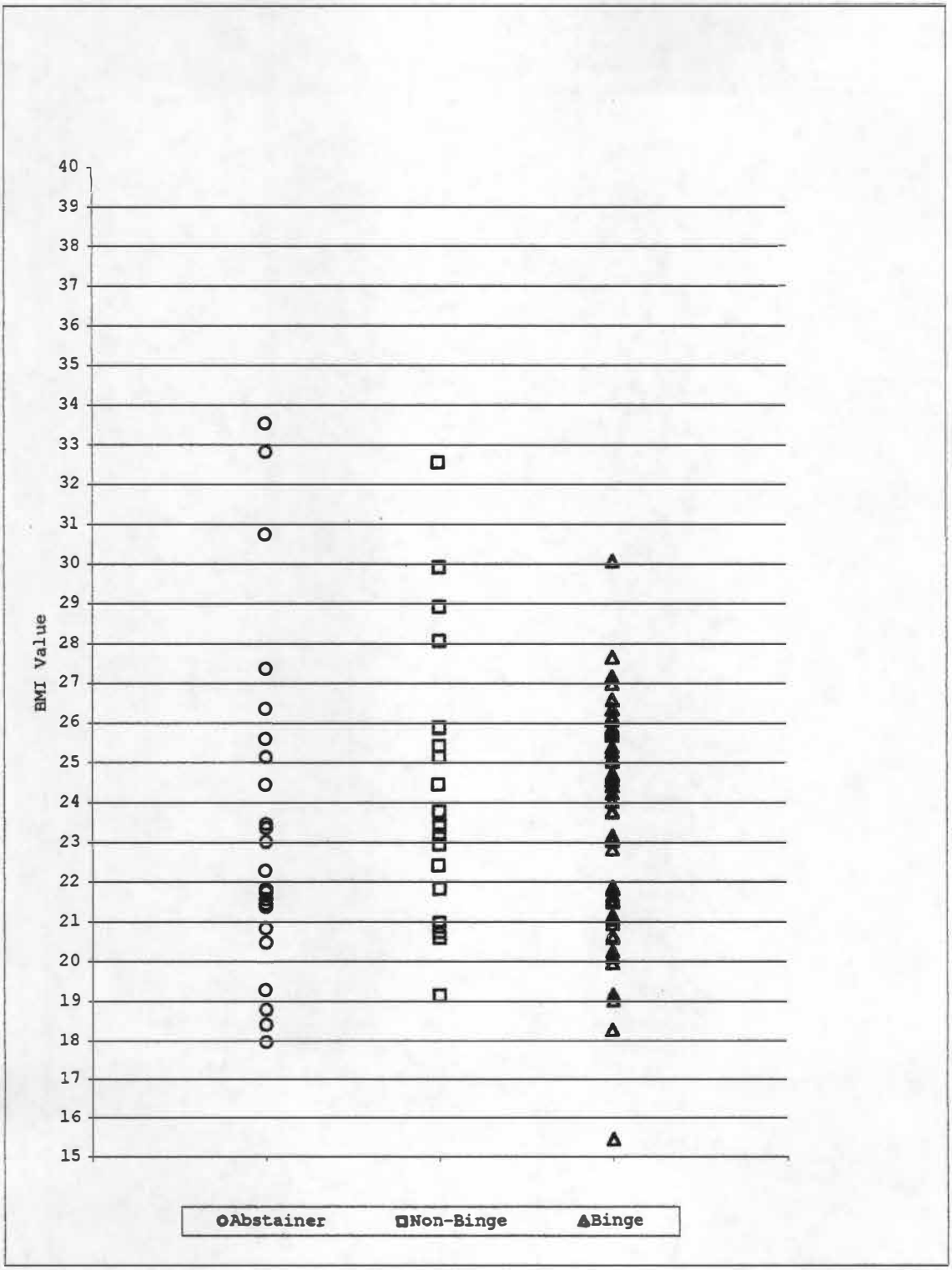

Figure 8 - Distribution of Body Mass Index (BMI) by drinking level for men

Drinking and Food Choices

Overall, of the 102 binge drinkers in the study, only 18 (18%) responded with foods or beverages they planned to consume prior to drinking alcohol. Among the total non-binge drinkers (120), only 12 (10%) responded with foods or beverages they planned to consume prior to drinking alcohol. Table 12 shows the percentage of men and women planning to consume food/beverages before, during, or after consuming alcohol.

Choices Before Drinking

Binge Drinking Men

Male binge drinkers predominantly chose to consume high carbohydrate foods before alcohol intake (Table 13). Food choices that contained a higher percentage of carbohydrate

Table 12. Percentage of students that plan to consume food or beverages before, during, and after drinking alcohol

Gender	N	Plan to consume food/beverage:		
		Before(%)	During(%)	After(%)
Men				
Non-binge	20	3%	3%	4%
Binge	54	13%	15%	22%
Women				
Non-Binge	99	7%	12%	21%
Binge	49	5%	11%	20%

Table 13 - Binge drinking men (n=13) food and beverage choices before alcohol intake

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Bread (2 slices)	1	1	13	75	12
French Fries	1	2.5	05	51	44
Pb/jelly sandwich	1	2	14	48	38
Salad	1	0.5	27	69	04
Steak & potato	1	1.5	25	45	30
Tostitos	1	0.5	06	52	42
High Fat:					
Chicken & macaroni	1	1.5	33	31	36
Chili (2 cups)	1	.5	19	40	41
Fried Foods	1	2	-	-	X
Hamburger	1	0.5	21	30	49
High Protein:					
Grilled Chicken	1	0	87	05	08
High Protein Meal	1	1	X	-	-
Beverages:					
Water (1-8 cups)	2	2-3	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

were bread, french fries, salad, Tostitos potato chips, and combination foods i.e., steak and potato, and peanut butter and jelly sandwich. The time of consumption of the high carbohydrate foods varied from 30 minutes to 2 hours and 30 minutes before drinking for male binge drinkers.

Non-Binge Men

Fewer men in the non-binge category (3%) chose to consume food prior to alcohol intake, compared to binge

drinking men (13%)(Table 14). Food choices for this group included high carbohydrate foods i.e., bread, and a steak sandwich. One respondent chose hot wings, a high fat food, for consumption before alcohol intake. Time varied from 1 minute to 3 hours for these foods. Water was the beverage chosen by two of the male non-binge group. Time for consumption of water prior to drinking was 1 to 2 hours.

Binge Drinking Women

The foods chosen by binge drinking women for consumption before drinking were all higher carbohydrate foods, i.e., chicken sandwich, deli sandwich, and pizza (Table 15). Time of intake varied from 1 to 2 hours and 30 minutes prior to alcohol intake. Of the few binge drinkers that planned to consume beverages prior to alcohol intake, water and milk were the beverages of choice at approximately 1 to 2 hours before alcohol intake.

Non-binge Women

Non-binge drinking women primarily chose high carbohydrate foods to consume prior to alcohol intake (Table 16). Among these foods were bread, potato, pizza, deli sandwich, potato chips, and salad. Two chose hamburger or popcorn that are higher fat containing foods according to the Nutritionist IV program. Time of intake varied from 30 minutes to 2 hours. Beverages chosen by this group were

Table 14 - Non-binge men (n=4) food and beverage choices before alcohol intake

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)***	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Bread (2 slices)	1	1	13	75	12
Steak Sandwich	1	3	27	46	27
High Fat:					
Hot Wings (20 ea.)	1	0	25	09	65
Beverages:					
Water (1-8 cups)	2	1-2	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response
*** If zero, the person ate the food right before drinking

Table 15 - Binge drinking women (n=5) food and beverage choices before alcohol intake

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Any food available	1	2	-	-	-
Chicken sandwich	1	1	31	43	26
Pizza (2 slices)	1	2.5	22	44	34
Sandwich, deli	1	2.5	26	46	28
Beverages:					
Milk (1 cup)	2	1-2	31	46	23
Water (1-8 cups)	2	1-2	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

Table 16 - Non-binge drinking women (n=8) food and beverage choices before alcohol intake

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Bread (2 slices)	3	1	13	75	12
Bread & potato	1	0.5	08	91	01
Pizza (2 slices)	1	1	22	44	34
Potato chips	1	1	06	52	42
Salad	1	2	27	69	04
Sandwich, deli	1	1	26	46	28
High Fat:					
Hamburger	1	1	21	30	49
Popcorn (1 cup)	1	1	08	42	50
Beverages:					
Diet Coke (1 cup)	1	1	0	0	0
Water (1-8 cups)	2	0.5-3	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

water and diet coke. Intake of beverages varied from 30 minutes to 3 hours.

Choices While Drinking

Binge drinking men

Binge drinking men chose foods that have a high carbohydrate or fat content while drinking. The high carbohydrate foods were pizza, potato chips, pretzels, and a deli sandwich (Table 17). A few subjects chose the higher fat foods which were buffalo or chicken wings, Krystal hamburgers, or Taco Bell tacos. Only one binge drinker chose to drink water while drinking.

Table 17 - Binge drinking men (n=15) food and beverage choices while drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	PRO (%)	CHO (%)	FAT (%)
Foods:				
High Carbohydrate:				
Pizza (4-5 slices)	5	22	44	34
Potato chips	2	06	52	42
Pretzels	2	10	79	11
Sandwich (deli)	1	26	46	23
Tostitos	1	06	52	42
High Fat:				
Buffalo wings (10)	1	25	09	65
Chicken wings (20)	2	25	09	65
Krystal hamburger(3-5)	1	21	30	49
Taco bell taco (3-5)	1	22	24	54
Beverages:				
Water (1-3 cups)	1	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

Non-binge men

A few non-binge drinking men chose to consume foods while drinking (Table 18). The choices were again, either high fat (chicken wings), or high carbohydrate foods (pizza, pretzels). One non-binge drinker chose to consume water while drinking.

Binge drinking women

Binge drinking women chose mainly high fat foods, with a few high carbohydrate foods while drinking (Table 19). The high fat foods of choice were cheese, cheese bites,

Table 18 - Non-binge drinking men (n=4) food and beverage choices while drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	PRO (%)	CHO (%)	FAT (%)
Foods:				
High Carbohydrate:				
Pizza (4-10 slices)	2	22	44	34
Pretzels	1	10	79	11
High Fat:				
Chicken wings (20)	2	25	09	65
Beverages:				
Water (1-3 cups)	1	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

Table 19 - Binge drinking women (n=11) food and beverage choices while drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	PRO (%)	CHO (%)	FAT (%)
Foods:				
High Carbohydrate:				
Pizza (4-5 slices)	3	22	44	34
Potato chips	3	06	52	42
Potato skins(6)	2	06	59	34
Baked potato	1	08	91	01
Waffle	1	09	56	35
High Fat:				
Cheese (5 slices)	1	24	02	74
Cheese bings (35)	2	24	02	74
Chicken fingers (4)	1	27	24	49
Ham/turkey (5 slices)	1	39	07	54
Hamburger	1	21	30	49
Krystal hamburger(3-5)	2	21	30	49
Peanuts (1 cup)	1	15	14	71
Taco bell taco (2-4)	1	22	24	54
Beverages:				
Sprite (20 oz)	1	0	100	0
Water (1-3 cups)	1	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

ham/turkey slices, hamburger (or Krystal hamburgers), peanuts, and Taco Bell tacos. Only two binge drinkers chose to drink Sprite or water while drinking alcohol.

Non-binge drinking women

Non-binge women chose high carbohydrate foods to consume while drinking alcohol (Table 20). The food choices include crackers, pasta, pizza, and potato chips. Only four chose to drink liquids while drinking alcohol-containing beverages. Three non-binge drinkers chose to drink water, and one chose to drink fruit juice while drinking.

Choices After Drinking

Binge drinking men

The most popular food choice following alcohol intake for binge drinking men were either high fat, or high

Table 20 - Non-binge drinking women (n=14) food and beverage choices while drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	PRO (%)	CHO (%)	FAT (%)
Foods:				
High Carbohydrate:				
Crackers (3-5)	2	09	64	27
Pasta (2 cups)	1	14	82	04
Pizza (4-10 slices)	3	22	44	34
Potato chips	5	06	52	42
Beverages:				
Fruit juice (1 cup)		06	93	01
Water (1-3 cups)	3	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

carbohydrate foods (Table 21). The higher fat foods they chose to consume were greasy foods, ham sandwich, hamburger (or Krystal hamburger), and Taco Bell tacos. High carbohydrate foods chosen were bread, crackers, deli sandwich, or Tostitos potato chips. Time of consumption for most of these foods varied from 30 minutes to 3 hours. Time of consumption following alcohol intake for greasy food, ham sandwich, and hamburgers (Krystal hamburgers) was from was 8 to 15 hours, which would be the next day after. One reason for the Krystal hamburgers and Taco Bell tacos may be that these restaurants are open 24 hours on campus, and thus are available following alcohol intake. The most popular beverage chosen by binge drinking men was water, with 16 (of 22) choosing to drink water. Other beverage choices were fruit juice, Gatorade, and milk. Time of consumption for beverages varied from minutes to 12 hours.

Non-binge men

The most popular food chosen was high in fat, Krystal hamburgers, for the non-binge drinking men (Table 22). Time of consumption was around 1 hour following alcohol consumption. Next in line for food choices were chicken sandwich (high fat), and high carbohydrate foods were Doritos potato chips, Krystal french fries, and pizza. The time following alcohol consumption for these foods was

between 20 minutes to 4 hours. The beverage chosen for the non-binge drinking men was water, at around 1 hour following alcohol consumption.

Binge drinking women

The most popular choices for binge drinking women were the high carbohydrate foods (Table 23). Those foods included biscuit, bread, cereal, crackers, french fries, and pizza. Other foods chosen that were high in fat were

Table 21 - Binge drinking men (n=22) and food and beverage choices after drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Bread (2 slices)	1	3	13	75	12
Crackers(2-10)	3	2	09	64	27
Sandwich (deli)	1	1	26	46	23
Tostitos	1	0.5	06	52	42
High Fat:					
Greasy food	1	8	-	-	X
Ham sandwich	1	12	23	37	39
Hamburger (1-2)	1	15	21	30	49
Krystal hamburger(3-4)	3	1-3	21	30	49
Taco Bell tacos (3)	3	1-2	22	24	54
Beverages:					
Fruit juice (1-2 cup)	1	12	06	93	01
Gatorade (20 oz)	2	8	0	100	0
Milk (1 cup)	2	2	31	46	23
Water (1 cup-2 liters)	16	0-9	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

Table 22 - Non-binge drinking men (n=5) food and beverage choices after drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Doritos (2 cups)	1	0.75	06	52	42
Krystal french fries	1	1	05	51	44
Pizza (3-4 slices)	1	4	22	44	34
High Fat:					
Chicken sandwich	1	0.5	23	34	43
Krystal hamburger(3-4)	3	1	21	30	49
Beverages:					
Water (1 cup-2 liters)	2	1	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

hamburgers (or Krystal hamburgers). Times of consumption following alcohol intake for these foods varied from 1 hour to 9 hours. The major beverage of choice was, once again, water. Other beverages chosen were high in carbohydrates: Coca-Cola, Dr. Pepper, iced tea, orange juice, Sprite, and V-8 juice. Coffee was also chosen by this group. Consumption of the beverages ranged from 30 minutes to 12 hours following consumption of alcohol.

Non-binge women

Foods chosen by the non-binge women were mainly high carbohydrate foods i.e., bread, crackers, pretzels, and chips. Times varied from right after consumption up to 3 hours after consumption. The most popular beverage of choice

Table 23 - Binge drinking women (n=20) food & beverage choices after drinking alcohol

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Biscuit	1	9	07	53	40
Bread (2 slices)	2	1-2	13	75	12
Cereal (1 cup)	1	8	15	70	15
Crackers (2-10)	2	1	09	64	27
French fries	2	3	05	51	44
Krystal french fries	2	1	05	51	44
Pizza (3-4 slices)	1	3	22	44	34
High Fat:					
Hamburger	3	1	21	30	49
Krystal hamburger(3-4)	2	1	21	30	49
Beverages:					
Coffee (2 cups)	1	12	0	0	0
Coke (8 oz)	2	1	0	100	0
Dr. Pepper (24 oz)	1	8	0	100	0
Iced tea (10 cups)	1	6	0	100	0
Orange juice (1 cup)	1	2	06	93	01
Sprite (12 oz)	1	8	0	100	0
V-8 juice (1 cup)	1	4	0	100	0
Water (1 cup-2 liters)	11	1-6	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

for non-binge women was water, with 18 of the 25 choosing to consume water following alcohol intake (Table 24). Other beverages chosen which were high carbohydrate, were Coca-Cola, Dr. Pepper, and Gatorade. Diet Coke was also chosen by one respondent. These beverages ranged from 30 minutes to 10 hours after alcohol consumption.

Table 24 - Non-binge women (n=25) food and beverage choices after alcohol

Food/Beverages Chosen & Amount*	(n)**	Time (hrs)	PRO (%)	CHO (%)	FAT (%)
Foods:					
High Carbohydrate:					
Bread (2 slices)	1	0.5	13	75	12
Crackers (2-10)	2	2	09	64	27
Pizza (3-4 slices)	1	0.5	22	44	34
Pretzels	1	0.5	10	79	11
Potato chips	1	1	06	52	42
High Fat:					
Krystal hamburger (3-4)	1	1	21	30	49
Beverages:					
Coke (8 oz)	2	7	0	100	0
Dr. Pepper (24 oz)	1	10	0	100	0
Diet Coke (20 oz)	1	0.5	0	0	0
Gatorade (20 oz)	1	8	0	100	0
Water (1 cup-2 liters)	18	1-5	0	0	0

*amount = 1 serving unless otherwise specified
**n = total number of subjects choosing this food; it is possible that one subject answered more than one food/beverage in their response

Nutritional Supplements

A majority of binge drinkers (71%) consumed supplements, while 54% of non-binge, and only 38% of abstainers chose to consume nutritional supplements (Table 25). Multivitamins, vitamin C, and vitamin E were the most popular dietary supplements.

Motivation to Drink Alcohol-containing Beverages

The question of motivation to drink alcohol verbal questionnaire via telephone did not provide a feasible amount of data secondary to poor response rate. Of those that chose to respond, the majority were not serious about the questions, and really had very little to say about why they drank alcohol. It would be beneficial for future studies to use focus groups with incentives to motivate students to participate in the study. This would promote discussion and magnify the seriousness of the questions to the subjects.

Table 25 - Relationship between Drinking Level and Nutritional Supplement Use

Supplement Chosen	Binge Drinker(%) (n = 103)	Non-Binge Drinker(%) (n = 119)	Abstainer(%) (n = 99)
Amino acids	0 (0%)	1 (1%)	0 (0%)
Vitamin B_{12}	1 (1%)	0 (0%)	0 (0%)
Vitamin B_6	0 (0%)	0 (0%)	1 (1%)
Vit B Complex	2 (2%)	0 (0%)	0 (0%)
Biotin	0 (0%)	1 (1%)	1 (1%)
Calcium	4 (4%)	4 (3%)	3 (3%)
Child Multivit	2 (2%)	0 (0%)	0 (0%)
Chromium picol	1 (1%)	1 (1%)	0 (0%)
Creatine mono	5 (5%)	0 (0%)	2 (2%)
Echinacea	1 (1%)	(1%)	0 (0%)
E. Excel Intl	0 (0%)	0 (0%)	1 (1%)
Iron	5 (5%)	2 (2%)	0 (0%)
GABA	1 (1%)	0 (0%)	0 (0%)
Garlic	0 (0%)	0 (0%)	1 (1%)
Ginseng	0 (0%)	1 (1%)	0 (0%)
L-glutamine	1 (1%)	0 (0%)	0 (0%)
Herb aller rel	1 (1%)	0 (0%)	0 (0%)
Herbs	0 (0%)	1 (1%)	0 (0%)
Kava kava	1 (1%)	0 (0%)	0 (0%)
Lecithin	0 (0%)	0 (0%)	1 (0%)
Metabolite	0 (0%)	1 (1%)	0 (0%)
Multi-mineral	0 (0%)	0 (0%)	2 (2%)
Multi-vitamin	22 (21%)	33 (28%)	12 (12%)
Papaya enzyme	0 (0%)	0 (0%)	1 (1%)
Phosphagen pow	1 (1%)	0 (0%)	0 (0%)
Protein powder	1 (1%)	0 (0%)	0 (0%)
Pyruvate	0 (0%)	0 (0%)	1 (1%)
Rip fuel	2 (2%)	0 (0%)	0 (0%)
Spirulina	0 (0%)	1 (1%)	0 (0%)
St John's Wort	2 (2%)	2 (2%)	0 (0%)
Tagamet	0 (0%)	1 (1%)	0 (0%)
Thymic formula	0 (0%)	1 (1%)	0 (0%)
Vita ved	0 (0%)	0 (0%)	1 (1%)
Vitamin C	15 (15%)	8 (7%)	7 (7%)
Vitamin E	4 (4%)	5 (4%)	4 (4%)
Zinc	1 (1%)	0 (0%)	0 (0%)
Total	73 (71%)	64 (54%)	38 (38%)

CHAPTER 6

DISCUSSION

Demographics

During the period of January to June 1998, the majority (81.3%) of undergraduate students attending UT were between 17 to 23 years old, with 50.7% women, and 49.3% men (109). The student sample included more women (68.5%) than men (31.5%). This is comparable to the Harvard Alcohol Study that was predominantly women (60%), and 40% men (111).

The student sample was predominantly Caucasian (91.5%). This almost coincides with the university data that report the majority (89.3%) of undergraduates are Caucasian (109). The remainder of the student sample included African American (4.0%), Hispanic (0.3%), Asian Indian (1.2%), Oriental (1.2%), and other (mixed race) (0.9%).

By comparison, this pattern was similar to the Harvard Alcohol Study where most students were Caucasian (77%), African American (5%), Hispanic (8%), Asian Indian (9%), and other (8%). In the Core Alcohol study the predominant group (82%) was Caucasian. Of our student population 44.6% of the sample was employed, and 54.2% were unemployed. A few that

responded were in the other category (1.2%). In comparison, 59.3% of the Core Alcohol study participants were employed, and 40.7% were unemployed.

The majority (97.8%) of the students were single. Of the seven remaining students, only 5 were married, 1 widowed, and 1 chose to be in the other category. This was also the case in the Core Alcohol Study as participants were predominantly single (83.3%), 13.3% married, and 0.3% widowed.

The majority of the students were either of the freshman (23.6%), sophomore (39.0%), or junior class (28.6%), altogether accounting for 91.2% of the student sample. The participation in the study by the sophomores and juniors was proportionately higher than would have been expected from the UT Fact Book (109), indicating 29% freshmen, 20% sophomores, 20% juniors, and 28% seniors in 1998. There were fewer (8.8%) seniors in our study than the actual UT demographics would have predicted because we focused on the 17-23 year age group which might have excluded many seniors.

In comparison, the percentage of the population in the Harvard Alcohol Study was more evenly distributed. The sample was composed of freshmen (23%), sophomore (21%), junior (23%), and senior (22%)(1). However, the Harvard

Alcohol Study did include students 24 years of age and over, in which one would expect a more even distribution across the collegiate classes.

The sample consisted of 40% fraternity and sorority members, therefore the remaining 60% were non-members. Approximately 1,400 men belong to 25 social fraternity chapters, and 1,300 women belong to 18 social sorority chapters located on the University of Tennessee, Knoxville, campus. Fraternity and sorority members make up 13.7% (2,700) of the total UT undergraduate population (109). It may be that the fraternity and sorority members did not feel as reluctant about answering the questionnaire, or it just happened that there was a larger number of fraternity and sorority members in the classes that were presented with the questionnaire. The Core Alcohol study had a much lower percentage of students as fraternity/sorority members (2.1%).

Over half of the sample lived on campus (59%), while 41% lived off campus. As of fall 1998, 6,788 (34.4%) students lived on UT campus in student residence halls (109). Our sample had a higher percentage of respondents that lived on campus. More students lived off campus in the Core Alcohol study, with 64.5% living in a house or apartment.

All students were in the predominant college age of 17 to 23 years. The majority of students in the study were in the 19-21 age range, which coincides with the majority of overall students at UT being within the 19-21 age range (Table 26). The age range of 17-23 years was targeted to both meet the definition provided by the national studies that it is the typical age range of college students, and to target 81.3% of the undergraduate population at UT. Only 83% of the student sample in the Harvard Alcohol Study were < 24 years of age, with 17% ≥ 24 years. The Core Alcohol study was predominantly comprised of 18-22 year olds (18 & under 18.9%, 19-20 years old 31.5%, and 21-22 years old, 25.8%).

Table 26 - Age distribution of the study sample versus the UT population (ages 17-23)

Age	Study Population	UT Population*
17 (<18)	2 (0.6%)	198 (1%)
18	35 (10.9%)	2,646 (13.4%)
19	92 (28.6%)	3,440 (17.5%)
20	96 (29.8%)	3,243 (16.5%)
21	70 (21.7%)	3,086 (15.7%)
22	19 (5.9%)	2,195 (11.1%)
23	7 (2.5%)	1,208 (6.1%)
Total	321(100%)	16,016 (81.3%)

*UT Fact Book 1998-99 (109)

Prevalence of Binge Drinking

The Monitoring the Future Project National study found that 41% of college students were binge drinkers (2). When we compare the two through statistical analysis we find that the UT student sample of 31.0% binge drinkers is significantly lower than the national result of 41%(2)(Table 27). The students in our sample from the University of Tennessee are below the national average when compared to prevalence of binge drinking among other colleges. The Harvard Alcohol Study prevalence of binge drinking was 42.7%, and the Core Alcohol Study was 40.2% (Table 28). In the research conducted by the Harvard Alcohol Survey, binge drinking rates varied extensively among 140 different colleges (90). In this study, middle level binge drinking

Table 27 - Student Sample Prevalence of Binge Drinking Compared to the National Data Results

Study Population	Prevalence of Binge Drinking*,**
Student Sample	31.0[a]
Monitoring the Future Project	41.0[b]
Harvard College Alcohol Study	42.7[b]
Core Alcohol Study	40.2[b]

*Means within a column with different superscripts (a,b) are significantly different at $p \leq 0.05$

**Binge drinking is defined as ≥5 drinks in a row on one occasion

Table 28 - Student Sample Categorized by Male and Female Gender Prevalence of Binge Drinking Compared to the Core Alcohol Study

Study Population	Prevalence of Binge Drinking* Men (%)	Women (%)
Student Sample	53%	22%
Core Alcohol Study	48%	33%

*Binge drinking is defined as ≥5 drinks in a row on one occasion

colleges had a range of 36% to 50% of students as binge drinkers. The low-level binge drinking colleges were defined as 35% or less of students classified as binge drinkers. The UT student sample, at 31.9%, falls into the category of colleges that have a low-level of binge drinking (35% or less) when compared to the Harvard Alcohol Study (90).

Overall, 43.4% of fraternity or sorority students responding were binge drinkers, versus only 24.4% of non-members. However, members of fraternities were more likely to be binge drinkers (85% vs. 24%), while sorority members had a similar prevalence of binge drinking than non-members (24% vs. 24%). This suggests that there was a relationship between being a fraternity member and an increase risk of being a binge drinker. The sorority prevalence of binge drinking was similar to non-members. Other investigations have shown that members of fraternities and sororities were

more likely to use alcohol (101,110).

Students living on campus had a slightly lower percentage of binge drinking, 31.9% vs. 32.1% for those off-campus. However, non-binge drinking was much higher (42.9%) among those on campus than those living off campus (29.0%). This suggests that students living on campus tend to drink on a more regular basis compared to the students located off campus. In addition, a larger percentage of abstainers were among those living off campus (39.0%) than those living on campus (25.1%). The Core Alcohol study showed that students living on campus binged more often than students living off campus. Although the UT campus population showed no difference between prevalence of binge drinking on or off campus, the amount of both binge and non-binge drinking was higher among those living on campus.

The percentage of binge drinking was almost identical for employed (30.7%) and unemployed students (32.0%). It is interesting that employment status is not related to increased prevalence of binge drinking as one would have thought given more money being available to those employed. On the other hand, unemployed students would have more time available for drinking and recovery from heavy drinking than employed students.

There was no significant difference in amount of drinking

among the different college classes and in drinking for ages <21 and >21 (Table 29). The Harvard Alcohol study also showed that students who are younger than the legal drinking age of 21 do not significantly differ in binge drinking rates from students aged 21 to 23 years (90).

Men were more likely to be binge drinkers, and women were more likely to be non-binge drinkers and abstainers. The Core Alcohol study also found that more men were binge drinkers, with 48% of men, and 33% of women that reported binge drinking (Table 30). When reviewing gender-specific distributions in Table 5 and 6 (pp.72-74), we find that binge drinking for men increased with education level, while women binge drinking decreased when they were seniors, although the number of seniors for both genders in the study is small.

Table 29 - Binge Drinking* and Legal Drinking Age

Age	Binge Drinker NO	Binge Drinker YES
Under 21	81 (68%)	64 (62%)
21 and above	39 (32%)	38 (38%)
Total	120 (100%)	102 (100%)

*Binge drinking is defined as ≥5 drinks in a row on one occasion. No significant difference was found between binge drinkers, vs the those that were non-binge drinkers above or below the legal age of 21.

Table 30 - Distribution of Drinking Level and Gender

	N	Binge Drinker*	Non-Binge Drinker	Abstainer
Gender				
Men	101	54(52.9%)	20(20.4%)	27(26.7%)
Women	220	49(22.3%)	99(45.0%)	72(32.7%)
Total	321	102(31.9%)	120(37.3%)	99(30.8%)

*Binge drinking is defined as ≥5 drinks in a row on one occasion

The percentage of binge drinking was greater in male fraternity members than non-fraternity members. Although the percentage of drinking (binge or non-binge) was higher among sorority members, the amount of binge drinking was not significantly different between sorority members and non-members. For both men and women living on campus, fewer were abstainers than those living off campus. However binge drinking had little difference for men or women living on or off campus, while the non-binge drinking was higher for those living on campus.

Men that were in the unemployed group had a higher percentage of binge drinkers, and a lower percentage of abstainers, which is contrary to expectations as the employed male would have more money for drinking. It is possible that they did not have as much time for drinking because they worked. Unemployed women also had fewer

abstainers, but the amount of binge drinking was higher for employed women. Employed women and unemployed men had higher prevalence rates of binge drinking. Therefore, we do see some difference with relation to employment and drinking patterns between the genders.

When we analyze the data using ≥4 drinks in a row definition of binge drinking for women (by the Harvard Alcohol Study), we found that significantly more women fit the binge drinking group(1). The rate of binge drinking by the ≥5 drink definition is 22.3%, while with the ≥4 drink definition binge drinking among women becomes 35.0% (Table 11). The amount of binge drinking for women at the ≥4 drink definition was significantly higher than the amount at the ≥5 drink definition (P value ≤ 0.05).

Beverage Preference

Beer was the most popular alcoholic beverage in the sample population, with 81 women (n=220) and 65 men (n=101) choosing to drink beer. The next popular beverage was liquor, and then wine, followed by wine coolers, and the least consumed was distilled spirits. One reason beer may be the most common is that it is the least expensive of the alcoholic beverages, and thus fits a student's budget. In the study by Windham (45) 48% of men drank beer, and only

24% of women drank beer. It is important to note that the study included ages 14 years and up, and excluded college dormitories. Our study shows that college students (both genders) chose beer more often than the overall population. This is important when calculating the amount of alcohol consumed because different beverages have different amounts of alcohol, and each gender may consume different amounts.

Energy Intake

Energy

The female student data show the mean energy intake was 10% (203 kcal) lower for non-binge drinkers when compared to abstainers. This suggests that for non-binge drinkers the energy consumed from alcoholic beverages may be replacing food energy, as shown in some prior human studies(15,31,36). The awareness of the energy intake from alcohol may be causing female non-binge drinkers to eat less. Further research with larger study groups for comparison would be warranted to find if this is truly the case.

Energy intake of the binge drinking women was similar to the abstainers. This suggests that the female binge drinkers are adding alcoholic beverage energy to their energy intake. This observation was also found in prior human studies (33,37,38,39).

In men, higher alcohol intake is associated with higher

energy intake. Due to the fact that both the non-binge and binge drinker energy intake was higher than that of abstainers, suggests that men are not substituting alcohol energy for diet energy, but are adding to them and thus are consuming more total energy.

Although energy intake increased for men who drank alcohol, no significant difference was observed between the non-binge versus binge drinking men, as was the case for women. This suggests that women may consume food energy in relation to alcohol intake differently than men. The only study reporting gender differences in relation to drinking alcohol and food consumption is by Colditz et al (24). It was observed that total energy increased with alcohol consumption in men, and in women energy from alcohol replaced energy from carbohydrate in the diet. Similarly, we found that male energy intake increased with alcohol consumption. Among non-binge women energy from alcohol replaced energy in the diet. However, female binge drinkers' food energy were not significantly different than the abstainer group; therefore, the energy from alcohol appears to be added to the diet for female binge drinkers.

Male binge drinkers consumed significantly more protein than abstainers, less carbohydrate and less fat than abstainers. Female binge drinkers consumed less protein,

more carbohydrate, and significantly less fat than abstainers. Binge drinking men in the sample are consuming more protein, while binge drinking women are consuming more carbohydrate. Other investigators have shown that macronutrient intake does vary with drinking, i.e. sucrose intake in women decreased with higher alcohol intake (24). Among men protein intake decreased with alcohol intake (31, 45). The higher carbohydrate consumption by women in our study is opposite that found by Colditz et al (24) where the amount of carbohydrate intake was lower in women. These differences may be due to the influence of binge drinking as alcohol consumption has been shown to suppress carbohydrate craving.

When we compare our results to those of Windham (45) we must bear in mind that Windham did not include college students, only had drinkers versus non-drinkers, and did not distribute data by gender. By comparison of Windham's study, we see that college students are consuming foods differently than the household population data compiled in the early 1980s. Carbohydrate intake is much higher for college students, fat intake is much lower, and protein intake is more variable with amount of drinking for college students versus the household population in Windham's study.

Carbohydrate

Carbohydrate intake was lower in binge drinking men compared to both the non-binge and abstainers. This has been shown in a lot of animal experiments, and a few human studies where the most prevalent effect of alcohol was suppression of carbohydrate consumption (40,111-12).

It was interesting that the carbohydrate intake of non-binge drinking men was higher. It suggests that one of two effects may be occurring, 1) alcohol intake isn't high enough to exert an effect to suppress the intake of carbohydrates, or 2) they may be "adapting" by increasing carbohydrate intake to reduce the craving to drink more alcohol, thus resulting in a lower intake of alcohol than the binge drinking group. It has been shown that consuming food high in carbohydrate caused subjects to abstain from drinking (41-44).

Fat

Mean fat intake was lower for both men and women who consumed alcohol. There may be an association with alcohol intake causing lower dietary fat intake. The average amount of fat intake was also shown to decrease in prior studies (31,45).

Protein

Mean protein intake remained virtually the same for all

female groups. This suggests there are no interactions with alcohol intake and level of protein intake for women.

Mean protein intake for men was higher as the level of drinking increased. This suggests an association between increased alcohol intake causing an increase in dietary protein intake, although this was not the case in prior studies (31,45).

Nutritional Supplements

A greater percentage of binge drinkers chose to take supplements, which may indicate they are trying to counteract their poor dietary habits more so than abstainers. This opposed the findings of the National Health Interview Survey of 1987 that found heavier drinkers in the general population are least likely to use dietary supplements (34).

Body Mass Index (BMI)

Why was BMI for women lower in spite of additional energy from alcohol added to the diet? One may suggest that alcohol is either replacing food energy, or the alcohol energy (7.1 kcal/g) was not bioavailable to cause weight gain. However, the energy intake was not significantly different between female binge drinkers and abstainers (2,072 vs. 2,092). Alcohol energy in the female binge drinking group are added to the diet, which suggests that

the alcohol energy are not bioavailable for weight gain. A reason for this has been theorized by Lieber (66) that it is due to the metabolism of alcohol by the MEOS pathway. In this pathway, the energy from alcohol is lost, causing energy wastage. Now, what about the female non-binge drinkers? We see that the BMI values are more spread over the ranges toward obese and underweight, closer to the BMI values of the female abstainers (Figure 8). This suggests that alcohol energy in non-binge drinkers may be substituting food energy. Further, the energy intake for female non-binge drinkers is lower than that of the female abstainers (1,889 vs. 2,092). The BMI values of non-binge and abstainers, are not different. The fact that the BMI values are not much different, and the energy intake is lower in female non-binge drinkers, suggest that alcohol energy are replacing food energy in the non-binge drinking group. The observation that female non-binge drinkers are replacing food energy with alcohol energy, and female binge drinkers are not, leads us to believe there may be a difference secondary to the level of alcohol intake.

Female non-binge drinkers average alcohol intake is 2 drinks, while female binge drinkers are drinking 5 or more drinks. The lower level of alcohol in 2 beer (25.7g) may not be enough to induce the MEOS system, therefore alcohol

energy are not wasted, and contribute to positive energy balance. On the other hand, drinking 5 or more beer (64+ g alcohol) may be high enough to induce the MEOS and thus, promote energy loss.

The BMI values for men were not significantly different across the different levels of alcohol intake (Figure 7). Why this is so may be explained by the higher level of alcohol (>64g from 5 beer) needed to induce the MEOS.

The majority of women of all groups (binge drinker, non-binge drinker, and abstainer) were within the healthy weight range according to BMI value of 19 to 24.9 (Figure 8). No female binge drinkers fell into the obese BMI value of greater than or equal to 30, while a small percentage (2.2%) of non-binge drinkers and (4.5%) of abstainers fell into the obese category. This may suggest that binge drinking is lowering intake of energy, and or the alcohol is not being metabolized efficiently to actually provide 7.1 energy per gram and therefore losing weight may be associated with higher alcohol intake (66). There was a relationship between alcohol consumption and BMI for obesity observed among women. The highest level of alcohol intake (binge drinking) was associated with lower BMI when comparing overweight (25-29.9) and obesity values (30+) for women. Further a greater percentage of binge drinkers are

in the healthy weight range when compared to the other groups (Figure 8).

The pattern is similar for men as was for the women with regard to obesity BMI values (30+)(Figure 7). In the obese BMI category, the highest percentage was associated with the abstainers, while the lowest percentage was in the binge drinkers. In the overweight male category (BMI=25-29.9), we find the binge drinkers and non-binge drinkers have a higher percentage that were in the male binge's and non-binge drinker than the abstainer group. This suggests there may be a relationship with binge drinking lowering the incidence of obesity (BMI>30) in men, but increasing the incidence of being overweight.

In the underweight category (BMI<19), there were more abstainers than those who chose to drink alcohol. This may be related to a different way of metabolizing alcohol in men than in women. Perhaps among men alcohol is added to energy intake, until it reaches the high level as in the binge drinkers where it is wasted energy. Colditz et al (24) reported a relationship between alcohol consumption and body mass index for women, but not for men. In their study, men's BMI values varied little no matter the level of alcohol intake. Our data suggests that for men in the obese category, the binge drinkers had the lowest percentage of

obese BMI values.

Mean fat intake was lower in both men and women with higher alcohol consumption. There may be an association with alcohol intake causing lower consumption of dietary fat. It has been suggested that voluntarily lowering fat in the diet may counteract the energy wastage effect caused by the MEOS, and therefore individuals may not have the resulting weight loss (66). The difference in fat intake among the groups was not significant enough to counteract energy wastage. A future study involving low-fat diet and alcohol intake may be warranted to counteract the weight loss found in alcoholics, and possibly found in other levels of alcohol abuse (6).

We have two major pathways to metabolize alcohol. One is the ADH pathway, the other is the MEOS pathway. The ADH pathway results in useable energy, but the MEOS pathway does not. It is hypothesized that the reason people that consume high amounts of alcohol and do not gain weight is the energy wastage due to the induction of the MEOS pathway. The lower amounts of alcohol intake does not induce the MEOS pathway, and thus spares energy resulting in weight gain. A look at the BMI values of women (figure 9), shows that with binge drinking group the BMI values are closer to the "healthy weight" range. It may be that the energy wastage is

operational, and the additional energy expected from 5 or more drinks are not bioavailable for anabolic purposes. Thus, there is no weight gain in the female binge drinkers. When we take into account the female non-binge drinker, we see that the distribution of BMI values are more spread out toward the overweight and underweight ranges. It may be that in the female non-binge drinkers, the energy from alcohol are added to the daily energy intake. This effect of increasing amount of alcohol intake causing lower BMI in women was also observed by Colditz et al (24).

Those differences in BMI between the groups of men were not indicated (Figure 10). This was also found to be the case in prior studies (24).

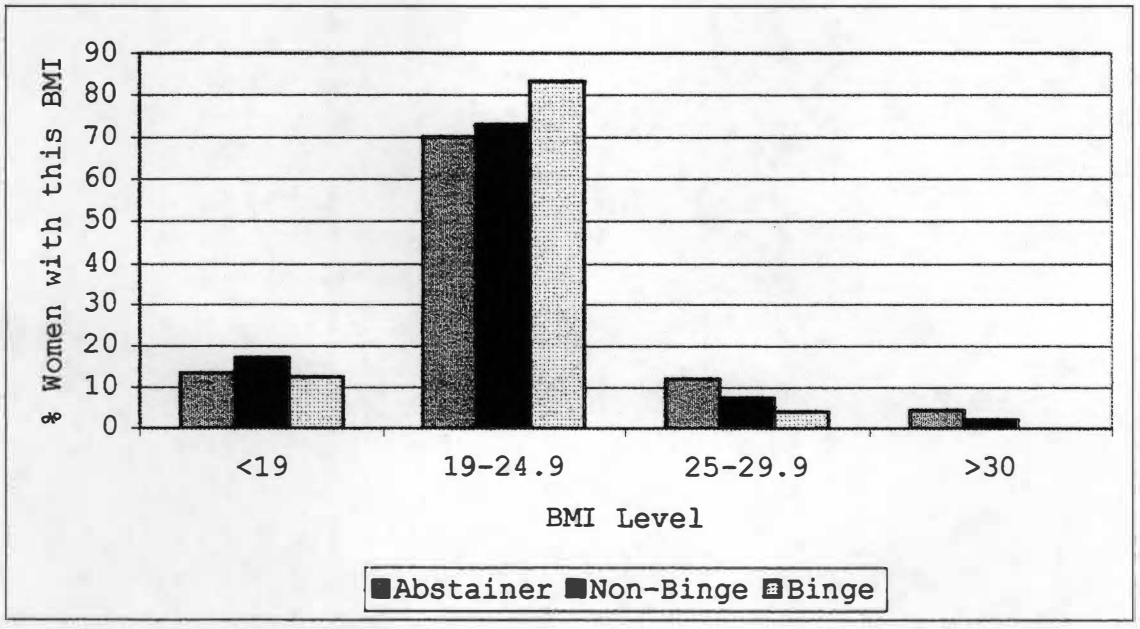

Figure 9 - Percentage of women within each BMI range according to level of alcohol consumption

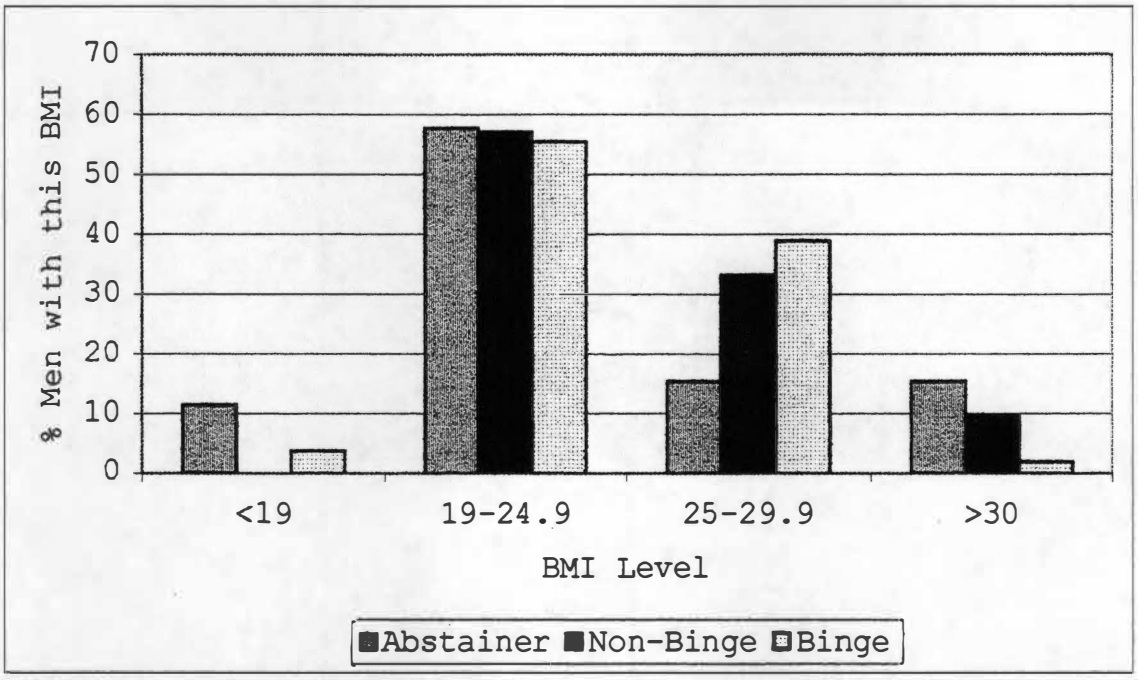

Figure 10 - Percentage of men within each BMI range according to level of alcohol consumption

Drinking and Food Choices

Before drinking

The high fat food intake by two of the male binge drinkers was up to 2 hours before drinking. Since it takes about 2 hours for the stomach to empty its contents via digestion, it may be that they could consume the high fat foods this far ahead of time and would still interact with the alcohol consumed.

Due to the fact that women get intoxicated quicker than men, the low number of women choosing to consume foods prior to drinking may suggest a need to increase awareness about lowering the risk of alcohol intoxication by eating prior to

drinking alcohol.

It may be that male non-binge drinkers do not plan to consume as much alcohol and do not have to "adapt" by consuming foods or beverages prior to drinking as shown with the binge drinking group. This may also explain the fewer number in the non-binge group choosing to consume food or beverages prior to drinking alcohol.

Female non-binge drinkers have adapted by choosing high carbohydrate intake, but there are too few subjects to determine if an association exists. All groups, binge and non-binge, chose to drink water before drinking alcohol.

While Drinking

Female non-binge drinkers chose to consume high carbohydrate foods while drinking alcohol. This may be an adaptation to decrease the degree of intoxication (30). Forsander believes that when we consume carbohydrates it satiates our craving for sweets/carbohydrate foods, and therefore decreases our craving for alcohol (30). The female non-binge drinkers may be choosing these foods, resulting in the decreased levels of drinking by this group.

After Drinking

It is interesting that male and female binge drinkers, and non-binge women, consumed high carbohydrate foods and water after drinking. The literature indicates that less

carbohydrate is consumed by drinkers secondary to alcohol intake. This may be replacing or satisfying the craving for further alcohol consumption. All of the alcohol drinking categories chose to drink water following drinking. Alcohol intake is most likely the result of increased thirst secondary to the dehydration effect of alcohol.

This study will be useful in that it will:

1) Provide baseline data for further research
2) Provide information to assist institutions of higher education in development of alcohol prevention programs
3) Increase awareness of potential health risks related to alcohol abuse, not only alcoholism, but also other levels of drinking such as binge drinking.

Conclusions

In spite of the inherent limitation of the study, the following conclusions are drawn.

The choice of alcoholic beverage in decreasing order was beer, liquor, wine, wine coolers, and distilled spirits. The student population had significantly lower prevalence of binge drinking (31.9%) than the national average (41%). However, binge drinking among women in the population was lower than the national studies (22%) while binge drinking among men was higher (53%). The members of fraternities were

more likely to be binge drinkers (85% vs. 24%), while sorority members had a similar prevalence of binge drinking as non-members (24% vs. 24%). Energy intake was higher among non-binge men, women, and binge men compared to the abstainers. The binge drinking men consumed more protein, less carbohydrate, and less fat than abstainers. The binge drinking women consumed less protein, more carbohydrate, and less fat than abstainers.

Nutrition supplements were taken by 71% of binge drinkers, 54% of non-binge drinkers, and 38% of abstainers. The most popular supplements were vitamin C, vitamin E, and multivitamins.

More binge drinking men than women ate food before drinking alcohol. Group and individual counseling is recommended to increase awareness to food-alcohol effects, especially among women.

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APPENDICES

APPENDIX A

LIST OF INCIDENTS TIED TO COLLEGIATE DRINKING

List of incidents tied to drinking

By The Associated Press

Here's a list of tragic incidents involving alcohol on campus:

1997

Feb. 2: Leigh Ann Prevatte, of Pennsylvania State University, falls from her dorm window and dies after drinking.

April 12: Ryan Waldron, 22, of Middlebury College, dies in a car accident while driving home drunk from a party.

Sept. 28: Benjamin Wayne, 20, of Louisiana State University, dies of alcohol poisoning at a party. Blood-alcohol level was 0.588.

Sept. 30: Scott Krueger, 18, of the Massachusetts Institute of Technology, dies three days after he was found unconscious on a fraternity floor. He had a blood-alcohol level of 0.41.

Oct. 31: Melissa Somers, 18, of Virginia Polytechnic University, dies after falling from her dorm window. Blood-alcohol level was 0.21.

Oct. 31: Matthew West, 18, of Virginia Polytechnic University, and Jonathan Levy, 20, of Radford University, die after the car West was driving crashed. West had been drinking. Also killed was the driver of the other car, Ann Moore, 46, a Radford University professor.

Nov. 10: Nicole Breckenridge, 21, of Virginia Commonwealth University, dies when the car she was riding in crashed. The driver had been drinking.

1998

April 25: Keith Nobel, 19, of Ohio University, dies after falling into a river while drunk. His blood-alcohol level was 0.24.

May 1: More than 3,000 Michigan State University students riot to protest a university decision to ban alcohol at a popular tailgating field.

July 12: Alcohol-fueled rioters cause $150,000 in damage in the midst of an arts festival in State College, Pa., home of Penn State.

Oct. 8: Jason Greco, 20, of Rutgers University, dies after falling down a flight of stairs while drunk.

Oct. 13: John Kostek, 21, of the University of Tampa, drowns after diving in a river while drunk.

Nov. 5: Bradley McCue, 21, of Michigan State, dies after drinking 24 shots of liquor to celebrate his 21st birthday. Blood-alcohol level was 0.44.

Nov. 7: David Wasdyke, 18, of Cornell University, dies after falling into a gorge while drunk.

Nov. 11: Jack Ivey Jr., 23, of the University of Texas, dies of alcohol poisoning after a night of drinking. Blood-alcohol level was 0.40.

Dec. 12: Allan Hewer, 24, dies of alcohol poisoning on the couch of a Ferris State University sorority. He was not a student at the university.

1999

Jan. 15: Adriene Allen, 20, of Ferris State University, falls from her apartment window and dies after a night of drinking.

Jan. 30: Barry Joseph Vail, 18 of Texas A&M University, dies after falling from a school parking garage. Blood-alcohol level was 0.23.

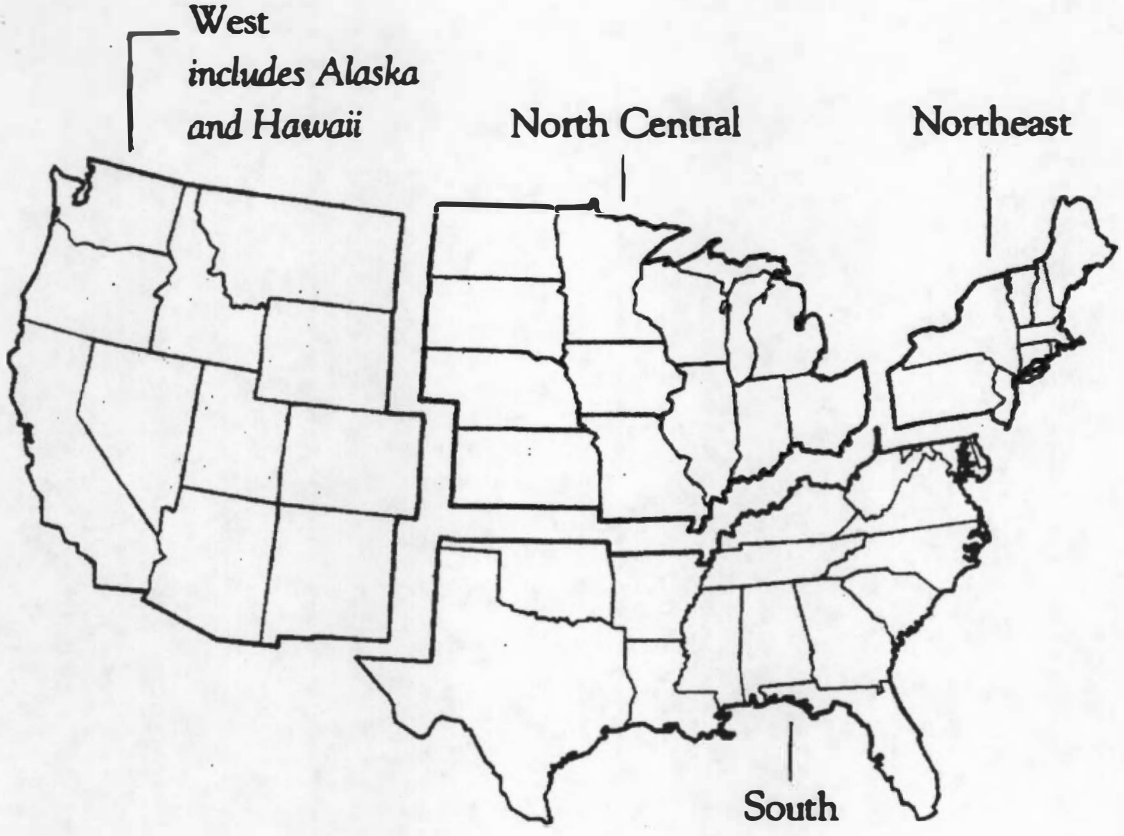
March 27-28: Alcohol-fueled riot at Michigan State after the school's loss in the NCAA Final Four causes more than $238,000 in damage to the campus and the city of East Lansing.

April 24: Kyle Hagmann, 20, of Cal Lutheran dies of alcohol poisoning after a night of drinking.

August 24: Kristine Lurowist, 21, of Penn State, nearly dies after drinking on her 21st birthday. Blood-alcohol content was 0.682.

APPENDIX B

DEFINITIONS OF REGIONS FOR REGIONAL ANALYSIS BY THE CORE ALCOHOL STUDY

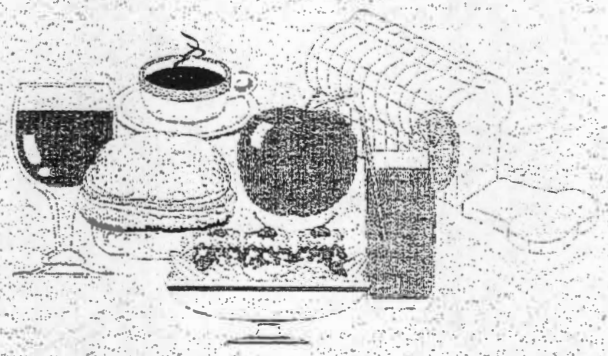


APPENDIX C

THE QUESTIONNAIRE

FOOD AND BEVERAGE

Help us determine what types of food and beverages University of Tennessee students consume



Melanie Moyers, graduate student
Dileep Sachan, Ph.D.
Department of Nutrition
College of Human Ecology
The University of Tennessee
Knoxville, TN 37996-1900

Code # _____

APPENDIX C

UNIVERSITY OF TENNESSEE, KNOXVILLE
Project Consent Form **Code # _____**

Prior to participating in this study, please read the following information very carefully.

1. This research is being conducted as part of Melanie Moyers' thesis project within The Department of Nutrition, at the University of Tennessee, Knoxville, TN.

2. The title of the research project is, "Alcohol and Dietary Choices Among College Students."

3. The purpose of this research project is to learn about the viewpoints of UTK students for consumption of food and alcohol-containing beverages. This may benefit in developing awareness of alcohol and food interactions.

4. You will be asked to respond to the following:
   a. Food and alcohol-containing beverage survey, including a 24 hour dietary recall
   b. Telephone questionnaire about your reasons to drink, or not to drink alcohol-containing beverages

5. Your participation in this study is voluntary. There will be no penalty for refusing to participate, or for choosing to withdraw at any time during participation.

6. Participation in this research project will involve no specific risks.

7. The amount of time required will be within 20-30 minutes.

8. The results of this study will provide very important information for nutrition professionals who have a specific interest in learning about and working with college students.

9. Your name, address, and telephone number will remain totally confidential and will only be used to contact you for the follow-up telephone interview. Your name will not be linked to the survey or interview data in any way. No one other than the project staff will know that you participated in the study. Confidentiality of your participation and your responses to the research questionnaire is assured. All data will be kept in locked file in the investigators office and only investigators will have access to it.

10. Participation in this study is considered verification of your informed consent.

11. If you have any questions, please contact:
    Melanie R. Moyers or Professor Dileep S. Sachan
    The University of Tennessee
    Department of Nutrition
    229 Jessie Harris Building
    Knoxville, TN 37996-1900
    Phone: (423) 974-5445 or 974-6257

Date: _____ Signed: _____

Witness: _____

APPENDIX C

Please take a few minutes to complete the following questions about yourself and the foods and beverages you consume. First, please answer the following questions about yourself.

1. What is your age? _____YEARS Your height? _____ FT. _____ IN. Your weight? _____ LBS.

2. Your present marital status? (Please circle number)

1 SINGLE
2 MARRIED
3 DIVORCED
4 SEPARATED
5 WIDOWED
6 OTHER (Please specify) _____

3. Which best describes your ethnic origin? (Please circle number)

CAUCASIAN
2 AFRICAN AMERICAN
3 AMERICAN INDIAN
4 HISPANIC
5 ASIAN INDIAN
6 ORIENTAL
7 OTHER (Please specify) _____

4. Which is your current education level? (Please circle number)

1 FRESHMAN
2 SOPHOMORE
3 JUNIOR
4 SENIOR
5 GRADUATE/MASTERS
6 DOCTORAL

5. Are you a member of a fraternity or sorority?

1 YES
2 NO

6. Do you currently live on campus?

1 YES
2 NO

7. Your gender? (Please circle number)

1 MALE
2 FEMALE

8. How many hours are you currently enrolled at UT?

_____ HOURS

9. Are you currently employed? (This includes receiving pay for research assistant hours and any other university related work) (Please circle number)

1 NO
2 YES (How many hours per week?) _____ HOURS
3 OTHER (Please specify) _____

APPENDIX C

10. Do you take any vitamins, minerals, or other nutritional supplements? (Please circle number)

1 NO
2 YES, but NOT regularly
3 YES, fairly regularly

11. If you answered yes, fairly regularly, in the prior question, what do you take fairly regularly? (Please list in table below)

TYPE OF VITAMIN, MINERAL, HERB, OR OTHER:	# OF PILLS PER DAY (or amount of powder, etc)
	_____ pills per day
	_____ pills per day
	_____ pills per day
	_____ pills per day
	_____ pills per day

Next, please answer the following about the types of beverages you drink.

12. Do you drink alcohol-containing beverages?

1 YES (Please complete the table below as accurately as possible)
2 NO (If no, please go to question #18)

	HOW MANY?	HOW OFTEN?		
	What is your Highest Number of Drinks in a row (within the last 2 wks) for each beverage listed on the left?	Times Used in Past 2 Weeks?	Times Used in Past Month?	Times Used in Past Year?
BEER				
LIQUOR				
WINE				
DISTILLED SPIRITS				
WINE COOLER				
Other _____				

Note: One drink is defined as:
12 fluid ounces of beer
5 fluid ounces of wine
1.5 fluid ounces of distilled spirits
and contains about 0.5 fluid ounce of pure alcohol

APPENDIX C

Please answer the following questions about the foods and beverages, if any, that you always choose prior to, following, or while drinking alcohol containing beverages.

13. Are there any specific foods or beverages you will plan to eat or drink within 24 hours BEFORE drinking an alcohol containing beverage?

1 YES (Please list the foods and beverages in the table below)
2 NO (If no, please go to next question)

BEFORE DRINKING Food or Beverage Description:	Amount: (ex: 1 cup, 1 Tbsp, etc)	How long *BEFORE* drinking alcoholic beverage?
1.		____hr. ____ min.
2.		____hr. ____ min.
3.		____hr. ____ min.
4.		____hr. ____ min.
5.		____hr. ____ min.

14. Are there any specific foods or beverages you will plan to eat or drink within 24 hours AFTER drinking an alcohol containing beverage?

1 YES (Please list the foods and beverages in the table below)
2 NO (If no, please go to next question)

AFTER DRINKING Food or Beverage Description:	Amount: (ex: 1 cup, 1 Tbsp, etc)	How long *AFTER* drinking alcoholic beverage?
1.		____hr. ____ min.
2.		____hr. ____ min.
3.		____hr. ____ min.
4.		____hr. ____ min.
5.		____hr. ____ min.

APPENDIX C

15 Are there any specific foods or beverages you plan to eat or drink **WHILE** you are drinking alcohol-containing beverages?

1 YES (Please list the foods and beverages in the table below)
2 NO (If no, please go to next question)

WHILE DRINKING Food or Beverage Description:	Amount: (ex: 1 cup, 1 Tbsp, etc)
1.	
2.	
3.	
4.	
5.	

16 If a food supplement that prevented possible side effects resulting from alcohol was available in the future, would you choose to use this food supplement?

17 After how many alcohol-containing drinks do you begin to feel light-headed?
(1 drink = 12 oz. beer, or 5 oz. wine, or 1.5 oz. distilled spirits)

_____ DRINKS

18 Please list all of the foods and beverages you have eaten within the last 24 hours on the food recall form on the next page.

Please be sure to list:

- **List everything you ATE and DRANK during the last 24 hours**
- **Include the amount** (i.e. 1 biscuit, 1 cup, 1 Tablespoon, 1 teaspoon, etc.)
- **Describe how food was prepared** (i.e. fried, baked, steamed, etc)
- **Describe ingredients in mixed dishes**, soups, etc. in as much detail as possible
- **List everything added to the food before you ate it** (i.e. butter, salad dressing, etc.)

***Please go to next page for food recall* form ➪**

APPENDIX C

24 HOUR FOOD RECALL FORM

*Please begin by thinking back to 24 hours ago, then list all food & drink you ate up to right now:

APPROX. TIME OF DAY:	FOOD & DRINK DESCRIPTION:	APPROXIMATE AMOUNT: (example: 1 cup, 1 Tbsp, 1 slice bread, etc.)
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		
Time food & drink was eaten: time ___ am ___ pm where ______ with someone? yes ___ no ___		

19. Did the foods you listed above represent the amount you would eat on a **typical day**?

1 YES
2 NO

APPENDIX C

20. Would you please consider answering a few more questions over the telephone regarding your alcohol-containing beverage choices? If so, please leave your name (or you may make up a name), phone number, & campus address on the attached post card so we may contact you.

Please tear off post card & mail the post card through Campus Mail

---

FROM: _____

_____

_____

TO:

Melanie Moyers
Department of Nutrition
College of Human Ecology
Room 229, JHB
1215 W. Cumberland Avenue
CAMPUS MAIL 1900

(BACK OF POST CARD)

Thank you for your time and contribution to this research.

Please address any questions or comments to the following:

Melanie Moyers, graduate student, or
Dileep Sachan, Ph.D.
Department of Nutrition
College of Human Ecology
Rm #229 Jessie Harris Bldg.
1215 W. Cumberland Ave.
Knoxville, TN 37996-1900
(423) 974-5445 or (423) 974-6257

APPENDIX D

IRB COMMITTEE APPROVAL OF THE STUDY PROTOCOL

THE UNIVERSITY OF TENNESSEE
KNOXVILLE

February 26, 1998

Office of Research
404 Andy Holt Tower
Knoxville, Tennessee 37996-0140
PHONE: (423) 974-3466
FAX: (423) 974-2805
URL: http://www.ra.utk.edu/ora

IRB #: 5485- B - revised

Title: Alcohol and Dietary Choices Among Fraternity and Sorority Students

Dr. Dileep S. Sachan
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229 Jessie Harris Building
1215 West Cumberland Ave.
University of Tennessee
Knoxville, TN 37996-2700
CAMPUS

✓Ms. Melanie R. Moyers
Department of Nutrition
229 Jessie Harris Building
1215 West Cumberland Ave.
University of Tennessee
Knoxville, TN 37996-2700
CAMPUS

Your project listed above was approved as revised.

This approval is for a period ending one year from the date of this letter. Please make timely submission of renewal or prompt notification of project termination (see item #3 below).

Responsibilities of the investigator during the conduct of this project include the following:

1. To obtain prior approval from the Committee before instituting any changes in the project.
2. To retain signed consent forms from subjects for at least three years following completion of the project.
3. To submit a Form D to report changes in the project or to report termination at 12-month or less intervals.

The IRB Committee wishes you every success in your research endeavor. This office will send you a renewal notice on the anniversary of your approval date.

Sincerely,

Greg Pompelli
IRB Chair

APPENDIX E

ETHANOL CONTENT OF BEVERAGES

Calculation:

12 oz. beer x 5 cans = 60 oz. beer

Amount of Ethanol in 60 oz. beer:

60 oz. beer x 0.045% ethanol = 2.7 oz ethanol in 5 beer

Calculation:

12 oz can beer = 356 g beer

12 oz can beer = 12.8 g ethanol

356 g beer = 12.8 g ethanol

5 beer x 12.8 g ethanol = 64 g ethanol in 5 beer

APPENDIX F

CALCULATIONS FOR RDA CONVERSION TO AMOUNT PER 1,000 KCAL

Protein. For males aged 19-24, protein intake per 1,000 kcal is equal to 20g protein. (Calculation: Males age 19-24, average kcal allowance =2,900 kcal/day; RDA for protein = 58g)

$$\frac{58g\ Protein}{2,900\ kcal} \times 1,000 = 20g\ Pro/1,000\ kcal\ for\ males$$

For females aged 19-24, protein intake per 1,000 kcal is equal to 21g protein. (Calculation: Females age 19-24, average kcal allowance =2,200 kcal/day; RDA for protein = 46g)

$$\frac{46g\ Protein}{2,200\ kcal} \times 1,000 = 21g\ Pro/1,000\ kcal\ for\ females$$

Fat. For males aged 19-24, fat intake per 1,000 kcal is equal to 33g fat. (Calculation: Males age 19-24, average kcal allowance =2,900 kcal/day; Dietary Guidelines for Americans is 30% fat)

$$\frac{97g\ Fat}{2,900\ kcal} \times 1,000 = 33g\ Fat/1,000\ kcal\ for\ males$$

For females aged 19-24, fat intake per 1,000 kcal is equal to 33g fat. (Calculation: Females age 19-24, average kcal allowance =2,200 kcal/day; Dietary Guidelines for Americans is 30% fat)

$$\frac{73g\ Fat}{2,200\ kcal} \times 1,000 = 33g\ Fat/1,000\ kcal\ for\ females$$

Carbohydrate. For males aged 19-24, carbohydrate intake per 1,000 kcal is equal to 155g carbohydrate. (Calculation: Males age 19-24, average kcal allowance =2,900 kcal/day; Remainder of total dietary intake as carbohydrate = 62%)

$$\frac{450g\ Carbohydrate}{2,900\ kcal} \times 1,000 = 155g\ CHO/1,000\ kcal\ for\ males$$

For females aged 19-24, carbohydrate intake per 1,000 kcal is equal to 155g carbohydrate. (Calculation: Females age 19-24, average kcal allowance =2,200 kcal/day; Remainder of total dietary intake as carbohydrate = 62%)

$$\frac{341g\ Carbohydrate}{2,200\ kcal} \times 1,000 = 155g\ CHO/1,000\ kcal\ for\ females$$

APPENDIX G

CALCULATIONS FOR INDEX OF NUTRITIONAL QUALITY (INQ)

$$\frac{\text{Macronutrient content of food consumed(g)}}{\text{RDA (or suggested allowance)}} = \text{INQ}$$

Females Fat Intake:

Abstainer = $\frac{33.6g}{33.0g} = 1.02$

Non-binge = $\frac{29.4g}{33.0g} = 0.89$

Binge = $\frac{31.1g}{33.0g} = 0.94$

Females Carbohydrate Intake:

Abstainer = $\frac{140.6g}{155.0g} = 0.91$

Non-binge = $\frac{148.8g}{155.0g} = 0.96$

Binge = $\frac{145.7g}{155.0g} = 0.94$

Females Protein Intake:

Abstainer = $\frac{39.0g}{21.0g} = 1.86$

Non-binge = $\frac{40.9g}{21.0g} = 1.95$

Binge = $\frac{38.1g}{21.0g} = 1.81$

Males Fat Intake:

Abstainer = $\frac{38.1g}{33.0g} = 1.15$

Non-binge = $\frac{33.2g}{33.0g} = 1.01$

Binge = $\frac{34.7g}{33.0g} = 1.05$

Males Carbohydrate Intake:

Abstainer = $\frac{133.9g}{155.0g} = 0.86$

Non-binge = $\frac{144.2g}{155.0g} = 0.93$

Binge = $\frac{127.3g}{155.0g} = 0.82$

Males Protein Intake:

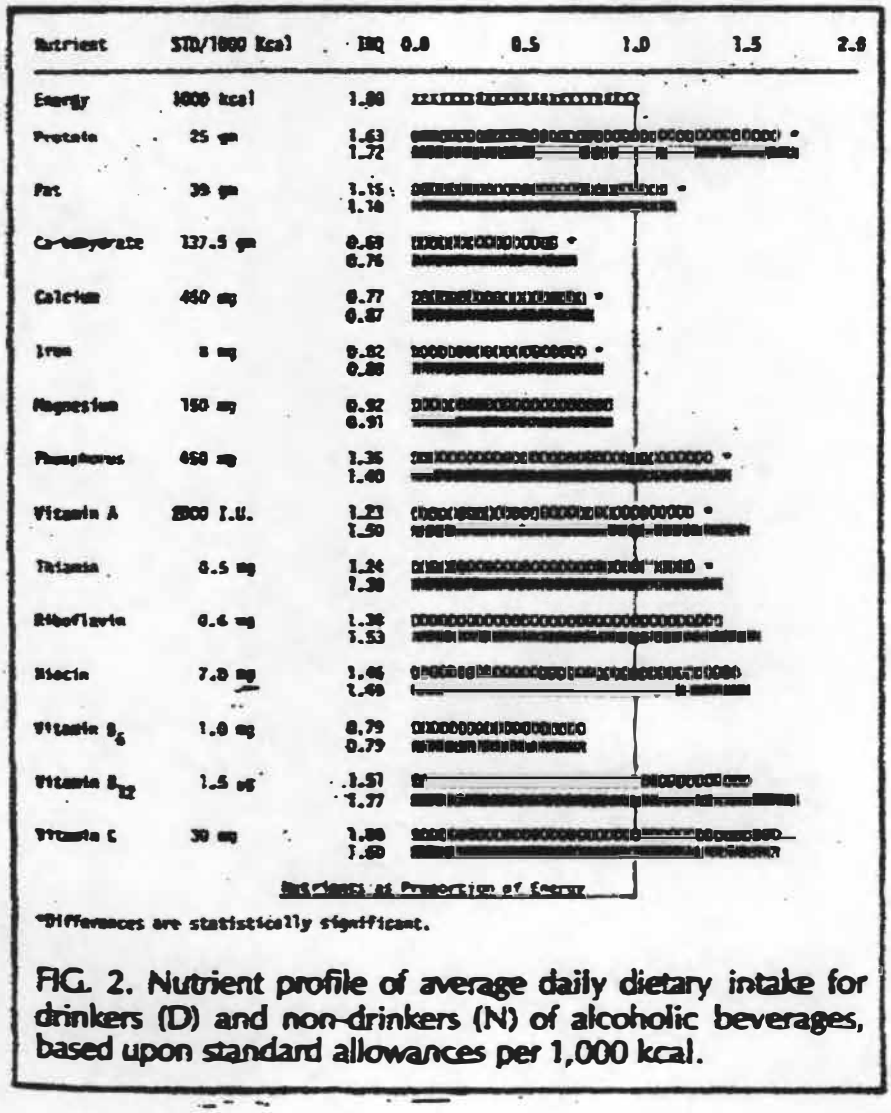
Abstainer = $\frac{34.9g}{20.0g} = 1.75$

Non-binge = $\frac{37.3g}{20.0g} = 1.87$

Binge = $\frac{45.9g}{20.0g} = 2.30$

APPENDIX H

COPY OF WINDHAM REFERENCE



*Differences are statistically significant.

FIG. 2. Nutrient profile of average daily dietary intake for drinkers (D) and non-drinkers (N) of alcoholic beverages, based upon standard allowances per 1,000 kcal.

VITA

Melanie Moyers earned a B.S. degree in Human Ecology with a major in Nutrition and Food Science at the University of Tennessee in Knoxville. In 2000, a dietetic internship accredited by the American Dietetic Association was successfully completed at the University of Tennessee in Knoxville.

Her professional work experiences include Clinical and Outpatient Registered Dietitian at Fort Sanders Regional Medical Center. Prior experiences included Dietetic Technician and Clerk at other medical facilities, and assistance with doctoral projects and laboratory experiments.