2012

Self reported alcohol consumption and its effects on fatigue and hydration status.

David Dziedzicki
Indiana State University

SELF REPORTED ALCOHOL CONSUMPTION AND ITS EFFECT ON FATIGUE AND HYDRATION STATUS

A Thesis

Presented to

The College of Graduate and Professional Studies

Department of Applied Medicine and Rehabilitation

Indiana State University

Terre Haute, Indiana

In Partial Fulfillment

of the Requirements for the Degree

Masters of Science in Athletic Training

---

by

David Dziedzicki

May 2012

Keywords:

Athlete, Alcohol Consumption, Fatigue, Hydration

COMMITTEE MEMBERS

Committee Chair: Lindsey Eberman, Ph.D, LAT, ATC

Undergraduate ATEP Program Director

Department of Applied Medicine and Rehabilitation

Indiana State University

Committee Member: Leamor Kahanov, Ed.D, LAT, ATC

Department Chair

Department of Applied Medicine and Rehabilitation

Indiana State University

Committee Member: Heather Mata MPAS, PA-C

Physician Assistant Studies Program Director

Department of Applied Medicine and Rehabilitation

Indiana State University

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

Introduction

Alcohol consumption has been associated with some decreases in health from liver disease to central nervous system disruptions in the general population, yet an understanding of the effect on athletic performance is lacking.[1] College student athletes are at an increased risk for binge drinking behaviors and alcohol related injuries.[1] The literature has suggested that collegiate student athletes are motivated to drink to relieve stress related to sport participation and furthermore they do not change with increased education.[1] The exact quantities consumed, the perceived impact, and the physiological effects of the alcohol for collegiate athletes remain unclear. There are negative physiological effects associated with alcohol consumption within the average population,[2-9] but for athletes, consumption can decrease performance. Alcohol acts as a diuretic, causing urination and subsequently a decrease in levels of hydration. Injury recovery may slow since alcohol consumption negatively impacts the quality of sleep which is important for the body's ability to heal.[10,11] Sleep can have an effect on levels of fatigue, which in athletes, is detrimental because of the need to recover post competition and practice. Alcohol consumption has negative physiological effects, some of which may be more pronounced in the athletic population.

Research conducted on alcohol consumption and alcohol education has focused on the alcohol type consumed, when consumed, where consumption occurred, and if alcohol education

had any impact on an athlete's decision to consume alcohol. Although the literature is flush with the short term and long term affects of alcohol on the body, little research has focused specifically on the physiological effects of alcohol on athletes and their performance (particularly hydration and fatigue).

Problem Statement

Athletes consume large amounts of alcohol, but because of the delicate nature of self-report and experimental studies, data is incomplete. Further, we do not know the impact of this consumption on levels of hydration and fatigue.

Purpose Statement

The purpose of this study is to determine if self reported alcohol consumption will have a relationship with self reported fatigue and hydration status.

Operational Definitions

Drink: According to the Alcohol Use Disorders Identification Test (AUDIT) a drink is defined as:

1 can beer (330 ml) at 5% x (strength) 0.79 (conversion factor) = 13 grams of ethanol

1 glass wine (140 ml) at 12% x 0.79 = 13.3 grams of ethanol

1 shot spirits (40 ml) at 40% x0.79 = 12.6 grams of ethanol.[12-14]

Athlete: According to the National Collegiate Athletic Association (NCAA), a student athlete is any person who competes in an organized and competitive sport at an educational institution recognized by the NCAA. This includes student athletes at the Division I, II and III levels. This does not include any student who participates in intramural athletics or for a club team sponsored by the institution.

Hydration status: Product of fluid loss and fluid gain. This ratio between fluid loss and gain constitutes a person's hydration status. Hydration is affected by sweat rate, urine output, vomit, diarrhea, and fluid intake. [25]

Dehydration and hypohydration: Dehydration is the process of losing water content in the body. Hypohydration is the state of having decreased levels of water content in the body.[25]

Experimental Hypothesis

The following hypotheses will direct this study:

- A strong, positive relationship exists between self reported alcohol consumption and hydration status, where high AUDUT scores will correlate with high USG values.
- A strong, positive relationship between self reported alcohol consumption and fatigue, where high AUDUT scores will correlate with high fatigue scores.

Assumptions

We assume that the athletes will honestly report their levels of consumption. Although we will protect the confidentiality of the participants and coaches/administrators will not have access to the data, participant honesty is a large, but necessary assumption of the study.

Limitations & Delimitations

The study has both limitations and delimitations. Alcohol consumption among collegiate athletes is a sensitive subject. Research has indicated that athletes do consume alcohol; however a disconnect remains between players and coaches when alcohol is discussed. Ensuring athletes their confidence will not be breached will be an integral part of this study. Self reporting of alcohol consumption is a sensitive subject among collegiate athletes. There is fear of judgment

from sports medicine staff, coaches and players is a concern. The fear an athlete possesses can affect the amount of information they choose to share therefore this is a limitation to this study. Athletes who choose not to participate in consumption activities may be more likely to participate in this study, where as athletes who choose to binge drink may be less likely to participate, another limitation to the study.

This study will occur at Indiana State University, which is a NCAA division I athletic institution, therefore the results of this study cannot be generalized across all levels of NCAA divisions and regions of the United States. A delimitation of this study is the use of a medium size Midwestern public institution that represents a homogenous sample. Requiring athletes to self report alcohol consumption and fatigue are delimitations as well.

Conclusion

Athletes are at an increased risk for binge drinking and alcohol related injuries. High-risk behavior among athletes that is often under-reported or unreported altogether has resulted in largely incomplete data regarding this population. Further, we do not know the physiological impact of alcohol consumption on hydration status and fatigue. This study will contribute to the body of knowledge by identifying the relationships between self-reported alcohol consumption, hydration level, and fatigue.

CHAPTER 2

Review of Literature

A long standing correlation exists between alcohol consumption and college students, specifically collegiate student-athletes.[8] Studying the effects of alcohol on sport participation is a controversial topic, and has been under researched. Athletic trainers (AT) find themselves in a unique position in the sense that they work with their athletes on an everyday basis. This could potentially mean that AT may need to treat an athlete with an injury that was caused by the consumption of alcohol. Injuries can occur for a number of different reasons, particularly central nervous system (CNS) dysfunction resulting in decreased cognitive ability and poor decision making.[7] Alcohol consumption could also lead to decreased performance, and injury on the playing and practice field.[7] The consumption of alcohol has been linked to cardiovascular, thermoregulatory, and neuromuscular deficits.[6] In addition to these affects on the CNS, multiple systems of the body are affected by the consumption of alcohol.

Search Strategy

Searches on the topic were completed in the following databases: PubMed, PubMed Central, CINAHL, and Medline. These key words were used in combination and individually to search the literature; alcohol consumption, hydration status, fatigue, sleep, collegiate athletes, urine specific gravity, hangovers and recovery. Searches provided over 125 articles that fulfilled the key words searched. Of those 125 articles, 95 met the main criteria. We included articles

related to alcohol consumption among college students and college athletes. We also included research about how alcohol affects the body negatively, specifically a decreases in liver function, the central nervous system, and the cardiovascular system. Finally, we included athletes regarding hydration, fatigue, and measurement strategies for our dependent measures.

Liver Function

The liver is negatively impacted by the consumption of alcohol. The liver serves to store glycogen, which is essential to athletic participation. Research has indicated that the presence of low levels of alcohol in the liver impaired the re-synthesis of glycogen.[6] The effects alcohol consumption of muscle glycogen stores in cyclists, and identified a considerable decrease in the amount of stored carbohydrates due to moderate alcohol consumption. Studies have also shown that there is an adverse effect on an athlete's recovery.[7] The liver has a decreased ability to store the glycogen necessary for the athlete to recover properly, up to 50%.[15] Research indicates that consumption of alcohol in small to medium doses may be associated with immunomodulatory effects.[7] Alcohol may also affect the body's ability to fight infection because of altered inflammatory neutrophil, leukocyte, and microphage production.[7] Ultimately, alcohol consumption adversely effects the production of substances by the liver, necessary for cell life causing cells to die, which could play an important role in anti-bacterial immune defense. All of this negatively affects an athlete's ability to perform at high levels. Decreases in glycogen stores lead to decreases in energy stores, ultimately leading to increases fatigue. Altered immune defense places athletes at increased risk for illness which can alter performance.[7]

Central Nervous System

A clear correlation exists between alcohol consumption and neurocognitive function. However, athletes may be unaware of the brain's inability to process glucose metabolism. The

research that decreased brain metabolism was greater in males than in females. This study also showed that alcohol had a greater effect on the behavior of women. They reported significantly higher incidences of intoxication, dizziness, and sleepiness when consuming the same amount of alcohol In a recent study of 600 twenty one year old Scottish subjects, binge drinking significantly increased the possibility of ischemic stroke, and alcohol poisoning.[7] Because alcohol falls into the category of a depressant, it significantly slows the ability of the CNS to process information both in the long and short term.[7] CNS may lead to poor decision making and can lead to serious injury and or death. Football players who habitually consume alcohol increase their chances of sport related injury up to 50%.[3] In addition to these increased sport related injuries, a marked increase in non-related sports injuries due to increased aggression and this poor decision making raises concerns.

Cardiovascular System

Alcohol and its effects on the heart have been studied for many years. However, the results of these studies, positive or negative cannot be translated into the athletic population, specifically the collegiate student-athlete population. Not until recently have these effects on athletes been studied because of the increase in problematic drinking patterns and increase in binge drinking on college campuses.[8] Excessive alcohol use may cause cardiomyopathy and cardiac dysfunction.[7] The chronic consumption of alcohol can have negative effects on heart rhythm, and even single heavy doses of consumption can cause brief cardiac arrhythmias. Moderate to heavy consumption of alcohol is the second greatest risk factor for developing hypertension.

Meditational Influences

Factors related to why athletes engage in these drinking behaviors are multiple.

Literature has shown that athletes and students alike feel that the consumption of alcohol is a social norm, that college is somehow synonymous with consuming alcohol.[6] In addition to these social norms, athletes also tend to use alcohol as an escape or a coping mechanism to deal with the increased perceived stress. Other influences include over-estimation of peer consumption, and whether or not student-athletes live on campus in residence halls, or in off campus housing.[16] Research has also shown that athletes engage in riskier behavior than the average college student and that it could be related to availability of alcohol, peer influence, peer approval, and direct offers from other athletes.[16] Literature suggests that t a large discrepancy exists between which athletes are consuming alcohol, and when alcohol is being consumed. Previous research is suggesting that off season athletes are consuming more alcohol than in season athletes; however the data did not suggest that in season athletes are not consuming alcohol.[17]

The Alcohol Hangover

Veisalgia is the medical term to describe an alcohol hangover.[18-20] The lay term hangover describes the physical feeling a person has after consuming alcohol in large quantities. It is characterized by numerous symptoms including but not limited to: headache, nausea, vomiting, dry mouth, thirst, and inability to focus. A hangover is associated with a decrease cognitive performance, spatial awareness, and occupational performance.[18-20] Recent studies have focused on the cause of hangovers. Previously it had been thought that quantity alone causes hangovers. Other studies have shown that hangovers may also be caused by the type of alcohol consumed. Dark liquors such as whiskey and brandy contain higher quantities of congeners, a by-product of alcohol metabolism.[18-20] While many studies have focused on the consumption of alcohol, literature is still lacking on veisalgia and its exact quantities.

Hydration

Consumption of alcohol has direct negative effects on an athlete's ability to maintain proper hydration levels, and their body's ability to maintain thermoregulatory function, particularly in cold weather. Alcohol acts as a natural diuretic and this negatively affects athlete's ability to maintain an adequate hydration level. An inadequate hydration level will have negative effects on an athlete's athletic performance, and also an athlete's ability to recover after hydration loss has already occurred. Literature states that there can be up to 10 mL of urine output for every gram of alcohol ingested.[6] Research has shown that alcohol that is consumed before playing or practicing at a low temperature can cause an increase in peripheral vasodilatation causing decreased core temperature.[21] Alcohol has been shown to increase peripheral vasodilation and leads to heat loss, and a decrease in core body temperature (CBT) when exercising in cold environments. However, in warm environments, the consumption of alcohol in previous days before exercise also has detrimental effects. Consumption of alcohol leads to dehydration because of its diuretic properties. Exercising in a dehydrated state predisposes athletes to different heat illnesses. Three exertional heat illnesses that ATs encounter most are exercise associate muscle cramps (EAMC), exertional heat exhaustion (EHE), and exertional heat stroke (EHS).[22] EAMCs are characterized by intense, involuntary muscle spasms. The cause of EAMC varies depending on the source, however according the National Athletic Trainers Association (NATA) position statement on exertional heat illnesses the cause of EAMC is multi-factorial, including dehydration, electrolyte imbalance, and muscular fatigue.[22] EHE is characterized by the body's inability to continue to exercise because of fluid imbalance, sodium loss, and energy depletion. Symptoms include dizziness, fainting, nausea or a slightly elevated core body temperature.[22-24] EHS is another heat illness that athletes

predispose themselves to when exercising in a hypohydrated state.[18] While dehydration is not the primary cause of EHS, it is a pre-disposing factor that clinicians need to be aware of. When athletes exercise, they sweat. This increased sweating causes a decrease in plasma volume, and an overall decrease in central blood volume. This causes in increase in HR to maintain cardiac output.[22] This combination of alcohol consumption and arriving at practices in a hypohydrated state could lead to decreases in performance and an increased risk of injury.[25]

Fatigue

Alcohol has been shown to have a negative effect on an athlete's ability to recover during sleep. Alcohol suppresses the rapid eye movement (REM) cycle, which is a necessary portion of sleep.[10] The REM cycle is controlled by nerve centers in the lower brain stem, where it joins with the spinal cord. The nerve cells in that portion of the brain stem produce chemicals that control REM. Sleep is an important part of an athlete's ability to recover. Sleep allows athletes to recover physiologically and psychologically. During competition, athletes push their bodies to extreme limits, breaking down muscle and creating waste products. It is necessary for athletes to actively recover; however it is pivotal that incorporate long term recovery is part of the per iodization plan. This includes adequate sleep. The body uses this downtime to allow for the CNS to recover and for the repair of damaged tissues to occur. Consumption of alcohol can affect the production of these chemicals, and alter REM cycles. REM cycles decrease levels of fatigue after the total sleep cycle has ended. Alcohol can also exacerbate pre-existing sleep disorders such as sleep apnea, periodic limb movement and insomnia. This decrease in sleep can lead to increased levels of fatigue during the day, stress, and depression. Disturbances in sleeping patterns can be long lasting, and can become permanent.[26,27] Sleep disturbances also prevent the body from long-term recovery. Muscles do not repair themselves, cortisol levels

increase, and overall mood changes occur that can have negative impacts on athlete's ability to perform.[25,27]

Conclusion

Consumption of alcohol by collegiate athletes occurs for a multitude of reasons. Consuming alcohol may have negative effects on the body. The liver has a decreased ability to properly use glycogen and an inability to store carbohydrates. The CNS becomes temporarily impaired. Impairment of the CNS leads to a decreased ability to process information and could lead to injury. Consumption of alcohol can lead to altered heart function. One dose of alcohol can cause arrhythmias and cardiomyopathy. Alcohol negatively affects sleep patterns not allowing for proper cycles of REM to occur, and increases levels of fatigue. An overall decrease in hydration level occurs because alcohol's diuretic properties. The sum of all of these effects leads to what is termed veisalgia or the alcohol hangover.

CHAPTER 3

Methods

Research Design

Our study will use a correlational design to identify the relationship between our dependent measures: self-reported alcohol consumption, self-reported fatigue, and hydration status.

Participants

Participants will consist of volunteers from Indiana State University's Division I athletic teams active during the Fall season including: men's football, men's baseball, women's soccer, women's volleyball, and women's softball. We anticipate participation form approximately 200 athletes. Participants will range from 18-26 years old, with no participation from athletes under the age of 18. To recruit these participants, we will solicit athletes during the Pre-Participation Examination administered by Athletic Training Services. We will acquire Institutional Review Board permission prior to soliciting the participation from any athletes.

Instruments

Alcohol Use Disorders Identification Test (AUDIT) Questionnaire

To determine self reported measures of alcohol, we will use the AUDIT questionnaire (Table 1).[28] The AUDIT questionnaire assesses recent and past instances of consumption. The AUDIT explains the concept of what a "drink" constitutes, how much alcohol was consumed in recent history, and what types of alcohol are consumed. The questionnaire contains questions

about previous injuries while consuming alcohol, and what motivates consumption.[13,29] The AUDIT places respondents into zones based on their answers (Figure 2). The zones describe the risk level of that particular respondent, the intervention necessary based on their AUDIT score. Although not intended to determine consumption, the investigators that developed the AUDIT describe using the AUDIT as a consumption questionnaire. The questions encompass all aspects that pertain to alcohol consumption.

Clinical Refractometer

To measure the hydration status of each urine sample we will use a clinical refractometer. Clinical refractometer have been identified as valid and reliable measurements of hydration levels.[30] Clinical refractometers measure a ratio of water to urine by establishing the amount of urine. Urine quantity is determined by calculating the amount of urine particles for every unit of urine. Different ranges determine hydration level. This study will use a range pre-determined in the literature (Table 1).[30] To analyze urine, we will place 1-2 drops of urine on the cover plate and view the sample through the lens. We will clean and calibrate the refractometer after each use to prevent cross contamination of samples.

Fatigue Questionnaire

A visual analog scale will be used to measure fatigue severity (VAS-F). The scale consists of eighteen questions assessing a variety of aspects of fatigue (Figure 3). The scale is both valid and reliable.[31]

Procedures

We can acquire our necessary baseline data from the Indiana State University Athletic Training Services. Athletic Training Services incorporates a hydration station in their pre-participation (PPE) and this data can provide the baseline hydration status for all potential

participants. At the beginning of the academic year, we will meet with all competing teams to invite individuals to participate. We will explain the objectives and expectations, ensure confidentiality, and ask that participants sign an informed consent and waiver to acquire baseline data approved by the Institutional Review Board. Once athletes have chosen to participate, we will provide a list to the head Athletic Trainer to gather the baseline hydration data. At the familiarization meeting, we will consult with teams to identify the weekend data collection session that best suits the teams; social, athletic, and academic commitments. We will also obtain baseline fatigue measurements on each athlete that chooses to participate, at the familiarization session. We will remind the teams about data collection weekends on the Friday prior.

During data collection weekends, we will meet teams at their Sunday morning check-in with Athletic training Services and at the following Wednesday practice (normal team activities). Participants will complete the AUDIT questionnaire, the VAS-F questionnaire, and provide a urine sample at each session. We will code each sample and questionnaire so that we can correlate the data.

Statistical Analysis

Each instrument used in this study produces a different variable score, some of which are ordinal, others of which are continuous. The use of ordinal data and the non-random sample violate the assumptions of parametric statistics and therefore will force us to use non-parametric correlational statistics. We intend to use the Spearman rho correlation statistic to describe the relationship between the dependent measures, specifically examining the correlations between the AUDIT questionnaire and levels of hydration, and the AUDIT questionnaire and the VAS-F.

CHAPTER 4

Manuscript

College student athletes are at an increased risk for binge drinking behaviors and alcohol related injuries.[1] The literature has suggested that collegiate student athletes are motivated to drink to relieve stress related to sport participation and furthermore they do not change these behaviors with increased education.[1] The exact quantities consumed, the perceived impact, and the physiological effects of the alcohol for collegiate athletes remain unclear. There are negative physiological effects from alcohol consumption within the average population,[2-9] but for athletes, consumption can decrease performance. Alcohol acts as a diuretic, causing urination and College student athletes are at an increased risk for binge drinking behaviors and alcohol related injuries.[1] The literature has suggested that collegiate student athletes are motivated to drink to relieve stress related to sport participation and furthermore they do not change these behaviors with increased education.[1] The exact quantities consumed, the perceived impact, and the physiological effects of the alcohol for collegiate athletes remain unclear. There are negative physiological effects from alcohol consumption within the average population,[2-9] but for athletes, consumption can decrease performance. Alcohol acts as a diuretic, causing urination and subsequently a decrease in levels of hydration. Sleep is an important process in the body's ability to recover, and consumption of alcohol negatively impacts the quality of sleep.[10,11] This

disturbance in sleep can have an effect on levels of fatigue; in athletes, this is detrimental because of the need to recover post competition and practice. Research conducted on alcohol consumption and alcohol education has focused on the alcohol type consumed, when consumed, where consumption occurred, and if alcohol education had any impact on an athlete's decision to consume alcohol.[17] Although the literature is flush with the short term and long term affects of alcohol on the body, little research has focused specifically on the physiological effects of alcohol on athletes and their performance (particularly hydration and fatigue). Therefore, we investigated the relationship between self-reported alcohol consumption with self-reported fatigue and hydration status.

Methods

Design

We used a correlational design to identify the relationship between dependent measures: self-reported alcohol consumption, self-reported fatigue, and hydration status.

Participants

We acquired IRB approval to evaluate 5 Division I athletic teams at a mid-size Mid-western institution (ages of 18-26; football=15, baseball=25, softball=11, soccer=25, volleyball=15; men=40, women=51). Participant's age range was from 18-26 years old, with no participation from athletes under the age of 18. We recruited participants from each team during pre-season meetings and pre-participation physicals.

Instruments

AUDIT Questionnaire

To determine self reported measures of alcohol, we used the AUDIT questionnaire (Figure 1).[28] The AUDIT questionnaire is used to assess recent and past instances of

consumption. The AUDIT articulates how a "drink" is defined and then determines how much and what type of alcohol was consumed in recent history. The questionnaire contains questions about previous injuries while consuming alcohol, and what motivates consumption.[13,29] Upon analysis, the AUDIT allowed us to classify respondents into zones based on their answers (Figure 2). The zones describe the risk level and suggested intervention for each respondent. Although not particularly intended to measure repeated bouts of consumption, the AUDIT is the best consumption questionnaire available to use without creating an entirely new tool. One such study utilizing the AUDIT as a consumption questionnaire obtained a Spearman correlation coefficient of 0.88 as compared to using the AUDIT for its original purpose identifying alcohol consumption disorders.[32]

Clinical Refractometer

To measure the hydration status of each urine sample, we used a clinical refractometer. Clinical refractometers have been identified as valid and reliable measurements of hydration levels.[30] Clinical refractometers measure a ratio of water to urine by establishing the quantity of urine particles for every unit of urine. To analyze urine, we placed 1-2 drops of urine on the cover plate and view the sample through the lens. We cleaned and calibrated the refractometer after each use to prevent cross contamination of samples. We used a range pre-determined in the literature to classify hydration status (Table 1).[30]

Fatigue Questionnaire

We used a visual analog scale will be used to measure fatigue severity (VAS-F). The scale consists of eighteen questions assessing a variety of aspects of fatigue (Figure 3). The scale is both valid and reliable (Cronbach's α=.94, Pearson's correlation range=0.36-0.81 for Stanford Sleepiness Scale).[31]

Procedures

At the beginning of the academic year, we met with all competing teams to invite individuals to participate. We explained the objectives and expectations, ensure confidentiality, and asked that participants sign an informed consent and waiver to acquire baseline data approved by the Institutional Review Board. The Athletic Training staff at this institution incorporates a hydration station in their pre-participation (PPE). Once athletes chose to participate, we provided a list to the head Athletic Trainer to gather the baseline hydration data. We collected data on three additional occasions: baseline/familiarization, day one after a "free night" of no team requirements and two days following. At the familiarization session, we obtained baseline fatigue measurements for each athlete that chose to participate. We consulted with teams to identify the weekend data collection session that best suited the team schedule and the athletes' social, athletic, and academic commitments. On the Friday prior to the second and third data collection sessions, we reminded the teams about data collection via the Athletic Trainer assigned to the team (team announcement to protect confidentiality).

During data collection weekends, we met teams at their Sunday morning check-in with Athletic Training Services and at the following Wednesday practice (normal team activities). Participants completed the AUDIT questionnaire, the VAS-F questionnaire, and provided a urine sample at each session. We used a number coding system for each sample and questionnaire to protect the confidentiality of the data and to so that we can correlate the data.

Statistical Analysis

Each instrument used in this study produced a different variable score, some of which are ordinal, others of which are continuous. The use of ordinal data and the non-random sample violate the assumptions of parametric statistics and therefore led us to use non-parametric

correlational statistics. We used the Spearman rho correlation statistic to describe the relationship between the dependent measures, specifically examining the correlations between the AUDIT questionnaire and levels of hydration, and the AUDIT questionnaire and the VAS-F.

Results

We identified no significant or strong relationships between our dependent variables (Spearman's rho correlation range=0.003-0.079, p range=0.192-0.973). We identified significant differences in hydration status over time ($F_{2,269}$=5.226, p=0.006, η^2=0.037) with significant differences between baseline hydration status (1.017±0.001) and follow-up day 1 (1.021±0.001) as well as follow-up day 3 (1.020±0.001) figure 2. We also identified a significant difference between sports on AUDIT score ($F_{4,86}$=4.279, p=0.003 η^2=0.166) with significant differences between this highest risk athletes from softball (9.73±1.22) and the lower risk athletes in soccer (4.36±0.81) and baseball (4.36±0.81) figure 3.

Discussion

We identified one team with a higher risk level according to the AUDIT questionnaire as compared to all other sports. The highest risk athletes from softball (9.73±1.22) and the lower risk athletes in soccer (4.36±0.81) and baseball (4.36±0.81). The self-report data comes with its own unique challenges both in interpreting the initial data, and determining which responses are truthful and which responses are not. Many athletes openly expressed feelings of anxiety when answering questions both on the AUDIT and VAS-f, which may have altered their responses.. . Many athletes felt it was a way for the athletic department to determine which underage athletes were consuming alcohol. We followed very specific recruiting procedures and explained that we as the researchers would not disclose any information obtained through this study, and that privacy of participants was the investigators' primary responsibility. As such, we consider these

findings preliminary and with limitations.[33,34]

Veisalgia is the medical term used to describe the alcohol hangover. Research has investigated the signs and symptoms of veisalgia severity.[35] The purpose of our study was to investigate the severity of dehydration and fatigue associated with veisalgia. Recent literature on veisalgia simply attempted to determine quantities of alcohol consumed and severity of veisalgia. A longitudinal study does not exist to evaluate the acute or repeated effects of multiple hangovers on the body as it relates to chronic dehydration or decrements in athletic performance due to increased fatigue. Literature suggests that dehydration is a byproduct of consuming alcohol because of alcohol's diuretic properties.[5,16] While this is true, we feel that the effects of dehydration may also cause many of the other symptoms of the alcohol hangover such as headache and fatigue. We identified that these athletes will remain dehydrated 72 hours post consumption. We know from literature that hydration plays a crucial role in how athletes perform. Athletes that practice and play in a hypohydrated state cannot perform at optimal level.[7] Athletes need to be aware of how consumption of alcohol will significantly decrease their ability to perform. Alcohol education for the athletic population needs address specific performance decrements that will occur for each athlete individually. We feel that demands for athletes vary not only among various sports, but also by position for each sport. Currently the literature focuses on the general student population most literature does not address the specific needs of athletes, and we know from the literature that athletes perceive themselves to be under more stress and are more likely to search for ways to relieve this stress.[17, 5]

We identified significantly increased hypohydration post alcohol consumption among our participants. We identified significant decreases in dehydration within 12-18 hours of consumption and 72 hours post consumption. Recent literature has shown that athletes are

reporting to pre-season physicals in a hypohydrated state.[36] Research indicates that athletes are continually playing and competing in a chronically dehydrated state, which likely has negative effects on performance.[24, 25] After consuming alcohol in excessive quantities the body is forced into hypohydration.[6] This hypohydration leaves the body in need of water to maintain its basic functions.[6] Water is shunted to the organs of the body so that they can continue to function. After consuming excessive amounts of alcohol there is not enough water in the body for the organs to continue functioning normally. In particular, a veisalgia related headache is caused by a loss of water in the brain.[33] This loss of water in the brain leads to a decrease in the size of the brain and it no longer fills the space in the skull, causing the brain at rest to deviate from its normal positioning, causing a headache.[37] Continually exerting the body in a hypohydrated state can also cause other physiological changes including desensitization to water deprivation and decreases in levels of thirst.[38] There is no literature to directly correlate consumption of alcohol to chronic dehydration and this topic should be considered for future research.

Frequent urination causes potassium and sodium decreases. Decreases in potassium and sodium effect nerve and muscle function.[39] The decrease in nerve function is felt primarily in the central nervous system. This may lead directly to decreased cognitive performance, spatial awareness and occupational performance.[7] For athletes this means decreased levels of performance on the playing fields, but more importantly and more frequently the practice field.[6] According to injury rate literature the majority of time loss injuries occur at practice rather than during competition.[40] Subsequently, athletes competing with veisalgia may be more susceptible to injury due to body water losses and the associated physiological changes.

Feelings of fatigue result from a lack of Rapid Eye Movement (REM) sleep.[10] The REM cycle is controlled by nerve centers in the lower brain stem, where it joins with the spinal cord.[10]

The nerve cells in that portion of the brain stem produce chemicals that control REM. When alcohol is consumed in excessive quantities it suppresses the chemicals that control REM sleep. REM sleep is an important part of an athlete's ability to recover. Sleep allows athletes to recover physiologically and psychologically. Although we were not able to identify strong correlations between the AUDIT and the VAS-f, research has shown that alcohol negatively affects the REM cycle.[10] The REM cycle is needed for the human body to recover from physical activity. We suspect that a correlation was not identified in our study because athletes did not honestly report their levels of fatigue. Test fatigue, the process of fatiguing while completing multiple tests may also be a factor in our study. Asking athletes numerous times about their fatigue may have lead to boredom and confusion. Athletes did not fully understand that it was normal for the analog scale to ask about fatigue using different terminology. Physiological fatigue plays a significant role in an athlete's ability to perform. Research shows that when the human body performs physical activity in a fatigued state, the minds ability to process information is slowed.[7] An athlete's ability to process information and execute plays on the field are crucial to their success. A slowed central nervous system will not allow them to execute to the best of their abilities.[7]

Limitations

Self report data and testing fatigue likely affected the findings in this investigation. In addition, a small, homogeneous sample size allows us only to generalize our findings to this institution. Other literature that used self-report data expressed similar issues and concerns, however that is the nature of using this type of data and studying anything pertaining to alcohol. It is well versed in the literature that women are more likely to answer honestly when asked to answer self reported data.[41,42] Previous Studies have focused on sexual behavior, academic dishonesty, and also ability to trust.[41,42]

Consuming alcohol is a factor that may affect the hydration status of an athlete. There are several factors that we did not account for. Amount of water consumed, type and amount of food, amount of exercise both in and out of practice, and injury status were not taken into account. Other factors that affect hydration are the amount of fluids consumed pre competition and practice.[43] Ambient temperatures also play a significant role in the hydration level of an athlete.[43] Cold and warm climates affect hydration levels and can predispose athletes to water content losses. [43,44]

Conclusions

Our study found that athletes report to pre-participation examinations in a hypohydrated state, while likely remaining in this state of hypohydration throughout their competition season, particularly after alcohol consumption. Of the five sports that participated, the women's sports report significantly higher mean AUDIT scores, yet the literature suggests men consume large volumes and more frequently than women. Women tend to self-report data more honestly than males. In our study, this led to an appeared increase in consumption as compared to males. This increase in consumption is more likely a result of males not answering honestly. Future research needs to focus on the result of the athletic contest. Up to date, no research has been conducted on how both winning and losing effects the amount of alcohol an athlete will choose to consume or not consume. It is our feeling that losing athletic contests could lead athletes to consume more alcohol than winning athletic contests. Future research relating to sport performance needs to be completed to determine how consumption of alcohol will effect sport performance 72 hours post consumption. To our knowledge no study exists that has examined the relationship between sport performance post consumption. In addition to analyzing how sport performance is affected, improving the educational tools that we use for our athletes needs to be addressed. Currently,

athletes are instructed that alcohol is bad and that they should avoid it so they can improve their performance. More emphasis needs to be placed on the sport specific portions of their sport such as decreases in eye hand coordination can alter an athlete's ability swing and make clean contact with a ball due to alterations of their brain. A clinician's ability to make connections for the athlete specifically speaking towards performance implications will allow athletes the ability to make better decisions on consuming alcohol. Future research using self report data should also consider developing and validating an alcohol consumption questionnaire and fatigue questionnaire. Although both tools used in the study were proven to be valid and reliable tools for the subject matter, refining the tools specifically for our purposes may have been beneficial.

REFERENCES

1. Nelson TF, Wechsler H. Alcohol and College Athletes. *Medicine & Science in Sports & Exercise.* 2001;33(1):43-47.
2. Toben F. Nelson HW. Alcohol and college athletes. *Medicine & Science in Sports & Exercise* 2001;33(1):43-47.
3. Obrien C.P. LF. Alcohol and the Athlete. *Sports Medicine.* 2000;29(5):295-300.
4. Weatherwax-fall D. Alcohol Consumption and its Effects on Performace. *American Swimming.* 2008;2008(4):22-24.
5. David A. Yusko P, Jennifer F. Buckman, PhD, Helene R. White, PhD, and Robert J. Pandina, PhD. Alcohol, Tobacco, Illicit Drugs, and Performance Enhancers: A Comparison of Use by College Student Athletes and Nonathletes. *Journal of American College Health.* 2008;57(3):281-290.
6. Susan M. Shirrefs RJM. The Effect of Alcohol on Athletic Performance. 2006;5(4):192-196.
7. Mahmoud S. El-Sayed NA, Zeinab El-Sayed Ali. Interaction Between Alcohol and Exercise: Physiological and Haematological Implications. *Sports Medicine.* 2005;35(3):257-269.
8. David A. Yusko JFB, Helene R. Whitea, Robert J. Pandina. Risk for excessive alcohol use and drinking-related problems in college student athletes. *Addict Behavior.* 2008;33(12):1546-1556.
9. Kim JH, Chan KWC, Chow JKW, et al. University Binge Drinking Patterns and Changes in Patterns of Alcohol Consumption Amoung Chinese Undergraduates in a Hong Kong University. *Journal of American College Health.* 2009;58(3).
10. Rundell OH. Alcohol and Sleep in Young Adults. *Psycho-Pharmacology.*26(3):201-218.
11. Lands WE. A Review of Alcohol Clearance in Humans. *Alcohol.* 1997;15(2):147-160.
12. Monteiro TFBJCH-BJBSMG. AUDIT. *The Alcohol Use Disorders Identification Test Guidelines for Use in Primary Care*. Second Edition ed: World Health Organization; 2001.
13. Affairs AGDoV. Alcohol Screen (AUDIT).
14. Danielle Frank AFD, Robert J. Volk, Emily C. Williams, Daniel R. Kivlahan, Katharine A. Bradley. Effectiveness of the AUDIT-C as a Screening Test for Alcohol Misuse in Three Race/Ethnic Groups. *JGIM.* 2008:78`-787.
15. Maher JJ. Exploring Alcohol's Effects on Liver Function. *Alcohol Health and Research World.* 1997;21(1):5-12.
16. Rob Turrisi NRM, Kimberly A. Mallett, Mary E. Larimer, Jason R. Kilmer. Examination of the Mediational Influences of Peer Norms, Environmental Influences, and Parent Communications on Heavy Drinking in Athletes and Nonathletes. *Psychology of Addict Behavior.* 2007;21(4):453-461.
17. Martin M. The use of alcohol among NCAA Division I female college basketball, softball, and volleyball athletes. *Journal of Athletic Training.* 1998;33(2):163-167.
18. Wiese JG, Shlipak MG, Browner WS. The Alcohol hangover. *The Annals of Internal Medicine.* 2000;132(11):897-902.
19. Pittler MH, Verster JC, Ernst E. Interventions for Preventing or Treating Alcohol

Hangover: Systematic Review of Randomised Controlled Trials. *British Medical Journal.* 2005;351(7531):1515-1517.
20. Swift R, Davidson D. Alcohol Hangover Mechanisms and Mediators. *Alcohol Health and Research World.* 1998;22(1):54-60.
21. Giesbrecht GG. Emergency Treatment of Hypothermia. *Emergency Medicine.* 2001(13):9-16.
22. Helen M. Binkley JB, Douglas J. Casa, Douglas M. Kleiner, Paul E. Plummer. National Athletic Trainers Association Position Statement: Exertional Heat Illnesses. *Journal of Athletic Training.* 2002;27(3):329-343.
23. Casa DJ. Exercise in the Heat. II. Critical Concepts in Rehydration, Exertional Heat Illnesses, and Maximizing Athletic Performance. *J Athl Train.* Jul 1999;34(3):253-262.
24. Casa DJ. Exercise in the heat. I. Fundamentals of thermal physiology, performance implications, and dehydration. *J Athl Train.* Jul 1999;34(3):246-252.
25. Casa DJ, Stearns RL, Lopez RM, et al. Influence of hydration on physiological function and performance during trail running in the heat. *J Athl Train.* Mar-Apr 2010;45(2):147-156.
26. Atkinson G, Buckley P, Edwards B, Reily T, Waterhouse J. Are There Hangover Effects on Physical Performance When Melatonin is Ingested by Athletes Before Nocturnal Sleep *International Journal of Sports Medicine.* 2001;22(3):232-234.
27. Baekeland F, Lasky R. Exercise and Sleep Patterns in College Athletes. *Perceptual and Motor Skills.* 1996;23(3):1203-1207.
28. Rob Turrissi Mel, Kimberly A. Mallett, Jason R. Kilmer, Anne E. Ray, Nadine R. Mastreoleo, Irene Markman Geisner, Joel Grossbard, Sean Tollison, TY W. Lostutter, Heidi Montoya. A Randomized Clinical Trial Evaluating a Combined Alcohol Intervention for High-Risk College Students. *JOURNAL OF STUDIES ON ALCOHOL AND DRUGS.* 2009;70:555-567.
29. Kelly S. DeMartini KBC. Correlates of AUDT Risk Status for Male and Female College Students. *Journal of American College Health.* 2009;58(3):233-239.
30. Dawn M. Minton LEE. Best practice for clinical hydration measurement. *Athletic Therapy Today.* 2009 14(1):9-11.
31. Lee KA, Hicks G, Nino-Murcia G. Validity and Reliability of a Scale to Assess Fatigue. *Physchiatry Research.* 1990;36:291-298.
32. Daeppen J-B, Yersin B, Landry U, Pecoud A, Decrey H. Reliability and Validity fo the Alcohol Use Disorders Identification Test (AUDIT) Imedded Within a General Health Risk Screening Questionnaire: Results of a Survey in 332 Primary Care Patients. *Alcoholism: Clinical and Experimental Research.* 2000;24(5):659-665.
33. Boca FKD, Darkes J. The Validity of self-reports of alcohol consumption: state of the science and challenges for research. *Addiction.* 2003;98(2):1-12.
34. Midanik L. The Validitiy of Self-Reported Alcohol Consumption and Alcohol Problems: A Literature Review. *British Journal of Addiction.* 2006;77(4):357-382.
35. Wiese JG, Shlipak MG, Browner WS. The Alcohol Hangover. *Annals of Internal Medicine.* 2000;132(11):897-902.
36. Eberman LE, Yeargin SW, Falconer S, Vaal T. Brief, One Time Educational Interventino Following PPE Does Not Improve Hydration Status Prior to First Practice. *Medicine and Science in Sports and Exercise.* 2010;42(5):641-642.
37. Klemm WR, Foster DM. Alcohol, in a single pharmacological does, decreases brain

gangliosides. *Life Sciences.* 1986;39(10):897-902.

38. Shirreffs SM, Maughan RJ. Restoration of fluid balance after exercise induced dehydration: effects of alcohol consumption. *Journal of Applied Physiology.* 1996;83(4):1152-1158.
39. Rubini ME, Kleeman CR, Lamdin E. Studies on Alcohol Diuresis. I. The Effect of Ethyl Alcohol Ingestion on Water, Electrolyte an Acid-Base Metabolism. *Journal of Clinical Investigation.* 1955;34(3).
40. Hootman JM, Dick R, Agel J. Epidemiology of Collegiate Injuries for 15 Sports: Summary and Recommendations for Injury Prevention Initiatives. *Journal of Athletic Training.* 2007;42(2):311-319.
41. Alexander CS, Somerfield MR, Ensminger ME, Johnson KE, Kim YJ. Consistency of adolescents' self-report of sexual behavior in a logitudinal study. *Journal of Youth and Adolescence.* 1993;22(5):455-471.
42. Brener ND, Billy JOG, Grady WR. Assesment of factors affecting the validity of self-reported health risk behaviors among adolescents: evidcence from the scientific literature. *Journal of Adolescent Health.* 2003;33(6):436-457.
43. Casa DJ, Armstrong LE, Hillman SK, et al. National Athletic Trainers Association Position Statement: Fluid Replacement for Athletes. *Journal of Athletic Training.* 2000;35(2):212-224.
44. Maughan RJ, Shirreffs SM, Leiper JB. Factors influencing the restoration of fluid and electrolyte balance after exercise in the heat. *British Journal of Sports Medicine.* 1997;31(1):175-182.

Table 1. AUDIT Questionnaire

The Alcohol Use Disorders Identification Test: Self-Report Version

PATIENT: because alcohol use can affect your health and can interfere with certain medications and treatments. It is important that we ask some questions about your use of alcohol. Your answers will remain confidential so please be honest.
Place an x in the box that best describes your answer to each question.

Questions	0	1	2	3	4	Score
How often do you have a drink containing alcohol?	Never	Monthly or less	2-4 times a month	2-3 times a week	4 or more times a week	
How many drinks containing acohol do you have on a typical day when you are drinking?	1 or 2	3 or 4	5 or 6	7 to 9	10 or more	
How often do you have six or more drinks on one occasion?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you found that you were not able to stop drinking once you had started?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you failed to do what was normally expected of you because of drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you had a feeling of guilt or remorse after drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
How often during the last year have you been unable to remember what happened the night before because of your drinking?	Never	Less than monthly	Monthly	Weekly	Daily or almost daily	
Have you or someone else been injured because of your drinking?	No		Yes, but not in the last year		Yes, during the last year	
Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?	No		Yes, but not in the last year		Yes, during the last year	
					Total	

Table 2. AUDIT Scoring Criteria

Risk Level	**Intervention**	**AUDIT Score**
Zone I	Alcohol Education	0-7
Zone II	Simple Advice	8-15
Zone III	Simple Advice + Brief Counseling and Continued Monitoring	16-19
Zone IV	Referral to Specialist for Diagnostic Evaluation and Treatment	20-40

Table 3. Urine Specific Gravity Classification

USG Measurement	Level of Hydration
1.001-1.0130	Sufficiently Hydrated
1.0110-1.020	Mild Dehydration
1.0201>1.030	Severe Dehydration

Any measurement between 1.002 and 1.010µG will be considered hydrated, any value between 1.010 to 1.020µG will be considered mild dehydration, and any measurement above 1.030 µG will be considered severely dehydrated.

Figure 1. Visual Analogue Scale for Fatigue

Time_____ a.m. _____p.m. ID#_____
Date_____
I am trying to find out about your level of energy before and after your night of sleep. There are 18 items I would like you to respond to. This should only take about 1 minute of your time. Thank you.
Directions: You are asked to place an "X" through these lines to indicate how you are feeling RIGHT NOW. For example, suppose you have not eaten since yesterday. Where would you put the "X" on the line below?

Not Hungry at all x Extremely Hungry
_____

This is where I put it.

Not Sleepy at all Extremely Sleepy
_____

Not Drowsy at all Extremely Drowsy
_____

Not Fatigued at all Extremely Fatigued
_____

Not Worn out at all Extremely Worn Out
_____

Not Energetic at all Extremely Energetic
_____

Not Active at all Extremely Active
_____

Not Vigorous at all Extremely Vigorous
_____

Not Efficient at all Extremely Efficient
_____

Not Lively at all Extremely Lively
_____

Not Bushed at all Extremely Bushed

Not Exhausted at all Extremely Exhausted

Keeping my eyes open is no effort Takes extreme effort

Moving body is no effort Moving body is tremendous chore

Concentrating is no effort Concentrating is a tremendous chore

Conversing takes extreme effort Conversing is a tremendous chore

I do not want to close my eyes I want to close my eyes

I do not want to lie down I want to lie down

*Items 1-5 and 11-18 belong to the fatigue subscale. Items 6-10 belong to the energy subscale. With actual use the horizontal lines should be exactly 100mm.

Figure 2. Baseline Mean Audit Score

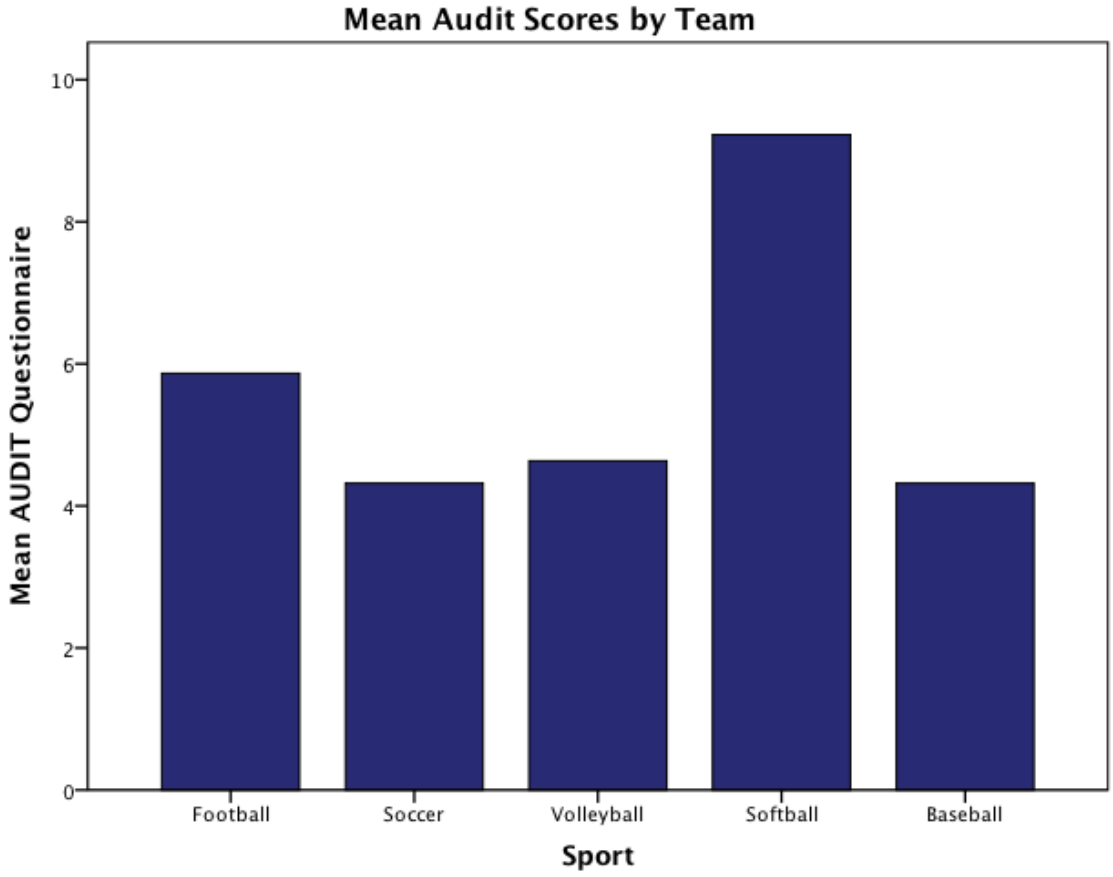
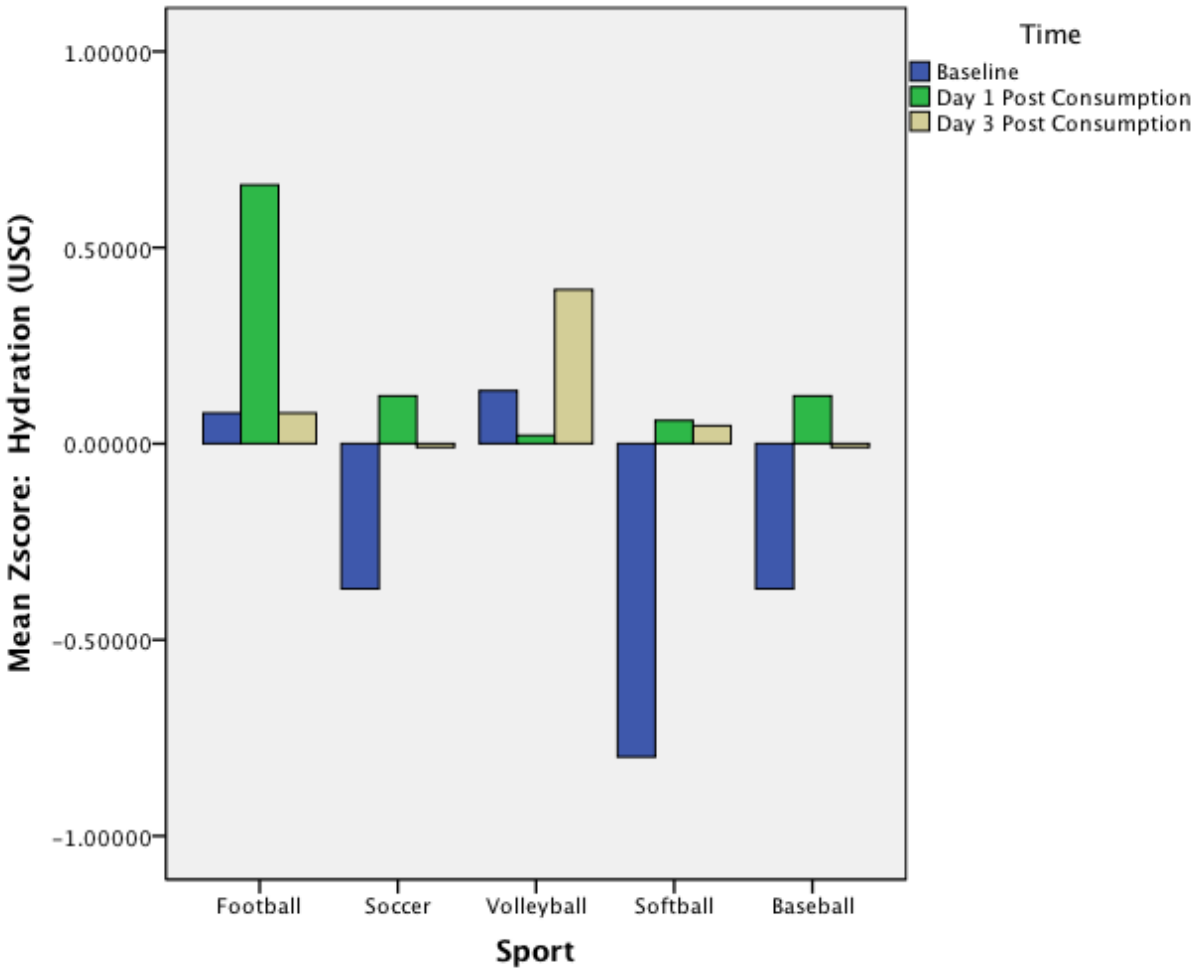


Figure 3. Hydration over 3 time points



APPENDIX A: Study Parameters

Operational Definitions

To determine how much alcohol athletes are consuming, it is first necessary to determine what constitutes a single drink. According to the Alcohol Use Disorders Identification Test (AUDIT) a drink is defined as:

1 can beer (330 ml) at 5% x (strength) 0.79 (conversion factor) = 13 grams of ethanol

1 glass wine (140 ml) at 12% x 0.79 = 13.3 grams of ethanol

1 shot spirits (40 ml) at 40% x0.79 = 12.6 grams of ethanol.

Assumptions

We assume that the athletes will honestly report their levels of consumption. Although we will protect the confidentiality of the participants and coaches/administrators will not have access to the data, participant honesty is a large, but necessary assumption of the study.

Limitations & Delimitations

The study has both limitations and delimitations. Alcohol consumption among collegiate athletes is a sensitive subject. Research has indicated that athletes do consume alcohol; however a disconnect remains between players and coaches when alcohol is discussed. Ensuring athletes their confidence will not be breached will be an integral part of this study. Self-reporting of alcohol consumption is a sensitive subject among collegiate athletes. There is fear of judgment from sports medicine staff, coaches and players is a concern. The fear an athlete possesses can affect the amount of information they choose to share, therefore this is a limitation to this study. This study will occur at Indiana State University, which is a NCAA division I athletic institution, therefore the results of this study cannot be generalized across all levels of NCAA divisions and

regions of the United States. A delimitation of this study is the use of a medium size Midwestern public institution that represents a homogenous sample. Requiring athletes to self-report alcohol consumption and fatigue are delimitations as well.

APPENDIX B: Relevant Study Forms

Indiana State University
More. From day one.

Institutional Review Board

Terre Haute, Indiana 47809
812-237-3092
Fax 812-237-3092

DATE:	June 9, 2011
TO:	David Dziedzicki
FROM:	Indiana State University Institutional Review Board
STUDY TITLE:	[237350-3] SELF REPORTED ALCOHOL CONSUMPTION AND ITS EFFECT ON FATIGUE AND HYDRATION STATUS
IRB REFERENCE #:	11-127
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
APPROVAL DATE:	June 9, 2011
EXPIRATION DATE:	May 18, 2012
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category #3, #7

Thank you for your submission of Amendment/Modification materials for this research study. The Indiana State University Institutional Review Board has APPROVED your submission. The approval for this study expires on May 18, 2012.

Prior to the approval expiration date, if you plan to continue this study you will need to submit a continuation request (Form E) for review and approval by the IRB. Additionally, once you complete your study, you will need to submit the Completion of Activities report (Form G).

This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Informed Consent: Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant.

Reporting of Problems: All SERIOUS and UNEXPECTED adverse events must be reported. Any problems involving risk to subjects or others, injury or other adverse effects experienced by subjects, and incidents of noncompliance must be reported to the IRB Chairperson or Vice Chairperson via phone or e-mail immediately. Additionally, you must submit Form F electronically to the IRB through IRBNet within 5 working days after first awareness of the problem.

Please note that any revision to previously approved materials must be approved by the IRB prior to initiation. Please use the appropriate revision forms for this procedure.

Modifications: Any modifications to this proposed study or to the informed consent form will need to be submitted using Form D for review and approval by the IRB prior to implementation.

CONSENT TO PARTICIPATE IN RESEARCH

Self Reported Alcohol Consumption and its Effect on Fatigue and Hydration Status

You are asked to participate in a research study conducted by David Dziedzicki and Dr. Lindsey Eberman, from the Department of Applied Medicine and Rehabilitation at Indiana State University. This study will help David Dziedzicki complete his requirements in his graduate coursework. Your participation will help Athletic Trainers and other health care providers understand the effect of alcohol on your fatigue and hydration status after consumption. Your participation in this study is voluntary. Please read the information below and ask questions about anything you do not understand, before deciding whether or not to participate. You have been asked to participate in this study because you are of an appropriate age and meet the criteria to be included among 400 participants in this study. To be included, you must be male or female, between the ages of 18 and 26, and participate in collegiate athletics at Indiana State University.

PURPOSE OF THE STUDY

The purpose of this study is to determine if self reported alcohol consumption will have a relationship with self reported fatigue and hydration status.

PROCEDURES

If you volunteer to participate in this study, you will be asked to do the following

- Attend your fall meeting for your team and stay for a short familiarization session (15 minutes). During this meeting, your teammates will be present. Your participation in the study will be implied to others in the room, when you sign this document and engage in the additional activities of the study. Your teammates will likely know that you are participating in the study.
    - Complete a questionnaire on fatigue.
- With your permission, we will ask the Athletic Training Services for your hydration status from the Pre-Participation Physical Exam, from the sample you already provided. By signing this document and choosing to participate in this study, you are allowing us to contact Athletic Training Services to acquire your baseline data. This means the Head Athletic Trainer will know that you are participating in this study. Please initial to the right indicating that you understand that someone outside the study will know about your participation. However, as a health care provider, the Head Athletic Trainer is bound to protect your health information and will not divulge this information because of the laws that dictate the practice of Athletic Training. _____
    - If you do not want us to divulge your participation to Athletic Training Services, but still want to participate in the study, you may provide a baseline urine sample today. We can establish your baseline hydration status using that sample instead. If this is the option, you wish to choose, please initial here. _____
- Return ___ weeks after this meeting on a Sunday morning
    - Provide a urine sample.
    - Complete the fatigue questionnaire
    - Complete the alcohol consumption questionnaire
- Return for a third and final visit 3 days after your Sunday visit
    - Provide a urine sample.

- Complete the fatigue questionnaire
- Complete the alcohol consumption questionnaire

Your participation should not exceed more than 1 hour total over the three sessions.

BENEFITS OF PARTICIPATION

There are no direct benefits for participating in this study. Athletic Trainers and other health care providers may learn more about how alcohol consumption effects hydration status and levels of fatigue over a period of 72 hours.

POTENTIAL RISKS AND DISCOMFORTS

There are no physical or psychological risks to participating in this study. The greatest risk in this study is that of a breach of confidentiality that someone might discover, though unlikely, your answers to these questions. To reduce this risk to a minimum we are numerically coding your responses. We are storing your responses in several locations to protect your identity, if documents were discovered. Only one master-file will be created that may connect your name to your responses and this file will be stored on a password protected on-line secure storage space (I-secure).

You may be at risk of embarrassment during this study since you will be asked to provide a urine sample. You will provide your urine sample in a public restroom, but your specimen cup can be coded if you choose to leave it there for data analysis.

In addition, to access baseline hydration status, we will be contacting Athletic Training Services to acquire that information. Although there is a risk to maintaining confidentiality, the Head Athletic Trainer is bound by law to protect your health information.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding data to eliminate your name. Data will be safeguarded and confidential. Data will be stored in a locked cabinet in the Applied Medicine Research Center. Only the primary investigator and faculty sponsor will have access to the data you provide.

PARTICIPATION AND WITHDRAWAL

You can choose whether or not to be in this study. If you volunteer to be in this study, you may withdraw at any time without consequences. You may also refuse to answer any questions you do not want to answer.

IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about this research, please contact either:

David Dziedzicki
216-904-6507
DDziedzicki@indstate.edu

Dr. Lindsey Eberman
812-237-7694
leberman@indstate.edu

RIGHTS OF RESEARCH SUBJECTS

If you have any questions about your rights as a research subject, you may contact the Indiana State University Institutional Review Board (IRB) by mail at Indiana State University, Office of Sponsored Programs, Terre Haute, IN 47809, by phone at (812) 237-8217, or e-mail the IRB at irb@indstate.edu. You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of members of the University community, as well as lay members of the community not connected with ISU. The IRB has reviewed and approved this study.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

_____

Printed Name of Subject

_____ _____

Signature of Subject Date

APPENDIX C: Raw Data

Baseline Hydration	Baseline Fatigue	Hydration1	Fatigue 1	Audit 1	Hydration2	Fatigue 2	Audit 2
1.017	28.2	1.017	20.1	10	1.017	53.5	10
1.007	29.1	1.025	22.5	16	1.025	42.8	11
1.008	13.4	1.021	37.8	9	1.015	80.6	8
1.004	17.1	1.019	27.1	10	1.001	42.4	7
1.009	31.3	1.020	15.8	0	1.020	26.4	0
1.008	32.1	1.015	40.4	12	1.019	39.2	11
1.022	20.1	1.018	35.7	12	1.024	45.6	12
1.027	24.0	1.019	29.9	7	1.026	38.5	7
1.018	29.0	1.022	35.5	7	1.025	49.6	7
1.018	20.2	1.026	14.4	12	1.012	35.5	12
1.016	14.2	1.018	23.2	12	1.035	46.5	11
1.035	31.4	1.031	58.4	8	1.021	46.9	6
1.008	30.4	1.012	38.4	0	1.017	48.4	0
1.027	40.7	1.021	29.6	8	1.027	54.6	3
1.028	37.7	1.018	44.1	7	1.026	39.5	8
1.023	31.9	1.025	38.4	0	1.026	35.1	0
1.021	41.8	1.013	39.5	4	1.008	48.7	4
1.026	53.8	1.026	67.2	6	1.023	38.8	7
1.025	28.9	1.016	39.5	10	1.028	28.6	7
1.026	28.8	1.017	56.2	6	1.030	56.7	6
1.004	23.4	1.025	50	0	1.025	34.5	0
1.004	35.2	1.012	42.5	7	1.016	10.7	4
1.027	24.8	1.019	48.4	3	1.021	29.9	2
1.020	60.2	1.017	55.8	5	1.016	35.8	3
1.034	16.5	1.021	40.1	11	1.027	47.3	1
1.018	3.8	1.022	20.6	0	1.012	32.5	0
1.024	26.4	1.02	19.8	12	1.030	39.3	6
1.010	33.8	1.024	25.9	4	1.021	22.3	3

Baseline Hydration	Baseline Fatigue	Hydration1	Fatigue 1	Audit 1	Hydration2	Fatigue 2	Audit 2
1.018	46.7	1.036	52.7	9	1.016	45.9	8
1.021	38.7	1.023	53.2	8	1.015	22.6	9
1.023	14.5	1.025	63.3	0	1.024	39.5	0
1.027	15.4	1.024	60	7	1.030	26.4	6
1.019	15.2	1.025	25.8	5	1.012	20.2	5
1.011	20.3	1.027	39.8	9	1.014	19.3	2
1.021	17.4	1.011	42.6	5	1.015	10.5	2
1.012	21.8	1.024	49.2	12	1.026	20.3	7
1.018	22.2	1.021	31.1	7	1.020	23.2	8
1.010	29.3	1.022	40.3	11	1.027	37.9	7
1.021	25.7	1.026	49.6	6	1.022	37.7	5
1.021	23.5	1.018	48.6	9	1.019	29.2	8
1.023	19.4	1.03	30.6	7	1.015	23.6	6
1.026	20.3	1.021	79.8	4	1.022	40.6	4
1.031	53.3	1.03	10.6	0	1.025	22.1	0
1.010	40.8	1.004	35.3	0	1.032	28.5	0
1.017	56.6	1.018	34.6	3	1.020	43.3	3
1.022	34.0	1.021	34.6	7	1.026	40.5	6
1.027	35.0	1.026	55.3	3	1.032	38.4	3
1.021	25.7	1.022	44.1	1	1.017	47.0	3
1.017	30.3	1.017	46.2	1	1.020	39.4	1
1.011	31.5	1.024	46.7	7	1.009	26.5	5
1.010	33.8	1.022	53.1	4	1.017	28.6	3
1.011	33.1	1.008	41.0	2	1.010	26.2	3
1.016	40.4	1.019	37.2	1	1.007	54.4	1
1.017	29.6	1.021	35.4	6	1.008	35.7	6
1.026	35.4	1.014	39.4	5	1.029	48.8	3
1.024	36.6	1.025	29.4	5	1.024	49.5	3
1.014	51.3	1.019	49.3	8	1.024	56.8	8
1.005	45.2	1.017	68.1	21	1.009	31.1	28

Baseline Hydration	Baseline Fatigue	Hydration1	Fatigue 1	Audit 1	Hydration2	Fatigue 2	Audit 2
1.009	48.4	1.023	55.7	7	1.030	37.8	7
1.011	47.5	1.014	51.4	5	1.007	55.0	6
1.015	49.5	1.025	38.9	3	1.010	38.7	3
1.028	47.6	1.028	43.6	8	1.027	36.9	6
1.015	29.7	1.022	36.8	2	1.020	54.8	2
1.025	39.9	1.026	42.3	5	1.027	42.6	3
1.023	21.2	1.020	50.1	0	1.028	51.9	0
1.017	44.7	1.021	42.4	3	1.016	42.3	3
1.021	17.3	1.030	32.6	2	1.027	47.3	1
1.013	25.1	1.025	31.2	0	1.012	32.5	0
1.019	45.0	1.019	42.6	9	1.032	28.5	0
1.027	13.3	1.024	24.8	0	1.020	43.3	3
1.029	6.01	1.030	57.5	8	1.026	40.5	6
1.029	14.6	1.024	17.2	13	1.032	38.4	3
1.022	39.9	1.027	32.1	17	1.017	47.0	3
1.020	29.4	1.022	50.5	8	1.020	39.4	1
1.025	42.4	1.020	48.4	6	1.009	26.5	5
1.027	43.4	1.022	43.5	6	1.017	28.6	3
1.027	41.8	1.012	52.6	9	1.010	26.2	3
1.026	22.4	1.026	22.2	5	1.007	54.4	1
1.016	21.6	1.010	48.0	14	1.008	35.7	6
1.022	43.8	1.021	48.3		1.029	48.8	3
1.025	32.0	1.020	36.7	10	1.024	49.5	3
1.029	31.5	1.015	25.4	0	1.024	56.8	8
1.019	48.8	1.022	79.0	12	1.009	31.1	28
1.019	16.8	1.024	37.2	1	1.030	37.8	7
1.027	39.5	1.011	52.8	5	1.007	55.0	6
1.009	41.7	1.011	51.5	6	1.010	38.7	3
1.023	33.1	1.010	38.1	12	1.027	36.9	6

Baseline Hydration	Baseline Fatigue	Hydration1	Fatigue 1	Audit 1	Hydration2	Fatigue 2	Audit 2
1.022	57.2	1.020	54.2	16	1.020	54.8	2
1.016	28.1	1.017	59.0		1.027	42.6	3
1.025	20.6	1.010	45.5	8	1.028	51.9	0
1.029	12.7	1.006	7.3	0	1.016	42.3	3
1.034	16.5	1.021	40.1	11	1.027	47.3	1
1.018	3.8	1.022	20.6	0	1.012	32.5	0

APPENDIX D: SPSS Data Analysis Output

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Hydration (USG)	273	1.001	1.036	1.01959	.006995
AUDIT Questionnaire	182	0	28	5.22	4.495
Fatigue (mean score)	273	10.5	80.6	37.997	12.2249
Valid N (listwise)	182				

Correlations

			Zscore: Hydration (USG)	Zscore: AUDIT Questionnaire	Zscore: Fatigue (mean score)
Spearman's rho	Zscore: Hydration (USG)	Correlation Coefficient	1.000	.003	.079
		Sig. (2-tailed)	.	.973	.192
		N	273	182	273
	Zscore: AUDIT Questionnaire	Correlation Coefficient	.003	1.000	.046
		Sig. (2-tailed)	.973	.	.540
		N	182	182	182
	Zscore: Fatigue (mean score)	Correlation Coefficient	.079	.046	1.000
		Sig. (2-tailed)	.192	.540	.
		N	273	182	273

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Time	1	Baseline	91
	2	Day 1 Post Consumption	91
	3	Day 3 Post Consumption	91

Levene's Test of Equality of Error Variances[a]

Dependent Variable:Hydration (USG)

F	df1	df2	Sig.
8.507	2	270	.000

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + sport + time

Tests of Between-Subjects Effects

Dependent Variable:Hydration (USG)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.001[a]	3	.000	4.359	.005	.046
Intercept	52.965	1	52.965	1.122E6	.000	1.000
sport	.000	1	.000	2.624	.106	.010
time	.000	2	.000	5.226	.006	.037
Error	.013	269	4.719E-5			
Total	283.812	273				
Corrected Total	.013	272				

a. R Squared = .046 (Adjusted R Squared = .036)

Tests of Between-Subjects Effects

Dependent Variable:Hydration (USG)

Source	Noncent. Parameter	Observed Power[b]
Corrected Model	13.077	.868
Intercept	1.122E6	1.000
sport	2.624	.365
time	10.453	.829

b. Computed using alpha =

Estimated Marginal Means

1. Grand Mean

Dependent Variable:Hydration (USG)

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
1.020[a]	.000	1.019	1.020

a. Covariates appearing in the model are evaluated at the following values: Sport = 3.07.

2. Time

Estimates

Dependent Variable:Hydration (USG)

Time	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Baseline	1.018[a]	.001	1.016	1.019
Day 1 Post Consumption	1.021[a]	.001	1.019	1.022
Day 3 Post Consumption	1.020[a]	.001	1.019	1.022

a. Covariates appearing in the model are evaluated at the following values: Sport = 3.07.

Pairwise Comparisons

Dependent Variable:Hydration (USG)

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Baseline	Day 1 Post Consumption	-.003*	.001	.002	-.005	-.001
	Day 3 Post Consumption	-.002*	.001	.019	-.004	.000
Day 1 Post Consumption	Baseline	.003*	.001	.002	.001	.005
	Day 3 Post Consumption	.001	.001	.457	-.001	.003
Day 3 Post Consumption	Baseline	.002*	.001	.019	.000	.004
	Day 1 Post Consumption	-.001	.001	.457	-.003	.001

Based on estimated marginal means

*. The mean difference is significant at the

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable:Hydration (USG)

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.000	2	.000	5.226	.006	.037	10.453	.829
Error	.013	269	4.719E-5					

The F tests the effect of Time. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha =

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Sport	1	Football	45
	2	Soccer	75
	3	Volleyball	45
	4	Softball	33
	5	Baseball	75

Levene's Test of Equality of Error Variances[a]

Dependent Variable:Hydration (USG)

F	df1	df2	Sig.
.845	4	268	.497

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + time + sport

Tests of Between-Subjects Effects

Dependent Variable:Hydration (USG)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.001[a]	5	.000	2.688	.022	.048
Intercept	39.748	1	39.748	837478.573	.000	1.000
time	.000	1	.000	5.502	.020	.020
sport	.000	4	9.421E-5	1.985	.097	.029
Error	.013	267	4.746E-5			
Total	283.812	273				
Corrected Total	.013	272				

a. R Squared = .048 (Adjusted R Squared = .030)

Tests of Between-Subjects Effects

Dependent Variable:Hydration (USG)

Source	Noncent. Parameter	Observed Power[b]
Corrected Model	13.442	.812
Intercept	837478.573	1.000
time	5.502	.647
sport	7.940	.592

b. Computed using alpha =

Estimated Marginal Means

1. Grand Mean

Dependent Variable:Hydration (USG)

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
1.020[a]	.000	1.019	1.021

a. Covariates appearing in the model are evaluated at the following values: Time = 2.00.

2. Sport

Estimates

Dependent Variable:Hydration (USG)

Sport	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Football	1.021[a]	.001	1.019	1.024
Soccer	1.019[a]	.001	1.017	1.021
Volleyball	1.021[a]	.001	1.019	1.023
Softball	1.018[a]	.001	1.016	1.020
Baseball	1.019[a]	.001	1.017	1.021

a. Covariates appearing in the model are evaluated at the following values: Time = 2.00.

Pairwise Comparisons

Dependent Variable: Hydration (USG)

(I) Sport	(J) Sport	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Football	Soccer	.003	.001	.055	-5.546E-5	.005
	Volleyball	.001	.001	.669	-.002	.003
	Softball	.004*	.002	.027	.000	.007
	Baseball	.003	.001	.055	-5.546E-5	.005
Soccer	Football	-.003	.001	.055	-.005	5.546E-5
	Volleyball	-.002	.001	.149	-.004	.001
	Softball	.001	.001	.480	-.002	.004
	Baseball	3.505E-15	.001	1.000	-.002	.002
Volleyball	Football	-.001	.001	.669	-.003	.002
	Soccer	.002	.001	.149	-.001	.004
	Softball	.003	.002	.068	.000	.006
	Baseball	.002	.001	.149	-.001	.004
Softball	Football	-.004*	.002	.027	-.007	.000
	Soccer	-.001	.001	.480	-.004	.002
	Volleyball	-.003	.002	.068	-.006	.000
	Baseball	-.001	.001	.480	-.004	.002
Baseball	Football	-.003	.001	.055	-.005	5.546E-5
	Soccer	-3.505E-15	.001	1.000	-.002	.002
	Volleyball	-.002	.001	.149	-.004	.001
	Softball	.001	.001	.480	-.002	.004

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the

Univariate Tests

Dependent Variable:Hydration (USG)

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.000	4	9.421E-5	1.985	.097	.029	7.940	.592
Error	.013	267	4.746E-5					

The F tests the effect of Sport. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha =

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
Sport	1	Football	15
	2	Soccer	25
	3	Volleyball	15
	4	Softball	11
	5	Baseball	25

Descriptive Statistics

Dependent Variable:AUDIT Questionnaire

Sport	Mean	Std. Deviation	N
Football	6.60	3.460	15
Soccer	4.36	4.300	25
Volleyball	5.33	3.599	15
Softball	9.73	4.125	11
Baseball	4.36	4.300	25
Total	5.54	4.329	91

Levene's Test of Equality of Error Variances[a]

Dependent Variable:AUDIT Questionnaire

F	df1	df2	Sig.
.028	4	86	.998

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + sport

Tests of Between-Subjects Effects

Dependent Variable:AUDIT Questionnaire

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	279.980[a]	4	69.995	4.279	.003	.166
Intercept	3033.703	1	3033.703	185.477	.000	.683
sport	279.980	4	69.995	4.279	.003	.166
Error	1406.635	86	16.356			
Total	4478.000	91				
Corrected Total	1686.615	90				

a. R Squared = .166 (Adjusted R Squared = .127)

Tests of Between-Subjects Effects

Dependent Variable:AUDIT Questionnaire

Source	Noncent. Parameter	Observed Power[b]
Corrected Model	17.118	.916
Intercept	185.477	1.000
sport	17.118	.916

b. Computed using alpha =

Estimated Marginal Means

1. Grand Mean

Dependent Variable:AUDIT Questionnaire

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
6.076	.446	5.189	6.963

2. Sport

Estimates

Dependent Variable:AUDIT Questionnaire

Sport	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Football	6.600	1.044	4.524	8.676
Soccer	4.360	.809	2.752	5.968
Volleyball	5.333	1.044	3.257	7.409
Softball	9.727	1.219	7.303	12.151
Baseball	4.360	.809	2.752	5.968

Dependent Variable:AUDIT Questionnaire

(I) Sport	(J) Sport	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
Football	Soccer	2.240	1.321	.094	-.386	4.866
	Volleyball	1.267	1.477	.393	-1.669	4.202
	Softball	-3.127	1.605	.055	-6.319	.064
	Baseball	2.240	1.321	.094	-.386	4.866
Soccer	Football	-2.240	1.321	.094	-4.866	.386
	Volleyball	-.973	1.321	.463	-3.599	1.652
	Softball	-5.367*	1.463	.000	-8.276	-2.458
	Baseball	-2.665E-15	1.144	1.000	-2.274	2.274

Volleyball	Football	-1.267	1.477	.393	-4.202	1.669
	Soccer	.973	1.321	.463	-1.652	3.599
	Softball	-4.394*	1.605	.008	-7.585	-1.202
	Baseball	.973	1.321	.463	-1.652	3.599
Softball	Football	3.127	1.605	.055	-.064	6.319
	Soccer	5.367*	1.463	.000	2.458	8.276
	Volleyball	4.394*	1.605	.008	1.202	7.585
	Baseball	5.367*	1.463	.000	2.458	8.276
Baseball	Football	-2.240	1.321	.094	-4.866	.386
	Soccer	2.665E-15	1.144	1.000	-2.274	2.274
	Volleyball	-.973	1.321	.463	-3.599	1.652
	Softball	-5.367*	1.463	.000	-8.276	-2.458

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the

Univariate Tests

Dependent Variable:AUDIT Questionnaire

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	279.980	4	69.995	4.279	.003	.166	17.118	.916
Error	1406.635	86	16.356					

The F tests the effect of Sport. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha =

Post Hoc Tests

Sport

Multiple Comparisons

AUDIT Questionnaire

Bonferroni

(I) Sport	(J) Sport	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Football	Soccer	2.24	1.321	.935	-1.57	6.05
	Volleyball	1.27	1.477	1.000	-2.99	5.52
	Softball	-3.13	1.605	.547	-7.75	1.50
	Baseball	2.24	1.321	.935	-1.57	6.05
Soccer	Football	-2.24	1.321	.935	-6.05	1.57
	Volleyball	-.97	1.321	1.000	-4.78	2.83
	Softball	-5.37*	1.463	.004	-9.58	-1.15
	Baseball	.00	1.144	1.000	-3.30	3.30
Volleyball	Football	-1.27	1.477	1.000	-5.52	2.99
	Soccer	.97	1.321	1.000	-2.83	4.78
	Softball	-4.39	1.605	.075	-9.02	.23
	Baseball	.97	1.321	1.000	-2.83	4.78
Softball	Football	3.13	1.605	.547	-1.50	7.75
	Soccer	5.37*	1.463	.004	1.15	9.58
	Volleyball	4.39	1.605	.075	-.23	9.02
	Baseball	5.37*	1.463	.004	1.15	9.58
Baseball	Football	-2.24	1.321	.935	-6.05	1.57
	Soccer	.00	1.144	1.000	-3.30	3.30
	Volleyball	-.97	1.321	1.000	-4.78	2.83
	Softball	-5.37*	1.463	.004	-9.58	-1.15

Based on observed means.
The error term is Mean Square(Error) = 16.356.

*. The mean difference is significant at the

Time

Case Processing Summary

Time		Cases					
		Valid		Missing		Total	
		N	Percent	N	Percent	N	Percent
Hydration (USG)	Baseline	91	100.0%	0	.0%	91	100.0%
	Day 1 Post Consumption	91	100.0%	0	.0%	91	100.0%
	Day 3 Post Consumption	91	100.0%	0	.0%	91	100.0%

Descriptives

Time				Statistic	Std. Error
Hydration (USG)	Baseline	Mean		1.01774	.000746
		95% Confidence Interval for Mean	Lower Bound	1.01625	
			Upper Bound	1.01922	
		5% Trimmed Mean		1.01779	
		Median		1.01700	
		Variance		.000	
		Std. Deviation		.007121	
		Minimum		1.004	
		Maximum		1.035	
		Range		.031	
		Interquartile Range		.012	
		Skewness		-.061	.253
		Kurtosis		-.815	.500

	Day 1 Post Consumption	Mean		1.02089	.000595
		95% Confidence Interval for Mean	Lower Bound	1.01971	
			Upper Bound	1.02207	
		5% Trimmed Mean		1.02109	
		Median		1.02100	
		Variance		.000	
		Std. Deviation		.005671	
		Minimum		1.004	
		Maximum		1.036	
		Range		.032	
		Interquartile Range		.007	
		Skewness		-.541	.253
		Kurtosis		1.052	.500
	Day 3 Post Consumption	Mean		1.02013	.000809
		95% Confidence Interval for Mean	Lower Bound	1.01852	
			Upper Bound	1.02174	
		5% Trimmed Mean		1.02024	
		Median		1.02000	
		Variance		.000	
		Std. Deviation		.007716	
		Minimum		1.001	
		Maximum		1.035	
		Range		.034	
		Interquartile Range		.012	
		Skewness		-.303	.253
		Kurtosis		-.847	.500