# THE EFFICACY OF A HYDRATION EDUCATION INTERVENTION PROGRAM ON CURRENT HYDRATION PRACTICES

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## DEDICATION

I would like to dedicate this thesis to my parents who have pushed me to always reach for my dreams. I would also like to dedicate this thesis to my committee members who, without them, none of this would be possible.

## ACKNOWLEDGEMENTS

I would like to acknowledge the participants from Texas State University that volunteered their time for this study. Also, I would like to acknowledge my committee members that made this all possible. Their guidance helped me conduct this research and I could not have completed this without them.

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## LIST OF ABBREVIATIONS

| Abbreviation | Description |
|---|---|
| 1. NATA | National Athletic Trainers' Association |
| 2. ACSM | American College of Sports Medicine |
| 3. NCAA | National Collegiate Athletic Association |
| 4. JMP | Statistical Discovery from SAS |
| 5. USG | Urine Specific Gravity |

## ABSTRACT

**Context:** Hydration has been a heavily researched area within the athletic population, but little research has been done on the effect of hydration education and its effect on hydration status with an emphasis on long term retention rate. Research has been conducted on short-term retention rate, but no studies have looked longer periods (>2 weeks) or the use of a text message intervention. This study was designed to fill those gaps of a longer retention period with multiple testing periods and reminders. **Objective:** The purpose of this study was to research the effect of a repeated social media hydration education intervention on a healthy, active general population. A secondary purpose was to determine if the education would have an impact on hydration practices, knowledge, and attitudes and retention of hydration information. We hypothesized that the participants would not be euhydrated when performing a urinalysis at baseline, but that the intervention will improve hydration status. **Design:** This study was a cohort, repeated measure study with the use of a hydration questionnaire and a collection of 3 urine samples over the course of 2 weeks**. Participants:** Thirty-six healthy, active (1-8 hours of exercise/week) participants between ages 18-31. **Intervention:** An intervention and control group was used for this study. The intervention group received text messages twice a day about proper hydration strategies and protocols while the control participants received text messages twice a day that were unrelated to hydration such as athletic events happening on campus. The data were analyzed pre-vs-post and correlated with the behaviors and practices of hydration through the use of ANOVA's and correlations.

**Setting:** The participants collected their urine sample upon waking in the morning and brought the sample into the lab on day 1, day 3, and day 14 for urine specific gravity analysis with a refractometer. **Main Outcome Measures:** Urine specific gravity was obtained via urinalysis with a refractometer. The knowledge of hydration was assed using a validated questionnaire. **Results:** No statistical significance was found between groups in this study for the effect of a repeated educational intervention on hydration status (P=0.516). There was also no statistical significance found when comparing hydration knowledge over the course of the 2 weeks (P=0.501). **Conclusions:** Education alone does not work in changing hydration status. Healthcare professionals should be aware that it may take a long time to change patients' practices regarding hydration and to be constant and consistent with their education if they do want to help patients become better hydrated.

# I. INTRODUCTION

Proper hydration strategies and practices are an important component in sport performance, yet active individuals are slow to appreciate the extent to which their performance is affected by hydration status and even slower to develop hydration strategies that will allow them to optimize their performance.[10,12]

There can be several obstacles to implementing good hydration practices among athletes. The first would be knowing that dehydration can have a negative effect on performance. A second obstacle to implementing a successful hydration practice is the individuals' knowledge base. An awareness of the role that fluid plays in athletic performance and a knowledge of how to maintain hydration during practices and competition is necessary to maximize athletic potential.

**Professional Position Statements on Hydration**

Both the National Athletic Trainers' Association (NATA) and the American College of Sports Medicine (ACSM) have published hydration position statements/stands and recommended standards of practice regarding hydration. The NATA position statement states that athletes whose sweat loss exceeds fluid intake become dehydrated during activity.[1] Dehydration of 1-2% of body weight begins to compromise physiologic function and has a negative impact on performance.[1] The position statement recommends that the athlete consume approximately 500 to 600 mL of water or sports drink 2-3 hours before exercise and 200 to 300 mL, 10 or 20 minutes before exercise.[1] They also recommend educating athletes on the effects of dehydration on performance and that healthcare professionals should have the proper equipment available to measure and test hydration status.

The American College of Sports Medicine mirrors is similar to the NATA position statement. ASCM recommends that pre-hydrating with fluids should be initiated at least several hours before the exercise task to enable proper fluid absorption.[2] During exercise, fluid intake is more based on an individual basis, aiming for no more than a 2% body weight loss. ACSM recommends fluids post-exercise of approximately 1.5 liters of fluid for each kilogram of body weight lost from exercise.[2] Post-exercise fluids are especially important when athletes have back-to-back games or multiple games in one day.[2]

**Hydration Education**

Hydration research has been conducted over a wide spectrum of athletic performance. Most of this research has focused primarily on measuring pre-and post-training hydration status of athletes. There are only a few studies that examine the effect of a hydration education intervention.

Cleary et al.[3] assessed hydration status and behaviors in female athletes before and after a one-time education intervention. The authors had a total of four observational periods throughout the study and assigned subjects to one of the four groups which included, control, educational intervention, prescribed hydration intervention and observational follow up. They measured body mass changes post-exercise and found that the participants in the prescribed hydration intervention group were the only ones to maintain body mass. The authors concluded that a one-time educational intervention was not successful in changing hydration behaviors.[3]

In another study, Kavouras et al.[4] researched the effect of a hydration education intervention in 92, young athletes exercising in hot climates. The intervention group

attended a one hour lecture on hydration and the authors mounted urine color charts in all the bathrooms. The participants' performance in field tests such as 600-m run, 30-m sprint, vertical jump, and skills tests for volleyball and basketball were measured. The authors' main finding was that an intervention program showed successful for enhancing hydration status over just a 2-day period. They concluded that "an intervention to teach and facilitation of hydration accessibility, along with simple and realistic hydration strategies will benefit youths exercising at summer camps."[4]

McDermott et al.[5] observed hydration status, sweat rates, fluid consumption, and the effectiveness of an education intervention in youth football players. The intervention included 4-8 minutes of a lecture discussing hydration importance. The authors found a positive change with an education intervention, but could not pinpoint if the change was due to the intervention or the athletes' prior hydration knowledge. McDermott et al.[5] showed that subjects came into camp in a dehydrated state and found it difficult to "catch" back up to a normal level during physical activity.

When dealing with hydration, it is important to keep in mind that it is extremely hard to generalize findings to the general population because each person's hydration strategies and sweat rates are different. Therefore, it would be beneficial to have this knowledge of individualized sweat rates to individualize hydration strategies to specific participants.

**Purpose**

The purpose of this study was to determine the effect of a repeated text message hydration education intervention, determine if hydration practices changed, and long term retention of information in a general, active population. In addition, this study analyzed

results from a completed urinalysis on the individuals' urine and correlated the findings from that to hydration knowledge.

**Hypothesis**

It was hypothesized that…

1. The educational intervention will have a positive impact for the intervention group on hydration for a short period of time (3 days) and will not have lasting effects at day 14.

2. Hydration, as measured by urinalysis, will not correlate with knowledge of hydration. Participants will overstate their hydration status and answer the questionnaire correctly but show through urinalysis that they are dehydrated.

3. Knowledge, behaviors and attitudes of hydration will improve over time after the education intervention.

**Operational Definitions**

1. Hypohydration is defined by the ACSM position stand on hydration and the NATA position statement as a >2% body weight loss from water deficit.[1,2]
2. Rehydration is defined as the process of replacing water in the body.
3. Euhydration is defined as a state of ideal total body water content. In this study, it will be measured by urinalysis.
4. Hydration knowledge is the knowledge of proper hydration practices and the correct way to perform those practices.
5. Baseline testing will consist of a validated questionnaire and a first morning urinalysis using a refractometer.

**Delimitations**

1. This study is delimited by the availability of volunteer subjects within the college setting.
2. Collecting urine only in the morning for specific urine gravity.

**Limitations and Assumptions**

1. This study is limited by the obstacles that come with using a questionnaire with outcomes like low response rate.
2. It is assumed that the questionnaire responses will be honest and reliable.
3. Assuming that an exercise session will lead to dehydration.
4. Assuming that both genders will have the same dehydration concerns.
5. Assuming that participants will all have routine hydration behaviors.

**Significance of Study**

Hydration is a key performance factor that can affect performance in a negative way if not practiced correctly. Because it is an intrinsic factor, unlike biomechanical factors or predisposing injury factors, hydration is a way to help athletic performance that one can control. As health care professionals, it is important to educate and treat active individuals holistically and hydration is an important factor.

Because hydration is not an injury or a rehabilitation technique, it is often overlooked by active individuals. It is important for health care providers (athletic trainers, physical therapists, nurses, etc.) to be the front line and provide them with knowledge and hydration strategies. Assumptions of already understanding hydration practices are made when in fact, it's shown that many athletes do not know how to

hydrate properly.[21,22] Hydration practices need to become habitual not only for athletic performance, but for quality of life continuing after sports.

There may be many reasons why active individuals do not have optimal hydration practices. Individuals may not know the current standards and recent research or they have done certain practices their whole life and do not perceive that it has impacted their performance. Individuals may also not know how to properly recover and might not know the proper fluid ounces needed to perform at their best.

Understanding the reasons behind certain hydration practices and current level of knowledge is significant in order to change these practices and provide the best care to each individual. This study will aim to develop the proper practices, attitudes, and knowledge about hydration.

## II. REVIEW OF RELATED LITERATURE

Dehydration and the use of an education intervention is an area of study that is minimally researched. Hydration is an aspect of performance that is often overlooked. When investigating performance, researchers and professionals tend to focus on speed, velocity, and strength. While these are important, hydration affects all human performance factors. Thus, knowing the importance of proper hydration both pre-and during activity is vital to human performance.

As dehydration increases there is a reduction in physical and mental performance.[9] Studies show that loss of fluid equal to 2% of body mass is enough to cause a decrease in cognitive function and aerobic exercise performance, particularly in warmer weather.[20,21] Severe body weight losses (6% to 10%) from dehydration, can lead to more severe consequences such as heat illness, heat stroke, and heat exhaustion.[20] Drinking fluid during exercise is necessary to replace fluids lost in sweat.

Hydration status can be measured in a variety of ways. One possible way is tracking body weight, such as weighing in before practice and weighing out after practice. For every pound of weight loss, it is recommended that athletes consume three cups of fluid.[9] Urine specific gravity and urine osmolality approximate hydration status by measuring the concentration of electrolytes in urine.[10] Health professionals often also use a urine color chart as an easy way to match the color of the athlete's urine to the chart to assess hydration status.[20]

The purpose of this literature review is to analyze previous research on a hydration education intervention. More specifically, this literature review analyzes the use of an education intervention on a variety of athletic populations. It further researches

hydration strategies and their effect on optimizing performance, behaviors, knowledge, and attitudes on hydration within those populations.

## Knowledge and Hydration Behaviors in Athletes

### Hydration Fluid Taste Preferences

Several researchers found that the hydration practices in athletes seemed to be determined by flavor of the fluid they are consuming.[11,12] Meyer and colleagues developed a study in which they investigated the thirst, drink preferences, and rehydration in children.[11] This study included 24, 9 to 13 year old children (14 females and 10 males) who participated in 4 cycling sessions, 90 minutes in length. The subjects were given the choice of water, an apple, orange, or grape flavored drink. During exercise, the children had an increase in thirst intensity overall for all drinks. The authors also found that grape was the most preferred drink among the exercising children throughout their workout. In a 30-minute recovery period, full rehydration was achieved with all drinks; however, rehydration was statistically greater with grape and orange flavored drinks than water and an apple flavored drink ($p<0.05$). In conclusion, mild hypohydration during exercise increased children's thirst and drink desirability for flavored drinks.

In a similar study, O'Neal et al. conducted a survey investigating fluid consumption, performance, and hydration of 146 men and 130 female runners in a half and full marathon.[12] Runners were separated into 3 groups (low, moderate, and high) based on z scores from training volume, expected performance, and running experience. The high running group reported greater consumption of sport beverages in exercise than the low and moderate groups ($p<0.05$), and sport beverages were preferred over water in

meeting hydration needs ($p<0.05$). Seventy percent of runners experienced one or more incidents in which they believed dehydration resulted in a major performance decrement. Twenty percent of runners reported monitoring their hydration status and urine color, which was the method most often reported. Only 2% reported measuring changes in body weight. The authors concluded the runners preferred sport drinks over water while running the marathon, and greater attention should be paid to informing runners of techniques to monitor hydration status.[12]

In both studies quoted above, the researchers found a preference for flavored drinks in both exercising children and adults. In addition, when offered flavored drinks the participants of Meyer et al. increased fluid consumption, which could prevent the symptoms and risk of dehydration, heat stroke, and heat illness.[11]

**Hydration Knowledge, Attitudes, and Behaviors**

While it appears active individuals prefer flavored drinks to help increase fluid intake, how does hydration knowledge, attitudes, and behaviors influence fluid intake? In a study conducted by Nichols and colleagues[13], they investigated 139 collegiate athletes' knowledge, attitudes, and behaviors concerning hydration and fluid replacement. The student-athletes scored higher on the questions regarding hydration knowledge, attitudes, and behaviors that pertained to practices that they were supposed to be doing already. A significant positive correlation was observed between knowledge, attitude, and behavior scores ($p<0.05$) meaning that all three sections were related to one another. A significant difference ($p<0.05$) was found in the hydration behaviors between skilled and endurance athletes, with the higher behaviors in the endurance runners. It was observed that the athletes answered the general hydration questions correctly, but did not answer the

National Athletic Trainers Association or American College of Sports Medicine position statement questions correctly, suggesting that collegiate athletes' knowledge behaviors and attitudes about hydration need to improve.[13]

A guideline published by Hoffman et al.[14] considered the area of nutrition and hydration issues for combat sport athletes. Because of the nature of sports like judo, wrestling, and taekwondo, they may need to cut weight to be able to perform in the proper weight class. Athletes commonly train in an already hypohydrated state (a finding in McDermott et al.[6,22]) which leads to impairment while performing tasks in sport.[14] The fact that these combat sport athletes choose to withhold fluid to cut weight shows that they need education on how to properly perform this. Not only does cutting weight impact hydration status, but also it can lead to decreased cognitive function.[14]

**Pre-Practice Hydration Status and Intervention**

**Perceived Exertion**

Hydration impacts performance; thus, researchers have examined the relationship between specific hydration interventions and perceived exertion. Riebe et al.[15] compared the effects of oral versus intravenous saline rehydration on differentiated ratings of perceived exertion and thirst. Eight men underwent three assigned rehydration treatments following a 2- to 4-hour workout. The treatments included 0.45% saline infusion, 0.45% saline oral ingestion, and no fluid. Ratings of perceived exertion during the oral ingestion was lower ($p<0.05$) than saline infusion and no fluids groups through the exercise duration. The authors concluded that oral rehydration is likely to elicit lower ratings of perceived exertion and thirst ratings compared with intravenous rehydration.[15]

**Pre-Practice Hydration Status**

Knowing that athletes would rather consume fluids orally is an important part of performance during practices and leads to a decrease in perceived exertion. Also, knowing that some studies have found that athletes are already in a hypohydrated state coming into practice, it is important to monitor hydration status throughout exercise.

Volpe et al.[16] researched and reported on the pre-practice hydration status of collegiate athletes and determined the factors that might lend influence. Participants included 138 males and 125 females from an NCAA Division I New England university. The researchers analyzed urine specific gravity of a one-time spontaneously voided urine sample before a team practice with a refractometer. Three-hydration status groups were defined based on the ACSM criteria. Groups were defined as euhydrated, when urine specific gravity was less than 1.020; hypohydrated, when levels ranged from 1.020 to 1.029; and significantly hypohydrated with levels equal to or more than 1.030. Thirteen percent of student-athletes appeared significantly hypohydrated; 53% of student athletes appeared hypohydrated, and 34% appeared euhydrated.[16] Also, they found that a greater percentage of men (47%) than women (28%) were hypohydrated. Overall, about a third of athletes were hydrated, while the majority were dehydrated.

Jones et al.[17] assessed if hydration strategies of female rugby league players were sufficient enough to maintain fluid balance during training days and game day. Ten international female rugby players provided a urine sample 60 minutes and 30 minutes before training and weighed in and out of every training event. During training, participants lost 0.50% of body mass and 0.56% during game play. They also measured blood sodium and found that it seemed to be well regulated despite the sodium loss in

sweat. The authors concluded that clinicians should evaluate the hydration status of athletes to determine if intervention is needed.

In a similar study, Magal et al.[19] conducted a study to analyze the pre-practice hydration status of current NCAA male athletes and to assess the impact of an education intervention. Fifty-six male athletes were divided into a control and experimental group. The authors measured urine specific gravity prior to morning practice for baseline. The control and experimental groups were told to maintain normal hydration and diet schedules and record fluid intake for 7 days. The experimental group was asked to consume an additional 23.9 oz. per day for one week. The authors measured urine specific gravity again after the 7 days. The experimental group consumed significantly more fluids than the control group ($p<0.05$), and changes in urine specific gravity demonstrated a difference in hydration between groups ($p<0.05$). Overall, increasing pre-practice fluid consumption to an athlete's daily routine led to a significant increase in fluid consumption but resulted in only small, but significant, improvements in the urine specific gravity.

**SMS/Text Message Interventions**

Cell phone usage is a prominent means of communication in young adults. Teenagers and young adults frequently use cell phones for just about everything from text messages to social media. There is evidence that SMS/Text-Message interventions can effectively distribute health information to this population.[24,30] Bill et al.[24] researched the effect of the delivery of a 6-week nutrition education text-message regimen that promoted self-efficacy to 27 college athletes. They concluded that there was no significance in the intervention and control groups and attributed it to the short nature of the text-messages

and intervention time.[24] Little evidence shows that the daily reminders through a text message or social media applications give a good reminder to the participant to finish the task at hand.[24]

In another study conducted by Suffoletto et al., the authors evaluated a text-message program as a booster to an in-person alcohol intervention within an undergraduate college setting.[30] A total of 224 undergraduate students who violated an on-campus alcohol policy participated in this study over a two-semester time span. The text-messages were sent on Thursday's and Sunday's and provided feedback for a 6-week period. The authors found that 90% of the text message queries were completed and saw that weekend binge drinking decreased over 6 weeks.[30] Preliminary evidence in this study suggested that a text-message program could be useful for helping students reduce binge drinking.[30]

Glowacki et al. examined the feasibility and acceptability of a campus-wide text-messaging program to help promote health behaviors.[31] Approximately 6,000 undergraduate students made up a "subscriber pool"[31] and from that pool 1,095 participants completed a posttest survey. The texts that were sent out consisted of a wide range of health topics and campus resources. Text-messages about sleep, stress management and hydration were considered most relevant and 61% of participants reported increased awareness regarding their health.[31] The authors concluded that text-message interventions are a feasible strategy to help improve a mass number of college student's health.

Most health-related research has been done with nutrition reminders[16] and none have been used to help with hydration reminders.

**Hydration Interventions**

Further research shows that a hydration education intervention may improve hydration status. Many researchers hypothesize that a formal presentation such as a PowerPoint or a lecture including proper hydration practices and guidelines may improve hydration status.[20,21,22]

In the study conducted by Cleary et al.,[20] the hydration status and behaviors of 36 adolescent female elite volleyball athletes before and after a 1-time educational intervention and before and after a prescribed hydration intervention were assessed. The authors performed 4 observational periods and assigned the subjects to one of the following groups: a control period, educational intervention, prescribed hydration intervention, and observational follow-up. After the control period, an educational intervention presentation was conducted. In the prescribed hydration intervention, a pre-calculated volume of water based on individual sweat rate was consumed every 20 minutes during each 2-hour practice. During all other periods, participants consumed their fluid of choice. The authors measured body mass changes and found that the prescribed hydration intervention was the only period that participants maintained body mass after exercise ($p=0.005$). The volume of fluid that was consumed was greatest during this time. The body mass changes were less for the prescribed group than the observational follow up group. Overall, a 1-time education session alone was not successful in changing hydration behaviors. However, prescribing individualized hydration protocols improved hydration for adolescents.

Kavouras et al.[21] evaluated an intervention program emphasizing increased fluid intake on exercise performance in children exercising in the heat. Ninety-two adolescent

athletes participated in this study with 31 in the control group and 61 in the intervention group. The authors assessed hydration first thing in the morning with a urine sample. After baseline testing, the intervention group attended a lecture on hydration, and urine color charts were mounted in all bathrooms. The authors found that hydration status was improved significantly ($p<0.05$) in the intervention group through measurement by urine osmolality, while no statistically significant changes were found within the control group. The authors concluded that improving hydration status by consumption of water could enhance performance in an endurance run in young children exercising in the heat.

Dubose et al.[18] had another similar study that researched the effect of an education intervention in high school male athletes. The authors recruited 82 participants who completed a questionnaire containing 34 true or false questions regarding hydration knowledge and current hydration practices. Some participants were then exposed to an education session via lecture and immediately completed the same exact questionnaire. The participants than completed the questionnaire one month after initial testing. The authors found that both the post tests were significantly different than the pretests ($p=0.001$, and $p = 0.002$, respectively). They concluded that improvement of athletes' knowledge and practices of hydration could help initiate everyday routines and introduce better ways to hydrate. While this was more of a questionnaire study, it shows the efficacy of an intervention and how it can impact changes.

McDermott et al.[22] measured hydration status and rehydration performance and examined the use of an educational intervention in thirty-three youth football athletes (mean age $12\pm2$ years). A urine sample was collected from the subjects to determine baseline hydration status. Each day before breakfast and dinner the campers provided a

urine sample to assess hydration. Hydration was determined by urine color, urine specific gravity, and urine osmolality. Sweat rate and a scale measuring thirst from 1-9, ranging from not thirsty at all to very, very thirsty was used as well. A questionnaire was used to assess knowledge and hydration habits. Subjects were assigned to an education intervention group or no-intervention group. The education intervention consisted of a 4-8 minute presentation of hydration importance, hydration indicators, and tips on how to improve hydration. McDermott et al.[22] found that there was an improvement in urine color over time in both groups ($p<.001$). They also found that there was not a significant difference between overall average sweat rate of the control and intervention groups ($p=.307$). There was also a significant difference in thirst rating over time and thirst at night was significantly less than thirst in the morning ($p<.009$). A major number of campers wished they had consumed more fluids during camp ($p=.008$) and they found that campers' knowledge was above expected levels. McDermott and colleagues concluded that the subjects maintained a hypohydrated state during the 5-day camp. The subjects did meet their fluid consumption and sweat rate levels during activities, but did not prevent dehydration outside of practices and games. The authors had some effect with an intervention, but cannot pinpoint if it was the intervention completely or not.

**Conclusion**

Collegiate athletes' knowledge of hydration practices and guidelines is already at a good level[18], however their behavior needs improvement in order to optimize performance. When comparing hydration status during the pre-practice period, in summary, athletes arrive at practice already in a hypohydrated state, which sets them up for failure in performance. The current evidence also shows mixed results on the use of

an education intervention. One-time interventions show poor results, but also showed that an intervention seemed to be effective when using a prescribed hydration protocol over a longer period of time.

Further studies need to be performed on the effect of a hydration education intervention protocol that includes more than a one-time intervention.

# III. METHODS

## Design

The methods of this study were designed to further understand the impact of a hydration education intervention and if it would change the practices and knowledge of hydration within an active population. This study was a mixed methods study by looking at both qualitative and quantitative data. The independent variables were the hydration education intervention and time with covariates being gender and workout type. The study's dependent variables were knowledge/behaviors of hydration, hydration practices and urinalysis.

## Participants

Participants were all active participants from the general student population at Texas State University. All participants were recruited by emails sent around campus, by the researcher speaking to specific classes, or by speaking to the athletic teams' athletic trainers. The inclusion and exclusion criteria are listed in Table 1. Participants who met all inclusion criteria for the study were then asked to sign an informed consent form to participate in the study. A total of forty-four participants between 18-31 years of age volunteered for this study. They were sent a sign-up sheet and 44 participants signed up to come to the initial meeting. Three of those 44 did not show up to their assigned time slot, giving us a total of 41 who signed informed consent forms. All participants brought back their day 1 and day 3 samples, yet 5 did not bring back their day 14 samples so a total of 36 participants were included in this study. All participants were offered a $10 gift card for participation upon completion in this study. This research thesis was approved by the Texas State University Institution Review Board (Approval #:2018203).

Participants were split into two groups: an intervention group (n=18) and a control group (n=18). Randomization of groups occurred when they came into the lab for their initial meeting. They drew a number out of a hat to determine what group they were going to be placed in.

**Table 1. Inclusion/Exclusion Criteria.**

| Inclusion Criteria | Exclusion Criteria |
|---|---|
| • Must be a current Texas State Varsity or club athlete or college student | • If they have recently been educated on hydration |
| • Between ages of 18-31 | • If they miss a urinalysis session |
| • On a consistent training regimen of exercise 1-10 hrs/week | • If they have sustained an injury within the last 2 weeks |

**Instrumentation**

A validated questionnaire (Appendix A) was used to assess previous hydration knowledge and current hydration practices. The questionnaire was previously validated by McDermott et al.[22] The questionnaire included both qualitative and quantitative questions while using Likert scales ranging from 0-10. The following are examples of the types of questions that were asked:

- My urine should appear pale yellow in color if I am drinking enough fluids (0-10). In this case, 0 would be strongly disagree and 10 would be strongly agree.

- Drinking soda or any other caffeinated beverages does not hydrate me as well as water (0-10). In this case, 0 would be strongly disagree and 10 would be strongly agree.
- Name two ways that you know that you are dehydrated.

After questionnaires were completed, a total sum score was given to each questionnaire. This was performed by adding up all Likert scale questions and calculating their total out of 160 total possible points (16 used total Likert scale questions). Two questions were left out of the analysis. The first one was a question asking "drinking soda or any other caffeinated beverages does not hydrate me as well as water" and the second one was "do you wish you could drink more fluids during exercise?" These were left out due to coding issues and skewing of results.

A urinalysis with a refractometer (General®, REF312ATC Protein/Urine Refractometer ATC) was used to determine the participants' hydration status. Urine refractometers are a simple and affordable tool, while still being accurate and consistent, to measure urine specific gravity[1]. A urine sample cup was provided to the participant the day before the sample was collected. Participants were instructed to provide a first morning urine sample and bring it into the lab at any point during the same day they provided the sample. This first morning sample was verbally verified by the participants when they dropped them off. They were immediately refrigerated after they dropped it off. All of the analysis was done within 8 hours after receiving the urine sample. Figure 1 shows the published averages for levels of being in a euhydrated state (normal/hydrated state of body water).

**Urine Specific Gravity (USG) / Osmolality (UOsmol)**

- USG of ≤ 1.020 = euhydrated
- UOsmol ≤ 700 mOsmol/kg = euhydrated

**Figure 1. Normative Values for Hydration.**

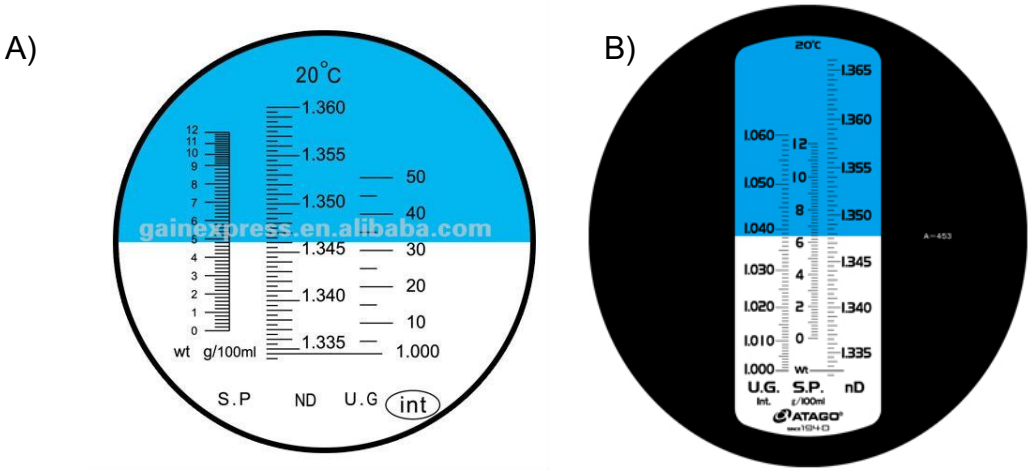



**Figure 2. Refractometer Scales.**
a) Picture on left is what was on the refractometer used in the study.
b) Picture on right is what was used to compare USG readings for better accuracy

**Data Collection Procedures**

Data were collected over a 2-week period. Participants signed up through an online sign-up sheet to come to the initial meeting either on a Wednesday, Thursday or Friday of the same week. When participants arrived in the lab, the study was explained to them and, if they met all inclusion criteria and were interested, they signed an informed consent form. After signing the consent, participants were given a baseline questionnaire to fill out and sample cups were given to them for their first urine sample. Participants were then split into control and intervention groups. Both groups received two text

messages per day for 14 days. The intervention group's text messages were messages on tips and strategies about hydration and reminders to drink adequate fluid (Appendix IV). They also got links to a flyer (Appendix III) that explained various aspects of hydration and the NATA hydration position statement. The participants brought the day 3 urine sample in and filled out the day 3 questionnaire. This was repeated for day 14 of data collection.

The control group received text message updates as well, but they were unrelated to hydration. They were regarding, for example, certain Texas State athletic events that day, study tips, or tips on how to find jobs. All text messages for both intervention and control groups were done by an online website (remind.com) that has features for automatic reminders. Some messages were sent out early in the morning to make sure they provide the first morning urine sample. The other messages were sent out any time during the day to facilitate engagement.

Participants received compensation of a $10.00 gift card for participating in the study. The gift card was issued towards HEB, a local grocery store, and was used to lessen the attrition rate within the study. The gift card was given to the participant after they brought in their day 14 sample.

Figure 3 shows a visual timeline of how the study data collection was conducted.

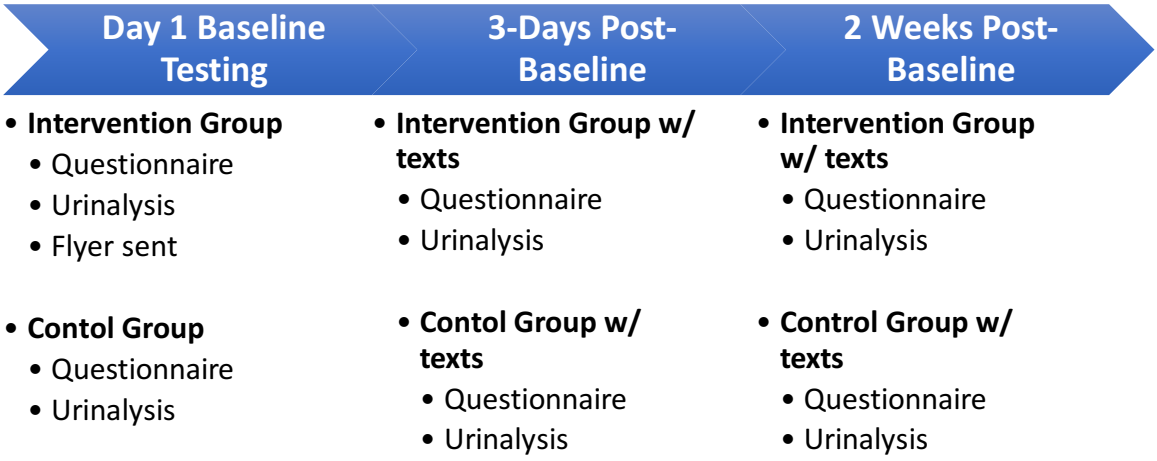



**Figure 3. Timeline of Data Collection**

**Proposed Data Analysis**

Data were analyzed using JMP, inputting the data and scanning again for errors. All statistical significance was set at $p \leq 0.05$. Descriptive statistics were run for all variables. Any type of open-ended question was considered and given a separate score. Measures of central tendency (mean, median, mode) and measures of variability (range, standard deviation) were also ran for all data. A repeated measures ANOVA was used to determine any significance between the interaction versus the treatment group and time. A bivariate correlation was used to determine the correlation between the urine specific gravity and the total knowledge score. Also, another repeated ANOVA was used to determine any significance between the interaction versus the survey totals and day.

## IV. RESULTS

### Participant Information

Participants included 36 undergraduate and graduate (undergraduate=28; graduate=8) students at Texas State University (male=14; female=22; mean age ± SD: 21.50±3.19 years with a range from 18-31). The average height for the participants was 66.17±4.28 in with a range from 56 to 74 in and the average weight of the participants was 176.17±51.14 pounds with a range of 101-320 pounds.

**Table 2. Demographics Table**

| | N | % | Mean | Std. Deviation |
|---|---|---|---|---|
| **Gender** | | | | |
| Male | 14 | 38.8% | | |
| Female | 22 | 61.1% | | |
| **Class Rank** | | | | |
| Freshman | 9 | 25% | | |
| Sophomore | 7 | 19.4% | | |
| Junior | 1 | 0.03% | | |
| Senior | 11 | 30.5% | | |
| Graduate Student | 8 | 22.2% | | |
| **Age** | | | | |
| 18-21 | 20 | 55.5% | | |
| 22-25 | 12 | 33.3% | | |
| 26-29 | 2 | 5.55% | 21.50 | 3.194 |
| 30+ | 2 | 5.55% | | |
| **Hours of Exercise/Week** | | | | |
| 0-5 | 12 | 33.3% | | |
| 5-10 | 17 | 47.2% | | |
| 10-15 | 7 | 19.4% | | |
| 20-25 | 0 | 0% | | |
| **Moderate Activity(hrs)/week** | | | | |
| 0-2 | 13 | 36.1% | | |
| 3-5 | 20 | 55.5% | | |
| 6-8 | 3 | 8.3% | | |
| **Vigorous Activity(hrs)/week** | | | | |
| 0-2 | 21 | 58.3% | | |

| | | |
|---|---|---|
| 3-5 | 12 | 33.3% |
| 6-8 | 3 | 8.3% |

**Table 3. Questionnaire Descriptives. Descriptives of all 16 Questionnaire Questions used.**

| Day 1 | Minimum | Maximum | Mean | Std. Dev |
|---|---|---|---|---|
| Proper Fluid Amount | 5 | 10 | 9.17 | 1.231 |
| Feeling Thirsty | 5 | 10 | 9.00 | 1.373 |
| Drinking Before Ex | 8 | 10 | 9.78 | .591 |
| Drinking During Ex | 3 | 10 | 9.50 | 1.320 |
| Drinking After Ex | 7 | 10 | 9.81 | .577 |
| Body Temp | 4 | 10 | 8.78 | 1.742 |
| Best Performance | 5 | 10 | 9.17 | 1.363 |
| Replace Sweat | 7 | 10 | 9.50 | .845 |
| Urine Color | 2 | 10 | 9.00 | 1.604 |
| Hot Outside | 7 | 10 | 9.64 | .798 |
| More Fluid if Harder Ex | 8 | 10 | 9.75 | .554 |
| More fluid if Long Practice | 5 | 10 | 9.50 | 1.028 |
| Weight Loss | 3 | 10 | 8.86 | 1.710 |
| Heat Illness | 8 | 10 | 9.67 | .676 |
| Importance of Drinking while Ex | 2 | 10 | 9.31 | 1.527 |
| Drink How Often During Ex | 3 | 10 | 8.25 | 1.933 |

| Day 3 | Minimum | Maximum | Mean | Std. Dev |
|---|---|---|---|---|
| Proper Fluid Amount | 7 | 10 | 9.54 | .817 |
| Feeling Thirsty | 5 | 10 | 9.37 | 1.190 |
| Drinking Before Ex | 8 | 10 | 9.77 | .547 |
| Drinking During Ex | 4 | 10 | 9.51 | 1.222 |
| Drinking After Ex | 8 | 10 | 9.83 | .453 |
| Body Temp | 6 | 10 | 9.37 | 1.140 |
| Best Performance | 6 | 10 | 9.14 | 1.375 |
| Replace Sweat | 6 | 10 | 9.46 | .980 |
| Urine Color | 5 | 10 | 9.00 | 1.283 |
| Hot Outside | 7 | 10 | 9.57 | .917 |
| More Fluid if Harder Ex | 6 | 10 | 9.57 | 1.008 |
| More fluid if Long Practice | 7 | 10 | 9.57 | .815 |
| Weight Loss | 5 | 10 | 9.06 | 1.434 |
| Heat Illness | 5 | 10 | 9.51 | 1.095 |
| Importance of Drinking while Ex | 6 | 10 | 9.31 | 1.207 |
| Drink How Often During Ex | 3 | 10 | 8.31 | 1.811 |

| Day 14 | Minimum | Maximum | Mean | Std. Dev |
|---|---|---|---|---|
| Proper Fluid Amount | 8 | 10 | 9.83 | .447 |
| Feeling Thirsty | 7 | 10 | 9.36 | 1.099 |
| Drinking Before Ex | 8 | 10 | 9.69 | .624 |
| Drinking During Ex | 4 | 10 | 9.33 | 1.373 |
| Drinking After Ex | 8 | 10 | 9.78 | .540 |
| Body Temp | 7 | 10 | 9.50 | .845 |
| Best Performance | 7 | 10 | 9.50 | .941 |
| Replace Sweat | 7 | 10 | 9.50 | .845 |
| Urine Color | 7 | 10 | 9.42 | .841 |
| Hot Outside | 6 | 10 | 9.58 | .874 |
| More Fluid if Harder Ex | 7 | 10 | 9.58 | .732 |
| More fluid if Long Practice | 7 | 10 | 9.53 | .810 |
| Weight Loss | 7 | 10 | 9.33 | .986 |
| Heat Illness | 7 | 10 | 9.56 | .773 |
| Importance of Drinking while Ex | 5 | 10 | 9.31 | 1.305 |
| Drink How Often During Ex | 3 | 10 | 8.44 | 1.843 |

**Questionnaire Descriptives**

Of the 36 participants, all completed day 1 and day 14 questionnaires. One participant started to fill out the questionnaire on day 3, but did not finish so a total of 35 participants completed the day 3 questionnaires. For the day 1 questionnaires, the total

score for the intervention group equaled 150.2 out of 160 (93.9%%), the total score for the control group was 147.1 (91.9%) and the average mean of answers to the Likert scale questions was 9.3±0.44. For the day 3 questionnaires, the total score for the intervention equaled 150.9 (94.3%), the total score for the control group equaled 143.3 (89.6%) and the average was 9.38±0.37. And for the day 14 questionnaires, the total score for the intervention group equaled 152.2 out of 160 (95.1%), the total score for the control group was 150.3 (93.9%) and the average was 9.46±0.31.

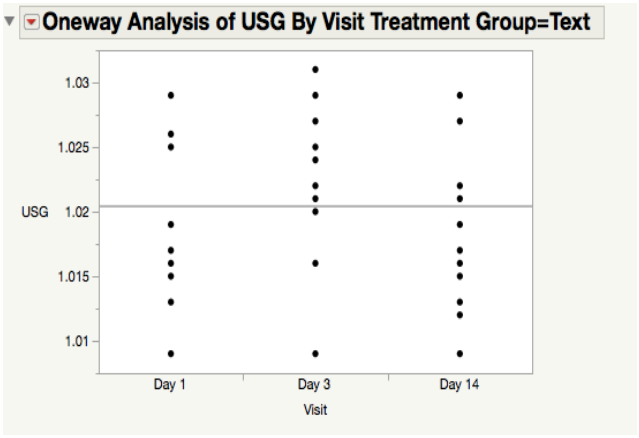
**Statistical Analysis**

In analyzing with a repeated measures ANOVA for the interaction effect between the educational intervention and time, there was no significant difference in hydration status treatment groups ($F_{2,68} = 0.667$, P=0.516). This showed that the educational intervention had no impact on hydration over the course of the 2 weeks. The average urine specific gravity readings on Day 1 for the intervention group was 1.019 and for the control group it equaled 1.020. For Day 3, the intervention group average equaled 1.018 and for the control group it equaled 1.021. For Day 14, the intervention group average equaled 1.019 and for the control group it equaled 1.020.

**Table 4. Repeated Measures ANOVA. Interaction effect between intervention and time.**

| Source | N | DF | DFDen | F Ratio | Prob |
|---|---|---|---|---|---|
| Treatment Group | 1 | 1 | 34 | 0.4321 | 0.5154 |
| Time | 2 | 2 | 68 | 0.0795 | 0.9236 |
| Treatment Group*Time | 2 | 2 | 68 | 0.6673 | 0.5164 |

A)




B)

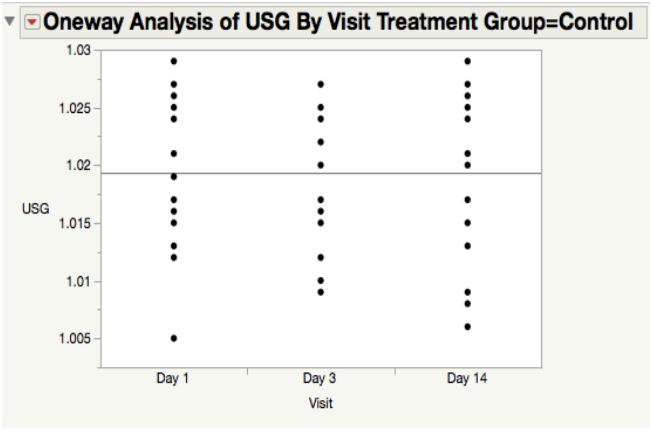



**Figure 4. Repeated Measures ANOVA. Analysis of Urine Specific Gravity separated by Day. A) Intervention Group. B) Control Group.**

*1.020 is the cut off line for hydration. Anything higher is considered dehydrated and lower is considered euhydrated.

**Table 5. Chi-Square Analysis**

| | Hydrated | Not Hydrated |
|---|---|---|
| **Day 1 Control** | 11 (61.1%) | 7 (38.8%) |
| **Day 1 Intervention** | 6 (33.3%) | 12 (66.6%) |
| **Day 3 Control** | 7 (38.8%) | 11 (61.2%) |
| **Day 3 Intervention** | 9 (50%) | 9 (50%) |
| **Day 14 Control** | 10 (55.5%) | 8 (44.4%) |
| **Day 14 Intervention** | 9 (50%) | 9 (50%) |

| | Pearson's Chi-Square |
|---|---|
| **Day 1** | P = .739 |
| **Day 3** | P = .127 |
| **Day 14** | P = .502 |

Table 5 is the chi-square analyses, alongside of the respective contingency tables, of hydration status and treatment group split into all 3 days. The chi-square analysis shows that neither day 1, 3, or 14 had statistical significance between treatment groups with p values of .739, .127, and .502, respectively.

A bivariate correlation (Figure 5) between the USG readings and the total score from the survey showed no significance ($R^2$=0.006, P=0.428). We had one outlier, so to have normalized data, we did not analyze this test with that outlier. This shows that there

was no correlation between the urine specific gravity samples and hydration knowledge.

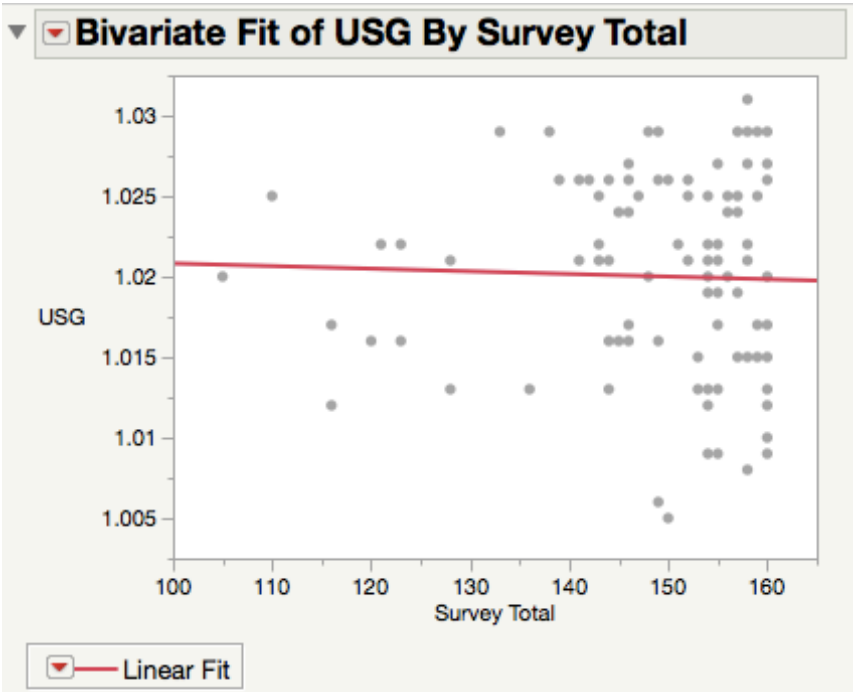



**Figure 5. Bivariate Correlation. Correlation of USG and Questionnaire Total**

Lastly, when comparing the questionnaire knowledge over the course of the study to the visit day, a repeated measures ANOVA shows no significant difference between all three time periods in both groups (P= 0.396) (Table 6). This shows that there were no significant changes in questionnaire total score over the course of the 2-week data collection.

**Table 6. Repeated Measures ANOVA. Analysis of Questionnaire Total Scores.**

| Source | N | DF | F Ratio | Prob |
|---|---|---|---|---|
| **Visit** | 2 | 2 | 0.0768 | 0.9261 |
| **Survey Total** | 1 | 1 | 0.0008 | 0.9773 |
| **Visit*Survey** | 2 | 2 | 0.9342 | 0.3962 |

The qualitative question at the end of the questionnaire that asks about two ways they would know they are hydrated, shown in Table 7. The totals were taken out of 216 possible survey answers (36 participants, 2 answers per person for all 3 days). About thirty percent of all survey answers for this question stated that urine color was one way to indicate dehydration. About 25 percent stated that dry mouth was another way to indicate dehydration.

**Table 7. Percentage of Questionnaire Answers. "2 ways participants knew they were hydrated".**

| | **Percentage of answers (N=216)** |
|---|---|
| Darker Urine Color | 30.09% |
| Dry Mouth | 25.46% |
| Headache | 9.72% |
| Fatigue | 9.72% |
| Increase of Sweat | 5.55% |
| Increase of Thirst | 8.33% |
| Decrease in Performance | 8.33% |
| More Pale Skin Color | 2.77% |

In conclusion, when analyzing the data for all three hypotheses in this study, there was no significance found in treatment groups through the use of repeated measure ANOVA's and correlation tests. Although we found no statistical significance, there is still clinical significance that will be discussed in the discussion.

## V. Discussion

### Major Findings

The results of this study suggest that an education intervention with text message reminders was not successful in improving hydration status within an active population. For the second hypothesis (stating that the comparison of the urinalysis results and the answers from the questionnaire will not correlate), showed no statistical significance therefore the null hypothesis was accepted. For the third hypothesis (stating that the hydration questionnaire scores will be lower at baseline than after educational intervention), we accepted the null hypothesis.

It is also important to acknowledge that when trying to change behaviors like this study aimed to do, it typically takes two things; the participants willingness to change those habits and enough change to be measurable. If individuals are not willing to change, it wouldn't matter how long a certain intervention is. Also, it is very hard to change certain behaviors if they already start out at a high baseline knowledge. Our population had an average score of 92.9% on their baseline scores. That shows us they already have a high knowledge of hydration practices. It is hard to see measureable changes when baseline scores are already high.

Building off that idea, it is speculated that our group population did not even need an education intervention to begin with. Since they did have a high baseline knowledge, it could be speculated that they are already proficient in hydration practices.

### Importance

One could interpret this data as while we think that we are educating individuals about hydration, there are outside factors that are impeding their ability to hydrate.

The data also found that the urine specific gravity numbers and questionnaires did not correlate with one another. The means of all 3 questionnaires were between 9.3-9.46 for each question so participants were agreeing with the importance of hydration and showing that they have a high baseline knowledge, yet were not properly hydrating themselves. This shows that their behavior does not match their knowledge.

As found in Cleary et al.[20] and McDermott et al.,[22] this study's findings are interpreted similarly. Clearly et al. found that a 1-time education session alone was not successful in changing hydration behaviors.[20] As noted, the changes in hydration practices takes a long time. Not only does it take time, but it takes determination to learn new skills and develop those skills over time. McDermott et al.[22] found that participants were already in a hypohydrated state coming into practice sessions. If an athlete or active person is already starting their exercise dehydrated, there will be an uphill battle to achieve proper hydration.

**Alternative Explanations**

There are many alternative explanations that could have influenced the results of this study. It is unknown if the participants in the intervention group read the text messages and links that were sent. A text message based reminder can be easily ignored or deleted by the participant.

A second explanation that could have influenced the results is that the majority of the population was undergraduate and graduate exercise science/athletic training students. This was not the ideal population because they should already have a good base knowledge of hydration so it's expected all the answers to the questionnaire to be at a higher level than the general population.

During the study, the participants had to perform a first morning urine sample for the urinalysis to get the best and most accurate reading of hydration. Since they were given the cup the day before the sample was due and told to bring it back into the lab, they could have forgotten to do the sample first thing in the morning so it would not have been as accurate. We sent text message reminders as early as 4am to help eliminate the forgetfulness, but it still could have occurred.

Since our study had the word "hydration" in the title and they were physically peeing in a cup and being told they were measuring hydration status, it could have skewed our results. The participants knew they were involved in a hydration study which could have influenced their daily hydration practices.

Lastly, we did collect some samples over a weekend. Alcohol intake was not assessed within this study which can influence the hydration status of a participant.

**Clinical Relevance**

This study can be translated into clinical practice in a few ways. One of those ways is that hydration reminders through repeated text messages with education is not effective for this study. For healthcare professionals, it shows us that we need constant education about hydration to our patients or athletes that we work with. We must keep up with reminders and education throughout seasons or careers to help form a habit of good hydration practices with the populations that we work with.

Another way it is clinically relevant is it shows healthcare professionals that it is very critical for us to monitor hydration status of our patients and athletes. The refractometer, weighing in and out of practice or competition, and the urine color chart is an easy and reliable way to get a quick read of hydration status. This can tell us if our

patients are able to perform to the best of their ability.

**Limitations**

The biggest limitation in this study was the number of participants. After a power analysis, it recommended we had a minimum of 50 participants. To get a greater effect there needed to be more participants and hopefully we would have seen some bigger changes from each day. Another limitation was that we used a non-digital refractometer and had to read measurements by eye. The screen was clear, but there could have been some misinterpretation of where the line was on the scale. Along those same lines, the refractometer we used gave us the USG numbers in whole numbers with minimal lines in between each number (Figure 2). Because of this we had to compare those whole numbers to another picture of a scale that was more accurate with better lines to read.

Another limitation is the weather that we had here in Texas over the course of the 2 weeks. This would be a limitation because it would skew the data results for true day to day hydration status.

**Further Research**

Further research should explore the effect of a longer duration intervention, to assess long term retention rate of hydration knowledge. Two weeks was not long enough to see a significant change in between groups. Further research should also concentrate on participants with a lower background knowledge in hydration.

Another option is to use an athletic population with greater training loads that result in more sweat loss during practice and games, and therefore at a greater risk for dehydration.

## Conclusion

Hydration is a very important part in physical activity and exercise so it is important for physically active individuals to have proper strategies and awareness of hydration. Healthcare professionals should be aware that it may take a long time to change patients' practices regarding hydration and to be constant and consist with their education if they do want to help patients become better hydrated.

## VI. MANUSCRIPT

# The Efficacy of a Hydration Education Intervention Program on Current Hydration Practices

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## ABSTRACT

**Context**: Hydration has been a heavily researched area within the athletic population, but little research has been done on the effect of education and its effect on hydration status with an emphasis on long term retention rate. Research has been conducted on short-term retention rate with regards to hydration education, but no studies have looked longer periods (>2 weeks) or the use of a text message intervention. This study was designed to fill those gaps of a longer retention period with multiple testing periods and reminders. **Objective**: The purpose of this study was to research the effect of a repeated social media hydration education intervention on a healthy, active general population. Also, to determine if the education would have an impact on hydration practices, knowledge, and attitudes and retention of hydration information. We hypothesized that the participants would not be euhydrated when performing a urinalysis at baseline, but the intervention will improve hydration status. **Design**: This study was a cohort, repeated measure study with the use of a hydration questionnaire and a collection of 3 urine samples over the course of 2 weeks. **Setting**: The participants collected their urine sample upon waking in the morning and brought the sample into the lab on day 1, day 3, and day 14 for urine specific gravity analysis with a refractometer. **Participants**: Thirty-six healthy, active (1-8 hours of exercise/week) participants between ages 18-31. **Intervention**: An intervention and control group was used for this study. The intervention group received text messages twice a day about proper hydration strategies and protocols while the control participants received text messages twice a day that were unrelated to hydration such as athletic events happening on campus. The data were analyzed pre-vs-post and correlated with the behaviors and practices of hydration through

the use of ANOVA's and correlations. **Main Outcome Measures**: Urine specific gravity was obtained via urinalysis with a refractometer. The knowledge of hydration was assed using a validated questionnaire. **Results**: No statistical significance was found between groups in this study for the effect of a repeated educational intervention on hydration status (P=0.516). There was also no statistical significance found when comparing questionnaire scores over the course of the 2 weeks (P=0.501). **Conclusions**: Education alone does not work in changing hydration status. Healthcare professionals should be aware that it may take a long time to change patients' practices regarding hydration and to be constant and consistent with their education if they do want to help patients become better hydrated.

**Word Count**: 411

**Keywords:** hydration, education, intervention, dehydration, urinalysis, refractometer

## Introduction

Proper hydration strategies and practices are an important component in sport performance, yet active individuals are slow to appreciate the extent to which their performance is affected by hydration status and even slower to develop hydration strategies that will allow them to optimize their performance.[10,12]

There can be several obstacles to implementing good hydration practices among athletes. The first would be knowing that dehydration can have a negative effect on performance. A second obstacle to implementing a successful hydration practice is the individuals' knowledge base. An awareness of the role that fluid plays in athletic performance and a knowledge of how to maintain hydration during practices and competition is necessary to maximize athletic potential.

### Professional Position Statements on Hydration

Both the National Athletic Trainers' Association (NATA) and the American College of Sports Medicine (ACSM) have published hydration position statements/stands and recommended standards of practice regarding hydration. The NATA position statement states that athletes whose sweat loss exceeds fluid intake become dehydrated during activity.[1] Dehydration of 1-2% of body weight begins to compromise physiologic function and has a negative impact on performance.[1] The position statement recommends that the athlete consume approximately 500 to 600 mL of water or sports drink 2-3 hours before exercise and 200 to 300 mL, 10 or 20 minutes before exercise.[1] They also recommend educating athletes on the effects of dehydration on performance and that healthcare professionals should have the proper equipment available to measure and test hydration status.

The American College of Sports Medicine mirrors is similar to the NATA position statement. ASCM recommends that pre-hydrating with fluids should be initiated at least several hours before the exercise task to enable proper fluid absorption.[2] During exercise, fluid intake is more based on an individual basis, aiming for no more than a 2% body weight loss. ACSM recommends fluids post-exercise of approximately 1.5 liters of fluid for each kilogram of body weight lost from exercise.[2] Post-exercise fluids are especially important when athletes have back-to-back games or multiple games in one day.[2]

**Hydration Education**

Hydration research has been conducted over a wide spectrum of athletic performance. Most of this research has focused primarily on measuring pre-and post-training hydration status of athletes. There are only a few studies that examine the effect of a hydration education intervention.

Cleary et al.[3] assessed hydration status and behaviors in female athletes before and after a one-time education intervention. The authors had a total of four observational periods throughout the study and assigned subjects to one of the four groups which included, control, educational intervention, prescribed hydration intervention and observational follow up. They measured body mass changes post-exercise and found that the participants in the prescribed hydration intervention group were the only ones to maintain body mass. The authors concluded that a one-time educational intervention was not successful in changing hydration behaviors.[3]

In another study, Kavouras et al.[4] researched the effect of a hydration education intervention in 92, young athletes exercising in hot climates. The intervention group

attended a one hour lecture on hydration and the authors mounted urine color charts in all the bathrooms. The participants' performance in field tests such as 600-m run, 30-m sprint, vertical jump, and skills tests for volleyball and basketball were measured. The authors' main finding was that an intervention program showed successful for enhancing hydration status over just a 2-day period. They concluded that "an intervention to teach and facilitation of hydration accessibility, along with simple and realistic hydration strategies will benefit youths exercising at summer camps."[4]

McDermott et al.[5] observed hydration status, sweat rates, fluid consumption, and the effectiveness of an education intervention in youth football players. The intervention included 4-8 minutes of a lecture discussing hydration importance. The authors found a positive change with an education intervention, but could not pinpoint if the change was due to the intervention or the athletes' prior hydration knowledge. McDermott et al.[5] showed that subjects came into camp in a dehydrated state and found it difficult to "catch" back up to a normal level during physical activity.

When dealing with hydration, it is important to keep in mind that it is extremely hard to generalize findings to the general population because each person's hydration strategies and sweat rates are different. Therefore, it would be beneficial to have this knowledge of individualized sweat rates to individualize hydration strategies to specific participants.

**Purpose**

The purpose of this study was to determine the effect of a repeated text message hydration education intervention, determine if hydration practices changed, and long term retention of information in a general, active population. In addition, this study analyzed

results from a completed urinalysis on the individuals' urine and correlated the findings from that to hydration knowledge.

**Hypothesis**

It was hypothesized that…

1. The educational intervention will have a positive impact for the intervention group on hydration for a short period of time (3 days) and will not have lasting effects at day 14.

2. Hydration, as measured by urinalysis, will not correlate with knowledge of hydration. Participants will overstate their hydration status and answer the questionnaire correctly but show through urinalysis that they are dehydrated.

3. Knowledge, behaviors and attitudes of hydration will improve over time after the education intervention.

**Significance of Study**

Hydration is a key performance factor that can affect performance in a negative way if not practiced correctly. Because it is an intrinsic factor, unlike biomechanical factors or predisposing injury factors, hydration is a way to help athletic performance that one can control. As health care professionals, it is important to educate and treat active individuals holistically and hydration is an important factor.

Because hydration is not an injury or a rehabilitation technique, it is often overlooked by active individuals. It is important for health care providers (athletic trainers, physical therapists, nurses, etc.) to be the front line and provide them with knowledge and hydration strategies. Assumptions of already understanding hydration practices are made when in fact, it's shown that many athletes do not know how to

hydrate properly.[21,22] Hydration practices need to become habitual not only for athletic performance, but for quality of life continuing after sports.

There may be many reasons why active individuals do not have optimal hydration practices. Individuals may not know the current standards and recent research or they have done certain practices their whole life and do not perceive that it has impacted their performance. Individuals may also not know how to properly recover and might not know the proper fluid ounces needed to perform at their best.

Understanding the reasons behind certain hydration practices and current level of knowledge is significant in order to change these practices and provide the best care to each individual. This study will aim to develop the proper practices, attitudes, and knowledge about hydration.

## Methods

### Design

The methods of this study were designed to further understand the impact of a hydration education intervention and if it would change the practices and knowledge of hydration within an active population. This study was a mixed methods study by looking at both qualitative and quantitative data. The independent variables were the hydration education intervention and time with covariates being gender and workout type. The study's dependent variables were knowledge/behaviors of hydration, hydration practices and urinalysis.

### Participants

Participants were all active participants from the general student population at Texas State University. All participants were recruited by emails sent around campus, by

the researcher speaking to specific classes, or by speaking to the athletic teams' athletic trainers. The inclusion and exclusion criteria are listed in Table 1. Participants who met all inclusion criteria for the study were then asked to sign an informed consent form to participate in the study. A total of forty-four participants between 18-31 years of age volunteered for this study. They were sent a sign-up sheet and 44 participants signed up to come to the initial meeting. Three of those 44 did not show up to their assigned time slot, giving us a total of 41 who signed informed consent forms. All participants brought back their day 1 and day 3 samples, yet 5 did not bring back their day 14 samples so a total of 36 participants were included in this study. All participants were offered a $10 gift card for participation upon completion in this study. This research thesis was approved by the Texas State University Institution Review Board (Approval #:2018203).

Participants were split into two groups: an intervention group (n=18) and a control group (n=18). Randomization of groups occurred when they came into the lab for their initial meeting. They drew a number out of a hat to determine what group they were going to be placed in.

**Table 1. Inclusion/Exclusion Criteria.**

| **Inclusion Criteria** | **Exclusion Criteria** |
|---|---|
| • Must be a current Texas State Varsity or club athlete or college student | • If they have recently been educated on hydration |
| • Between ages of 18-31 | • If they miss a urinalysis session |
| • On a consistent training regimen of exercise 1-10 hrs/week | • If they have sustained an injury within the last 2 weeks |

**Instrumentation**

A validated questionnaire (Appendix A) was used to assess previous hydration knowledge and current hydration practices. The questionnaire was previously validated by McDermott et al.[22] The questionnaire included both qualitative and quantitative questions while using Likert scales ranging from 0-10. The following are examples of the types of questions that were asked:

- My urine should appear pale yellow in color if I am drinking enough fluids (0-10). In this case, 0 would be strongly disagree and 10 would be strongly agree.
- Drinking soda or any other caffeinated beverages does not hydrate me as well as water (0-10). In this case, 0 would be strongly disagree and 10 would be strongly agree.
- Name two ways that you know that you are dehydrated.

After questionnaires were completed, a total sum score was given to each questionnaire. This was performed by adding up all Likert scale questions and calculating their total out of 160 total possible points (16 used total Likert scale questions). Two questions were left out of the analysis. The first one was a question asking "drinking soda or any other caffeinated beverages does not hydrate me as well as water" and the second one was "do you wish you could drink more fluids during exercise?" These were left out due to coding issues and skewing of results.

A urinalysis with a refractometer (General®, REF312ATC Protein/Urine Refractometer ATC) was used to determine the participants' hydration status. Urine refractometers are a simple and affordable tool, while still being accurate and consistent,

to measure urine specific gravity[1]. A urine sample cup was provided to the participant the day before the sample was collected. Participants were instructed to provide a first morning urine sample and bring it into the lab at any point during the same day they provided the sample. This first morning sample was verbally verified by the participants when they dropped them off. They were immediately refrigerated after they dropped it off. All of the analysis was done within 8 hours after receiving the urine sample. Figure 1 shows the published averages for levels of being in a euhydrated state (normal/hydrated state of body water).

**Urine Specific Gravity (USG) / Osmolality (UOsmol)**

- USG of ≤ 1.020 = euhydrated
- UOsmol ≤ 700 mOsmol/kg = euhydrated

**Figure 4. Normative Values for Hydration.**

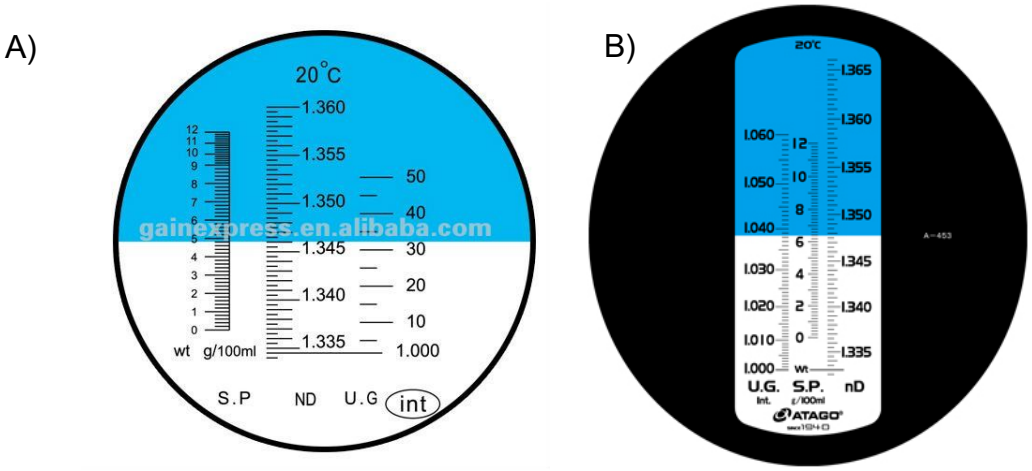



**Figure 5. Refractometer Scales.**
a) Picture on left is what was on the refractometer used in the study.
b) Picture on right is what was used to compare USG readings for better accuracy

**Data Collection Procedures**

Data were collected over a 2-week period. Participants signed up through an online sign-up sheet to come to the initial meeting either on a Wednesday, Thursday or Friday of the same week. When participants arrived in the lab, the study was explained to them and, if they met all inclusion criteria and were interested, they signed an informed consent form. After signing the consent, participants were given a baseline questionnaire to fill out and sample cups were given to them for their first urine sample. Participants were then split into control and intervention groups. Both groups received two text messages per day for 14 days. The intervention group's text messages were messages on tips and strategies about hydration and reminders to drink adequate fluid (Appendix IV). They also got links to a flyer (Appendix III) that explained various aspects of hydration and the NATA hydration position statement. The participants brought the day 3 urine sample in and filled out the day 3 questionnaire. This was repeated for day 14 of data collection.

The control group received text message updates as well, but they were unrelated to hydration. They were regarding, for example, certain Texas State athletic events that day, study tips, or tips on how to find jobs. All text messages for both intervention and control groups were done by an online website (remind.com) that has features for automatic reminders. Some messages were sent out early in the morning to make sure they provide the first morning urine sample. The other messages were sent out any time during the day to facilitate engagement.

Participants received compensation of a $10.00 gift card for participating in the study. The gift card was issued towards HEB, a local grocery store, and was used to

lessen the attrition rate within the study. The gift card was given to the participant after they brought in their day 14 sample.

Figure 3 shows a visual timeline of how the study data collection was conducted.

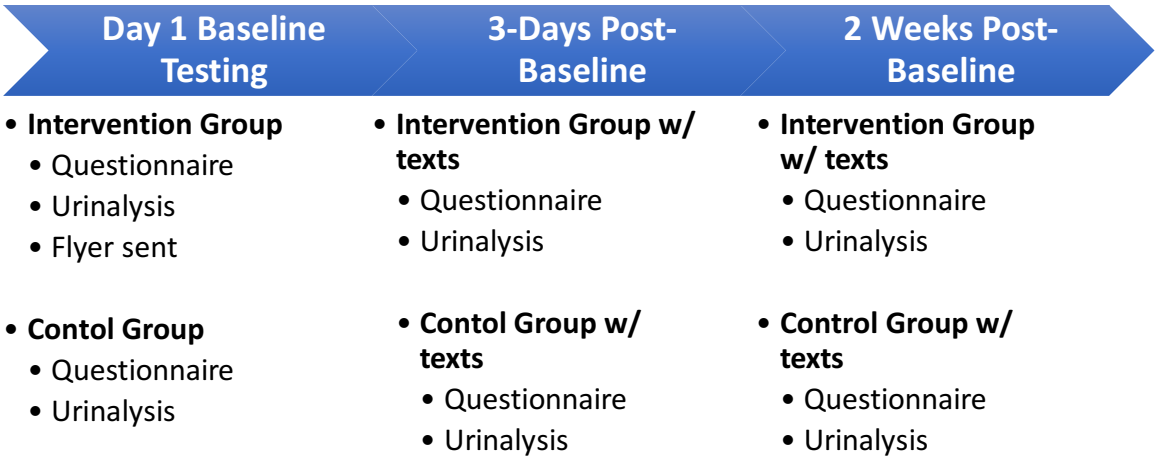



**Figure 6. Timeline of Data Collection**

**Proposed Data Analysis**

Data were analyzed using JMP, inputting the data and scanning again for errors. All statistical significance was set at $p \leq 0.05$. Descriptive statistics were run for all variables. Any type of open-ended question was considered and given a separate score. Measures of central tendency (mean, median, mode) and measures of variability (range, standard deviation) were also ran for all data. A repeated measures ANOVA was used to determine any significance between the interaction versus the treatment group and time. A bivariate correlation was used to determine the correlation between the urine specific gravity and the total knowledge score. Also, another repeated ANOVA was used to determine any significance between the interaction versus the survey totals and day.

## Results

### Participant Information

Participants included 36 undergraduate and graduate (undergraduate=28; graduate=8) students at Texas State University (male=14; female=22; mean age ± SD: 21.50±3.19 years with a range from 18-31). The average height for the participants was 66.17±4.28 in with a range from 56 to 74 in and the average weight of the participants was 176.17±51.14 pounds with a range of 101-320 pounds.

**Table 2. Demographics Table**

| | N | % | Mean | Std. Deviation |
|---|---|---|---|---|
| **Gender** | | | | |
| Male | 14 | 38.8% | | |
| Female | 22 | 61.1% | | |
| **Class Rank** | | | | |
| Freshman | 9 | 25% | | |
| Sophomore | 7 | 19.4% | | |
| Junior | 1 | 0.03% | | |
| Senior | 11 | 30.5% | | |
| Graduate Student | 8 | 22.2% | | |
| **Age** | | | | |
| 18-21 | 20 | 55.5% | | |
| 22-25 | 12 | 33.3% | | |
| 26-29 | 2 | 5.55% | 21.50 | 3.194 |
| 30+ | 2 | 5.55% | | |
| **Hours of Exercise/Week** | | | | |
| 0-5 | 12 | 33.3% | | |
| 5-10 | 17 | 47.2% | | |
| 10-15 | 7 | 19.4% | | |
| 20-25 | 0 | 0% | | |
| **Moderate Activity(hrs)/week** | | | | |
| 0-2 | 13 | 36.1% | | |
| 3-5 | 20 | 55.5% | | |
| 6-8 | 3 | 8.3% | | |
| **Vigorous Activity(hrs)/week** | | | | |
| 0-2 | 21 | 58.3% | | |

| | | |
|---|---|---|
| 3-5 | 12 | 33.3% |
| 6-8 | 3 | 8.3% |

**Table 3. Questionnaire Descriptives. Descriptives of all 16 Questionnaire Questions used.**

| Day 1 | Minimum | Maximum | Mean | Std. Dev |
|---|---|---|---|---|
| Proper Fluid Amount | 5 | 10 | 9.17 | 1.231 |
| Feeling Thirsty | 5 | 10 | 9.00 | 1.373 |
| Drinking Before Ex | 8 | 10 | 9.78 | .591 |
| Drinking During Ex | 3 | 10 | 9.50 | 1.320 |
| Drinking After Ex | 7 | 10 | 9.81 | .577 |
| Body Temp | 4 | 10 | 8.78 | 1.742 |
| Best Performance | 5 | 10 | 9.17 | 1.363 |
| Replace Sweat | 7 | 10 | 9.50 | .845 |
| Urine Color | 2 | 10 | 9.00 | 1.604 |
| Hot Outside | 7 | 10 | 9.64 | .798 |
| More Fluid if Harder Ex | 8 | 10 | 9.75 | .554 |
| More fluid if Long Practice | 5 | 10 | 9.50 | 1.028 |
| Weight Loss | 3 | 10 | 8.86 | 1.710 |
| Heat Illness | 8 | 10 | 9.67 | .676 |
| Importance of Drinking while Ex | 2 | 10 | 9.31 | 1.527 |
| Drink How Often During Ex | 3 | 10 | 8.25 | 1.933 |

| Day 3 | Minimum | Maximum | Mean | Std. Dev |
|---|---|---|---|---|
| Proper Fluid Amount | 7 | 10 | 9.54 | .817 |
| Feeling Thirsty | 5 | 10 | 9.37 | 1.190 |
| Drinking Before Ex | 8 | 10 | 9.77 | .547 |
| Drinking During Ex | 4 | 10 | 9.51 | 1.222 |
| Drinking After Ex | 8 | 10 | 9.83 | .453 |
| Body Temp | 6 | 10 | 9.37 | 1.140 |
| Best Performance | 6 | 10 | 9.14 | 1.375 |
| Replace Sweat | 6 | 10 | 9.46 | .980 |
| Urine Color | 5 | 10 | 9.00 | 1.283 |
| Hot Outside | 7 | 10 | 9.57 | .917 |
| More Fluid if Harder Ex | 6 | 10 | 9.57 | 1.008 |
| More fluid if Long Practice | 7 | 10 | 9.57 | .815 |
| Weight Loss | 5 | 10 | 9.06 | 1.434 |
| Heat Illness | 5 | 10 | 9.51 | 1.095 |
| Importance of Drinking while Ex | 6 | 10 | 9.31 | 1.207 |
| Drink How Often During Ex | 3 | 10 | 8.31 | 1.811 |

| Day 14 | Minimum | Maximum | Mean | Std. Dev |
|---|---|---|---|---|
| Proper Fluid Amount | 8 | 10 | 9.83 | .447 |
| Feeling Thirsty | 7 | 10 | 9.36 | 1.099 |
| Drinking Before Ex | 8 | 10 | 9.69 | .624 |
| Drinking During Ex | 4 | 10 | 9.33 | 1.373 |
| Drinking After Ex | 8 | 10 | 9.78 | .540 |
| Body Temp | 7 | 10 | 9.50 | .845 |
| Best Performance | 7 | 10 | 9.50 | .941 |
| Replace Sweat | 7 | 10 | 9.50 | .845 |
| Urine Color | 7 | 10 | 9.42 | .841 |
| Hot Outside | 6 | 10 | 9.58 | .874 |
| More Fluid if Harder Ex | 7 | 10 | 9.58 | .732 |
| More fluid if Long Practice | 7 | 10 | 9.53 | .810 |
| Weight Loss | 7 | 10 | 9.33 | .986 |
| Heat Illness | 7 | 10 | 9.56 | .773 |
| Importance of Drinking while Ex | 5 | 10 | 9.31 | 1.305 |
| Drink How Often During Ex | 3 | 10 | 8.44 | 1.843 |

**Questionnaire Descriptives**

Of the 36 participants, all completed day 1 and day 14 questionnaires. One participant started to fill out the questionnaire on day 3, but did not finish so a total of 35 participants completed the day 3 questionnaires. For the day 1 questionnaires, the total

score for the intervention group equaled 150.2 out of 160 (93.9%%), the total score for the control group was 147.1 (91.9%) and the average mean of answers to the Likert scale questions was 9.3±0.44. For the day 3 questionnaires, the total score for the intervention equaled 150.9 (94.3%), the total score for the control group equaled 143.3 (89.6%) and the average was 9.38±0.37. And for the day 14 questionnaires, the total score for the intervention group equaled 152.2 out of 160 (95.1%), the total score for the control group was 150.3 (93.9%) and the average was 9.46±0.31.

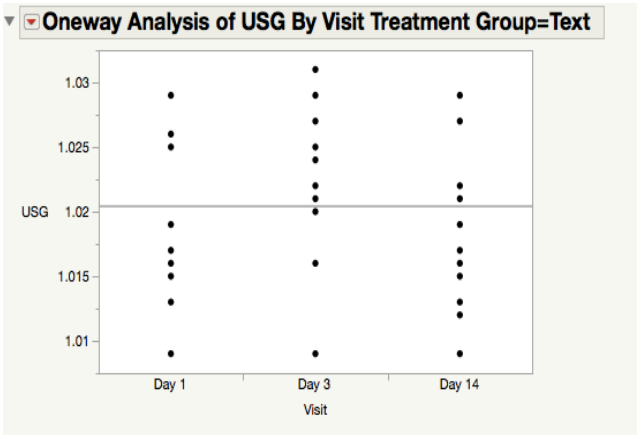
**Statistical Analysis**

In analyzing with a repeated measures ANOVA for the interaction effect between the educational intervention and time, there was no significant difference in hydration status treatment groups ($F_{2,68} = 0.667$, P=0.516). This showed that the educational intervention had no impact on hydration over the course of the 2 weeks. The average urine specific gravity readings on Day 1 for the intervention group was 1.019 and for the control group it equaled 1.020. For Day 3, the intervention group average equaled 1.018 and for the control group it equaled 1.021. For Day 14, the intervention group average equaled 1.019 and for the control group it equaled 1.020.

**Table 4. Repeated Measures ANOVA. Interaction effect between intervention and time.**

| Source | N | DF | DFDen | F Ratio | Prob |
|---|---|---|---|---|---|
| Treatment Group | 1 | 1 | 34 | 0.4321 | 0.5154 |
| Time | 2 | 2 | 68 | 0.0795 | 0.9236 |
| Treatment Group*Time | 2 | 2 | 68 | 0.6673 | 0.5164 |

A)




B)

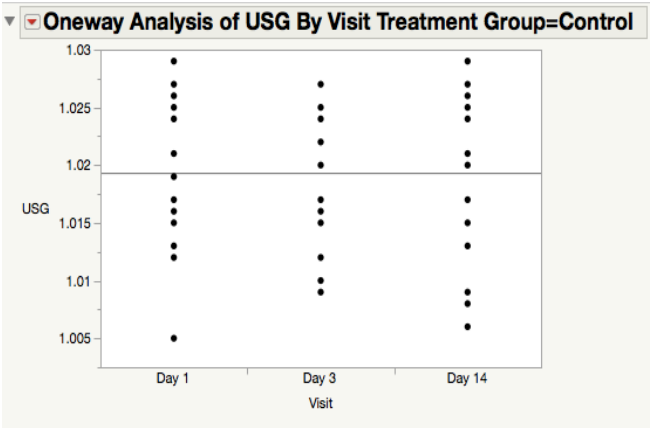



**Figure 4. Repeated Measures ANOVA. Analysis of Urine Specific Gravity separated by Day. A) Intervention Group. B) Control Group.**

*1.020 is the cut off line for hydration. Anything higher is considered dehydrated and lower is considered euhydrated.

**Table 5. Chi-Square Analysis**

| | Hydrated | Not Hydrated |
|---|---|---|
| **Day 1 Control** | 11 (61.1%) | 7 (38.8%) |
| **Day 1 Intervention** | 6 (33.3%) | 12 (66.6%) |
| **Day 3 Control** | 7 (38.8%) | 11 (61.2%) |
| **Day 3 Intervention** | 9 (50%) | 9 (50%) |
| **Day 14 Control** | 10 (55.5%) | 8 (44.4%) |
| **Day 14 Intervention** | 9 (50%) | 9 (50%) |

| | Pearson's Chi-Square |
|---|---|
| **Day 1** | P = .739 |
| **Day 3** | P = .127 |
| **Day 14** | P = .502 |

Table 5 is the chi-square analyses, alongside of the respective contingency tables, of hydration status and treatment group split into all 3 days. The chi-square analysis shows that neither day 1, 3, or 14 had statistical significance between treatment groups with p values of .739, .127, and .502, respectively.

A bivariate correlation (Figure 5) between the USG readings and the total score from the survey showed no significance ($R^2$=0.006, P=0.428). We had one outlier, so to have normalized data, we did not analyze this test with that outlier. This shows that there

was no correlation between the urine specific gravity samples and hydration knowledge.

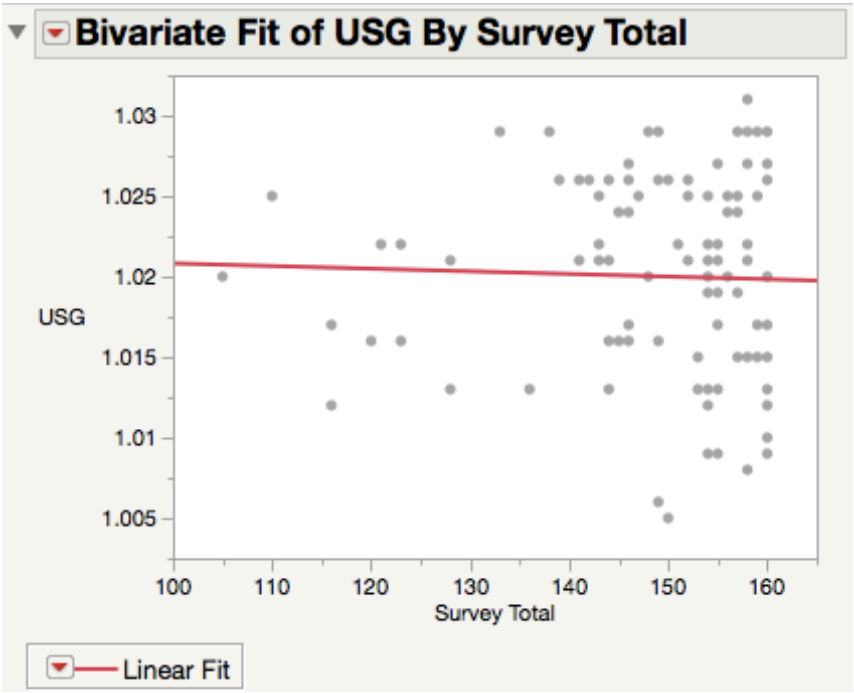



**Figure 5. Bivariate Correlation. Correlation of USG and Questionnaire Total**

Lastly, when comparing the questionnaire knowledge over the course of the study to the visit day, a repeated measures ANOVA shows no significant difference between all three time periods in both groups (P= 0.396) (Table 6). This shows that there were no significant changes in questionnaire total score over the course of the 2-week data collection.

**Table 6. Repeated Measures ANOVA. Analysis of Questionnaire Total Scores.**

| Source | N | DF | F Ratio | Prob |
|---|---|---|---|---|
| **Visit** | 2 | 2 | 0.0768 | 0.9261 |
| **Survey Total** | 1 | 1 | 0.0008 | 0.9773 |
| **Visit*Survey** | 2 | 2 | 0.9342 | 0.3962 |

The qualitative question at the end of the questionnaire that asks about two ways they would know they are hydrated, shown in Table 7. The totals were taken out of 216 possible survey answers (36 participants, 2 answers per person for all 3 days). About thirty percent of all survey answers for this question stated that urine color was one way to indicate dehydration. About 25 percent stated that dry mouth was another way to indicate dehydration.

**Table 7. Percentage of Questionnaire Answers. "2 ways participants knew they were hydrated".**

| | **Percentage of answers (N=216)** |
|---|---|
| Darker Urine Color | 30.09% |
| Dry Mouth | 25.46% |
| Headache | 9.72% |
| Fatigue | 9.72% |
| Increase of Sweat | 5.55% |
| Increase of Thirst | 8.33% |
| Decrease in Performance | 8.33% |
| More Pale Skin Color | 2.77% |

In conclusion, when analyzing the data for all three hypotheses in this study, there was no significance found in treatment groups through the use of repeated measure ANOVA's and correlation tests. Although we found no statistical significance, there is still clinical significance that will be discussed in the discussion.

## Discussion

### Major Findings

The results of this study suggest that an education intervention with text message reminders was not successful in improving hydration status within an active population. For the second hypothesis (stating that the comparison of the urinalysis results and the answers from the questionnaire will not correlate), showed no statistical significance therefore the null hypothesis was accepted. For the third hypothesis (stating that the hydration questionnaire scores will be lower at baseline than after educational intervention), we accepted the null hypothesis.

It is also important to acknowledge that when trying to change behaviors like this study aimed to do, it typically takes two things; the participants willingness to change those habits and enough change to be measurable. If individuals are not willing to change, it wouldn't matter how long a certain intervention is. Also, it is very hard to change certain behaviors if they already start out at a high baseline knowledge. Our population had an average score of 92.9% on their baseline scores. That shows us they already have a high knowledge of hydration practices. It is hard to see measureable changes when baseline scores are already high.

Building off that idea, it is speculated that our group population did not even need an education intervention to begin with. Since they did have a high baseline knowledge, it could be speculated that they are already proficient in hydration practices.

### Importance

One could interpret this data as while we think that we are educating individuals about hydration, there are outside factors that are impeding their ability to hydrate.

The data also found that the urine specific gravity numbers and questionnaires did not correlate with one another. The means of all 3 questionnaires were between 9.3-9.46 for each question so participants were agreeing with the importance of hydration and showing that they have a high baseline knowledge, yet were not properly hydrating themselves. This shows that their behavior does not match their knowledge.

As found in Cleary et al.[20] and McDermott et al.,[22] this study's findings are interpreted similarly. Clearly et al. found that a 1-time education session alone was not successful in changing hydration behaviors.[20] As noted, the changes in hydration practices takes a long time. Not only does it take time, but it takes determination to learn new skills and develop those skills over time. McDermott et al.[22] found that participants were already in a hypohydrated state coming into practice sessions. If an athlete or active person is already starting their exercise dehydrated, there will be an uphill battle to achieve proper hydration.

**Alternative Explanations**

There are many alternative explanations that could have influenced the results of this study. It is unknown if the participants in the intervention group read the text messages and links that were sent. A text message based reminder can be easily ignored or deleted by the participant.

A second explanation that could have influenced the results is that the majority of the population was undergraduate and graduate exercise science/athletic training students. This was not the ideal population because they should already have a good base knowledge of hydration so it's expected all the answers to the questionnaire to be at a higher level than the general population.

During the study, the participants had to perform a first morning urine sample for the urinalysis to get the best and most accurate reading of hydration. Since they were given the cup the day before the sample was due and told to bring it back into the lab, they could have forgotten to do the sample first thing in the morning so it would not have been as accurate. We sent text message reminders as early as 4am to help eliminate the forgetfulness, but it still could have occurred.

Since our study had the word "hydration" in the title and they were physically peeing in a cup and being told they were measuring hydration status, it could have skewed our results. The participants knew they were involved in a hydration study which could have influenced their daily hydration practices.

Lastly, we did collect some samples over a weekend. Alcohol intake was not assessed within this study which can influence the hydration status of a participant.

**Clinical Relevance**

This study can be translated into clinical practice in a few ways. One of those ways is that hydration reminders through repeated text messages with education is not effective for this study. For healthcare professionals, it shows us that we need constant education about hydration to our patients or athletes that we work with. We must keep up with reminders and education throughout seasons or careers to help form a habit of good hydration practices with the populations that we work with.

Another way it is clinically relevant is it shows healthcare professionals that it is very critical for us to monitor hydration status of our patients and athletes. The refractometer, weighing in and out of practice or competition, and the urine color chart is an easy and reliable way to get a quick read of hydration status. This can tell us if our

patients are able to perform to the best of their ability.

**Limitations**

The biggest limitation in this study was the number of participants. After a power analysis, it recommended we had a minimum of 50 participants. To get a greater effect there needed to be more participants and hopefully we would have seen some bigger changes from each day. Another limitation was that we used a non-digital refractometer and had to read measurements by eye. The screen was clear, but there could have been some misinterpretation of where the line was on the scale. Along those same lines, the refractometer we used gave us the USG numbers in whole numbers with minimal lines in between each number (Figure 2). Because of this we had to compare those whole numbers to another picture of a scale that was more accurate with better lines to read.

Another limitation is the weather that we had here in Texas over the course of the 2 weeks. This would be a limitation because it would skew the data results for true day to day hydration status.

**Further Research**

Further research should explore the effect of a longer duration intervention, to assess long term retention rate of hydration knowledge. Two weeks was not long enough to see a significant change in between groups. Further research should also concentrate on participants with a lower background knowledge in hydration.

Another option is to use an athletic population with greater training loads that result in more sweat loss during practice and games, and therefore at a greater risk for dehydration.

## Conclusion

Hydration is a very important part in physical activity and exercise so it is important for physically active individuals to have proper strategies and awareness of hydration. Healthcare professionals should be aware that it may take a long time to change patients' practices regarding hydration and to be constant and consist with their education if they do want to help patients become better hydrated.

## APPENDIX SECTION

## I. IRB Application

TEXAS STATE UNIVERSITY
SAN MARCOS
*The rising STAR of Texas*

In future correspondence please refer to 2018203

December 4, 2017

Kevin Berning
Texas State University
601 University Dr.
San Marcos, TX 78666

Dear Mr. Berning:

Your application 2018203 titled, "The Efficacy of a Hydration Education Intervention Program on Current Hydration Practices," was reviewed by the Texas State University IRB and approved. It has been determined there are: (1) research procedures consistent with a sound research design and they do not expose the subjects to unnecessary risk. (2) benefits to subjects are considered along with the importance of the topic and that outcomes are reasonable; (3) selection of subjects is equitable; and (4) the purposes of the research and the research setting is amenable to subjects' welfare and producing desired outcomes; that indications of coercion or prejudice are absent, and that participation is clearly voluntary.

1. In addition, the IRB found that you need to orient participants as follows: (1) informed consent is required; (2) Provision is made for collecting, using and storing data in a manner that protects the safety and privacy of the subjects and the confidentiality of the data; (3) Appropriate safeguards are included to protect the rights and welfare of the subjects.

**This project is therefore approved at the Expedited Review Level until November 30, 2018**

2. Please note that the institution is not responsible for any actions regarding this protocol before approval. If you expand the project at a later date to use other instruments, please re-apply. Copies of your request for human subjects review, your application, and this approval, are maintained in the Office of Research Integrity and Compliance.

Report any changes to this approved protocol to this office. A Continuing Review protocol will be sent to you in the future to determine the status of the project. Notify the IRB of any unanticipated events, serious adverse events, and breach of confidentiality within 3 days.

Sincerely,

Monica Gonzales

Monica Gonzales
IRB Regulatory Manager
Office of Research Integrity and Compliance
Texas State University

CC: Dr. Darcy Downey

OFFICE OF THE ASSOCIATE VICE PRESIDENT FOR RESEARCH
601 University Drive | JCK #489 | San Marcos, Texas 78666-4616
*Phone* 512.245.2314 | *fax* 512.245.3847 | WWW.TXSTATE.EDU

*This letter is an electronic communication from Texas State University-San Marcos, a member of The Texas State University System.*

# II. Hydration Questionnaire

**Hydration Questionnaire**

I am a graduate student in the Athletic Training Department looking to understand hydration and hydration strategies and knowledge. Please answer the questions to the best of your ability. This survey will take approximately 10-15 minutes to complete. If you have any questions regarding the survey, please feel free to contact Kevin Berning, krb189@txstate.edu or 303-601-4099.

Demographics:

1) Age: _____ Years

2) Gender (Check one)
- ☐ Male
- ☐ Female
- ☐ Transgender

3) Weight (lbs):_____

4) Height (in):_____ (example 64 inches)

5) Class standing at university? (Check one)
- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior
- ☐ Other _____

6) What sport(s) do you participate in at your university? (Check one)
- ☐ Basketball
- ☐ Volleyball
- ☐ Football
- ☐ Soccer
- ☐ Other: _____

7) How many hours a week do you exercise?
- ☐ 0-5
- ☐ 5-10
- ☐ 10-15
- ☐ 20-25

## *HYDRATION AWARENESS QUIZ/QUESTIONNAIRE*

Please circle a number.

To be hydrated means to have a proper amount of fluids in your body.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

Feeling thirsty while I am playing sports is one way I know my body is losing water and I need to drink.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

It is important to drink **before** practices and games.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

It is important to drink **during** practices and games.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

It is important to drink **after** practices and games.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

Drinking fluids helps keep my body temperature from getting too high while exercising.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

I need to drink fluids to perform at my best in sports.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

I need to drink fluids to replace the sweat I lose during exercise.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

My urine should appear pale yellow in color if I am drinking enough fluids.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

I may need to drink more fluid and more often if it is very hot out.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

I may need to drink more fluid and more often if I am practicing harder (more intensely) than usual.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

I may need to drink more fluid if practice is longer than usual.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

If I weigh less after a practice or game than I did at the beginning, then the weight I lost was probably due to sweat.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

Drinking fluids decreases my chances of having a heat illness (like heat exhaustion or heat cramps).

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

Drinking soda or any other caffeinated beverage does not hydrate me as well as water.

0 1 2 3 4 5 6 7 8 9 10

strongly disagree strongly agree

## *HYDRATION HABITS QUESTIONNAIRE*

How important do you feel that drinking fluids is while you play sports or exercise?

0 1 2 3 4 5 6 7 8 9 10

Not Important Very Important

Why or why not?

How often do you drink fluids when you play sports or exercise?

0 1 2 3 4 5 6 7 8 9 10

never always

What kind of fluids do you drink during sports or exercise?

Why do you choose these drinks?

Where do you get the fluids you drink during sports/exercise? (you may circle more than one)

Team cooler
Water fountain
Water bottle from home
Water bottle supplied by coach or team
Other (please list)_____

In a normal game or practice, how frequently do you drink? (you may circle more than one)

Whenever I want (I will stop playing to go drink)
Only during breaks
When not playing
When coach tells us
I don't drink during practice
Other (please explain)_____

21. Do you wish you could drink more fluids during practices and games?

0 1 2 3 4 5 6 7 8 9 10

|___|___|___|___|___|___|___|___|___|___|___|

Not at all A lot more

Explain why:

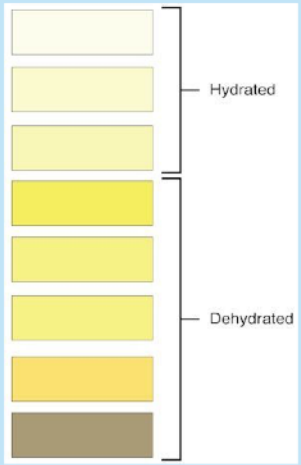
22. Name two ways you know you are dehydrated

## III. Hydration Flyer

# Hydration Information

### Hydration Facts

- The body can lose fluid through the skin as sweat, through the lungs while breathing, and through urination
- Factors that influence hydration:
  - Training Status & Intensity
  - Humidity
  - Temperature
  - Environment & Equipment
- While dehydration is a lot more common, it is possible to over-hydrate the body causing serious health problems




### What Is Dehydration?

Dehydration often occurs during exercise when the body loses more fluid than is being taken in. Losing as little as 2% of your total body weight can lead to a decreased performance.

Some common signs and symptoms of dehydration include:

- Headache
- Dizziness
- Dry Mouth
- Decreased Amount of Urine
- Dark Yellow Urine
- Thirst

To stay healthy and to optimize performance of exercise it is important to stay hydrated!

### How Do I Know If I am Hydrated?

A quick and easy way to determine your hydration status is to look at the color of your urine. Normally, the lighter the color of your urine the more more hydrated you are. Some foods can change the color and smell of your urine making the chart less accurate.

## Hydration Recommendations

- For good hydration strategies, sip on water throughout the day! Carry a water bottle or cup around with you
- Before exercise, drink 8-16 ounces of water 4 hours. If you are already dehydrated or it is hot and humid out, you may need an additional 8-16 ounces of water 15-30 minutes before exercise
- During exercise, 4-6 gulps of water every 15-30 minutes is recommended
- As a general rule, for every 1 pound lost, 3 (8oz) cups of fluid needs to be replaced post-exercise
- Thirst is not an indicator of hydration status! Drink whether you are thirsty or not and drink more than you think you need!

**Having a water bottle with ounce markings will help keep you on track and help you know how much you need to drink!**

## IV. Text Messages Distributed

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 2 (Fri. Group) | 5 | Reminder that if in town tomorrow I will be in the lab 9-1 for you to drop off your 1st sample! If not, please bring Sun(9-3)or Mon(8-4) |
| Hydration Study 1 (Fri. Group) | 6 | Reminder that if in town tomorrow I will be in the lab 9-1 for you to drop off your 1st sample! If not, please bring Sun(9-3)or Mon(8-4) |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to bring your day 3 sample to the lab tomorrow. I will be there 9-1 If not please let me know when the earliest you can bring it is |
| Hydration Study 1 (Thurs. Group) | 6 | Don't forget there is a baseball game tonight! Brace the rainy weather and come support! |
| Hydration Study 1 (Wed. Group) | 11 | Don't forget there is a baseball game tonight! Brace the cold and come support! |
| Hydration Study 2 (Wed. Group) | 10 | Here is some more, quick information about hydration!<br><br>**Attachment:** Hydration_Info_1.png |
| Hydration Study 2 (Thurs. Group) | 4 | Here is some quick information about hydration! Keep drinking fluids even when its cold out.<br><br>**Attachment:** NATA Publishes New Fluid Replacement for the Physically Active Position Statement in Journal of Athl.pdf |
| Hydration Study 1 (Thurs. Group) | 5 | Reminder to bring your urine sample to the lab today. I will be here from 8am-4pm. Please bring it anytime between then. |
| Hydration Study 2 (Thurs. Group) | 3 | Reminder to bring your urine sample to the lab today. I will be here from 8am-4pm. Please bring it anytime between then. |
| Hydration Study 1 (Thurs. Group) | 5 | Reminder to pee in your cup this morning and to drop it off in the lab anytime from 8am-4pm. |
| Hydration Study 2 (Thurs. Group) | 3 | Reminder to pee in your cup this morning and to drop it off in the lab anytime from 8am-4pm. |
| Hydration Study 1 (Thurs. Group) | 5 | Reminder to pee in your cup this morning and to drop it off in the lab anytime from 8am-4pm. |
| Hydration Study 2 (Thurs. Group) | 3 | Reminder to pee in your cup this morning and to drop it off in the lab anytime from 8am-4pm. |
| Hydration Study 2 (Thurs. Group) | 3 | Just one of many reminders to bring in your first morning urine sample from tomorrow morning to the lab anytime between 8am-4pm tomorrow. KB |
| Hydration Study 1 (Thurs. Group) | 5 | Just one of many reminders to bring in your first morning urine sample from tomorrow morning to the lab anytime between 8am-4pm tomorrow. KB |
| Hydration Study 1 (Wed. Group) | 11 | If you have not dropped your sample off in the lab, I will be here until 4:30. Please come by and drop that off. Thanks! |
| Hydration Study 2 (Wed. Group) | 10 | If you have not dropped your sample off in the lab, I will be here until 4:30. Please come by and drop that off. Thanks! |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 2 (Wed. Group) | 10 | Here is an overview of the NATA's hydration position statement. States proper hydration to follow while being active!<br><br>**Attachment:** NATA Publishes New Fluid Replacement for the Physically Active Position Statement in Journal of Athl.pdf |
| Hydration Study 2 (Wed. Group) | 10 | ...in my office which is D108. Right across the hall from the lab. I will be in there. Thanks! KB |
| Hydration Study 1 (Wed. Group) | 11 | ...in my office which is D108. Right across the hall from the lab. I will be in there. Thanks! KB |
| Hydration Study 1 (Wed. Group) | 11 | All: the lab is being used from 11-12:30pm today. If you are planning on dropping your sample off during that time please drop it off... |
| Hydration Study 2 (Wed. Group) | 10 | All: the lab is being used from 11-12:30pm today. If you are planning on dropping your sample off during that time please drop it off... |
| Hydration Study 1 (Wed. Group) | 11 | Reminder to pee in the cup this morning! Please bring to lab today anytime from 8am-5pm. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to pee in the cup this morning! Please bring to lab today anytime from 8am-5pm. |
| Hydration Study 1 (Wed. Group) | 11 | Reminder to pee in the cup this morning! Please bring to lab today anytime from 8am-5pm. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to pee in the cup this morning! Please bring to lab today anytime from 8am-5pm. |
| Hydration Study 2 (Wed. Group) | 10 | Another reminder to do the first morning urine sample and to do the sample mid-stream as well! Only need about 1/2 the cup full. |
| Hydration Study 1 (Wed. Group) | 11 | Another reminder to do the first morning urine sample and to do the sample mid-stream as well! Only need about 1/2 the cup full. |
| Hydration Study 1 (Wed. Group) | 11 | Just one of many reminders to bring in your first morning urine sample from tomorrow morning to the lab anytime between 8am-5pm tomorrow. KB |
| Hydration Study 2 (Wed. Group) | 10 | Just one of many reminders to bring in your first morning urine sample from tomorrow morning to the lab anytime between 8am-5pm tomorrow. KB |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 2 (Thurs. Group) | 4 | Jowers may be all locked up if you guys are trying to turn your sample in today, if you can't make it today I will be here 8-5 tomorrow.... |
| Hydration Study 2 (Fri. Group) | 5 | Remember to stay hydrated this weekend!! |
| Hydration Study 2 (Thurs. Group) | 4 | Remember to stay hydrated this weekend!! |
| Hydration Study 2 (Wed. Group) | 10 | Remember to stay hydrated this weekend!! |
| Hydration Study 2 (Thurs. Group) | 4 | If you can drop your day 3 your sample off to me tomorrow, I will be in the lab 10:00am-4pm. Please swing by and drop that off! |
| Hydration Study 1 (Thurs. Group) | 6 | If you can drop your day 3 your sample off to me tomorrow, I will be in the lab 10:00am-4pm. Please swing by and drop that off! |
| Hydration Study 1 (Wed. Group) | 11 | Reminder if you are dropping your sample off today, I will be here in the lab until 1pm. Please drop it off by then. |
| Hydration Study 1 (Fri. Group) | 5 | Reminder if you are dropping your sample off today, I will be here in the lab until 1pm. Please drop it off by then. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder if you are dropping your sample off today, I will be here in the lab until 1pm. Please drop it off by then. |
| Hydration Study 2 (Fri. Group) | 5 | Reminder if you are dropping your sample off today, I will be here in the lab until 1pm. Please drop it off by then. |
| Hydration Study 1 (Fri. Group) | 5 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. I will be in the lab until 1pm |
| Hydration Study 2 (Fri. Group) | 5 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. I will be in the lab until 1pm |
| Hydration Study 1 (Wed. Group) | 11 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. I will be in the lab until 1pm |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. I will be in the lab until 1pm |
| Hydration Study 1 (Wed. Group) | 11 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. |
| Hydration Study 1 (Fri. Group) | 5 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. |
| Hydration Study 2 (Fri. Group) | 5 | Reminder to pee in the cup this morning if you are bringing it to the lab today! First morning, mid stream. |
| Hydration Study 1 (Wed. Group) | 11 | Reminder to bring your day 3 sample to the lab tomorrow. I will be there 9-1 If not please let me know when the earliest you can bring it is |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 1 (Fri. Group) | 5 | Check out the athletic teams schedule this week. Mens and women's basketball, and baseball play this weekend! Come cheer on! |
| Hydration Study 1 (Wed. Group) | 11 | Check out the athletic teams schedule this week. Mens and women's basketball, and baseball play this weekend! Come cheer on! |
| Hydration Study 1 (Thurs. Group) | 6 | Check out the athletic teams schedule this week. Mens and women's basketball, and baseball play this weekend! Come cheer on! |
| Hydration Study 2 (Fri. Group) | 5 | Here is some quick information about hydration! Keep drinking fluids even when its cold out.<br><br>**Attachment:** NATA Publishes New Fluid Replacement for the Physically Active Position Statement in Journal of Athl.pdf |
| Hydration Study 1 (Fri. Group) | 5 | Reminder: I will be in the lab until 4 today. If you have a sample to turn in, please do so by 4pm today. |
| Hydration Study 1 (Thurs. Group) | 6 | Reminder: I will be in the lab until 4 today. If you have a sample to turn in, please do so by 4pm today. |
| Hydration Study 1 (Wed. Group) | 11 | Reminder: I will be in the lab until 4 today. If you have a sample to turn in, please do so by 4pm today. |
| Hydration Study 2 (Thurs. Group) | 4 | Reminder: I will be in the lab until 4 today. If you have a sample to turn in, please do so by 4pm today. |
| Hydration Study 2 (Fri. Group) | 5 | Reminder: I will be in the lab until 4 today. If you have a sample to turn in, please do so by 4pm today. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder: I will be in the lab until 4 today. If you have a sample to turn in, please do so by 4pm today. |
| Hydration Study 1 (Wed. Group) | 11 | All: If you have urine to turn in tomorrow, I will be in the lab from 8am-4pm tomorrow. Please drop it off in those times! |
| Hydration Study 2 (Wed. Group) | 10 | All: If you have urine to turn in tomorrow, I will be in the lab from 8am-4pm tomorrow. Please drop it off in those times! |
| Hydration Study 1 (Thurs. Group) | 6 | All: If you have urine to turn in tomorrow, I will be in the lab from 8am-4pm tomorrow. Please drop it off in those times! |
| Hydration Study 1 (Fri. Group) | 5 | All: If you have urine to turn in tomorrow, I will be in the lab from 8am-4pm tomorrow. Please drop it off in those times! |
| Hydration Study 2 (Thurs. Group) | 4 | All: If you have urine to turn in tomorrow, I will be in the lab from 8am-4pm tomorrow. Please drop it off in those times! |
| Hydration Study 2 (Fri. Group) | 5 | All: If you have urine to turn in tomorrow, I will be in the lab from 8am-4pm tomorrow. Please drop it off in those times! |
| Hydration Study 1 (Thurs. Group) | 6 | ... if you already have your sample in the cup, please refrigerate it until you can bring it in. Thanks! |
| Hydration Study 1 (Thurs. Group) | 6 | Jowers may be all locked up if you guys are trying to turn your sample in today, if you can't make it today I will be here 8-5 tomorrow.... |
| Hydration Study 2 (Thurs. Group) | 4 | ... if you already have your sample in the cup, please refrigerate it until you can bring it in. Thanks! |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 1 (Thurs. Group) | 6 | Check out the athletic events this weekend! Keep pushing through school... Spring break is in one more week! |
| Hydration Study 2 (Wed. Group) | 10 | Make sure you are staying hydrated this weekend! |
| Hydration Study 2 (Thurs. Group) | 4 | Make sure you are staying hydrated this weekend! |
| Hydration Study 2 (Fri. Group) | 5 | Make sure you are staying hydrated this weekend! |
| Hydration Study 2 (Fri. Group) | 5 | If you are an avid work out person, take a water bottle with marks on it with you to the gym to help you keep track of your water intake! |
| Hydration Study 2 (Thurs. Group) | 4 | If you are an avid work out person, take a water bottle with marks on it with you to the gym to help you keep track of your water intake! |
| Hydration Study 2 (Wed. Group) | 10 | If you are an avid work out person, take a water bottle with marks on it with you to the gym to help you keep track of your water intake! |
| Hydration Study 2 (Thurs. Group) | 4 | Reminder: if you still have a Day 3 sample to give to me, please do so tomorrow. I will be in the Biomechanics lab from about 8:30am-3:30pm |
| Hydration Study 1 (Thurs. Group) | 6 | Reminder: if you still have a Day 3 sample to give to me, please do so tomorrow. I will be in the Biomechanics lab from about 8:30am-3:30pm |
| Hydration Study 2 (Wed. Group) | 10 | Reminder: if you still have a Day 3 sample to give to me, please do so tomorrow. I will be in the Biomechanics lab from about 8:30am-3:30pm |
| Hydration Study 2 (Fri. Group) | 5 | Reminder: if you still have a Day 3 sample to give to me, please do so tomorrow. I will be in the Biomechanics lab from about 8:30am-3:30pm |
| Hydration Study 1 (Fri. Group) | 5 | Reminder: if you still have a Day 3 sample to give to me, please do so tomorrow. I will be in the Biomechanics lab from about 8:30am-3:30pm |
| Hydration Study 1 (Wed. Group) | 11 | Reminder: if you still have a Day 3 sample to give to me, please do so tomorrow. I will be in the Biomechanics lab from about 8:30am-3:30pm |
| Hydration Study 2 (Fri. Group) | 5 | As it gets warmer/more humid outside, it gets even more important to stay hydrated! Keep that in mind as it gets hotter out! |
| Hydration Study 2 (Wed. Group) | 10 | As it gets warmer/more humid outside, it gets even more important to stay hydrated! Keep that in mind as it gets hotter out! |
| Hydration Study 2 (Thurs. Group) | 4 | As it gets warmer/more humid outside, it gets even more important to stay hydrated! Keep that in mind as it gets hotter out! |
| Hydration Study 2 (Thurs. Group) | 4 | Here is some more good hydration info! Keep hydrated over this week!<br><br>**Attachment:** Hydration_Info_2.png |
| Hydration Study 2 (Wed. Group) | 10 | Here is some more good hydration info! Keep hydrated over this week!<br><br>**Attachment:** Hydration_Info_2.png |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 1 (Wed. Group) | 11 | Reminder to pee in the cup this morning!! I will be in the lab starting at 9 to 10. And then again from 11 to 4. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to pee in the cup this morning!! I will be in the lab starting at 9 to 10. And then again from 11 to 4. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder to pee in the cup this morning |
| Hydration Study 1 (Wed. Group) | 11 | Reminder to pee in the cup this morning |
| Hydration Study 2 (Wed. Group) | 10 | I will be proctoring an exam tomorrow from 10-11am so I will not be available for drop off during that time! Thanks |
| Hydration Study 1 (Wed. Group) | 11 | I will be proctoring an exam tomorrow from 10-11am so I will not be available for drop off during that time! Thanks |
| Hydration Study 2 (Wed. Group) | 10 | Reminder I will be in the lab 9am-4pm tomorrow. Please pee in your cup tomorrow morning and bring that in! Last one! |
| Hydration Study 1 (Wed. Group) | 11 | Reminder I will be in the lab 9am-4pm tomorrow. Please pee in your cup tomorrow morning and bring that in! Last one! |
| Hydration Study 2 (Fri. Group) | 5 | Reminder that you will turn in your Day 14 sample THIS FRIDAY. I will be in the lab from 9am-3:30pm |
| Hydration Study 1 (Fri. Group) | 5 | Reminder that you will turn in your Day 14 sample THIS FRIDAY. I will be in the lab from 9am-3:30pm |
| Hydration Study 2 (Thurs. Group) | 4 | Reminder that you will turn in your Day 14 sample THIS THURSDAY. I will be in the lab from 9am-4pm. |
| Hydration Study 1 (Thurs. Group) | 6 | Reminder that you will turn in your Day 14 sample THIS THURSDAY. I will be in the lab from 9am-4pm. |
| Hydration Study 2 (Wed. Group) | 10 | ... a test from 10-11am so I will not be available during that time. |
| Hydration Study 1 (Wed. Group) | 11 | ... a test from 10-11am so I will not be available during that time. |
| Hydration Study 2 (Wed. Group) | 10 | Reminder that you will turn in your Day 14 sample THIS WEDNESDAY. I will be in the lab from 9am-4pm. I will have to proctor... |
| Hydration Study 1 (Wed. Group) | 11 | Reminder that you will turn in your Day 14 sample THIS WEDNESDAY. I will be in the lab from 9am-4pm. I will have to proctor... |
| Hydration Study 1 (Wed. Group) | 11 | Check out the athletic events this weekend! Keep pushing through school... Spring break is in one more week! |
| Hydration Study 1 (Fri. Group) | 5 | Check out the athletic events this weekend! Keep pushing through school... Spring break is in one more week! |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 2 (Thurs. Group) | 4 | Reminder to pee in your cup this morning! |
| Hydration Study 1 (Thurs. Group) | 6 | Reminder to pee in your cup this morning!! |
| Hydration Study 2 (Thurs. Group) | 4 | Reminder to pee in your cup this morning!! |
| Hydration Study 2 (Thurs. Group) | 4 | I will be in the lab from now until about 4pm. Please bring your last sample in during that time! |
| Hydration Study 1 (Thurs. Group) | 6 | I will be in the lab from now until about 4pm. Please bring your last sample in during that time! |
| Hydration Study 2 (Thurs. Group) | 4 | Reminder to pee in your cup tomorrow morning and bring it in to the lab! I'll be in there from 9am-4pm. |
| Hydration Study 1 (Thurs. Group) | 6 | Reminder to pee in your cup tomorrow morning and bring it in to the lab! I'll be in there from 9am-4pm. |
| Hydration Study 1 (Wed. Group) | 11 | Sorry for all the messages today... I will be in the lab until 4. If you still have a sample to turn in please do so. |
| Hydration Study 2 (Wed. Group) | 10 | Sorry for all the messages today... I will be in the lab until 4. If you still have a sample to turn in please do so. |
| Hydration Study 2 (Wed. Group) | 10 | If you want or need you can drop it off on my desk in D108, you will have to fill out a 3rd questionnaire, but can do whenever before Friday |
| Hydration Study 1 (Wed. Group) | 11 | If you want or need you can drop it off on my desk in D108, you will have to fill out a 3rd questionnaire, but can do whenever before Friday |
| Hydration Study 2 (Wed. Group) | 10 | Also, I forgot I have a meeting from 12-12:45. Sorry about all the conflicts. Gotta love midterm week... |
| Hydration Study 1 (Wed. Group) | 11 | Also, I forgot I have a meeting from 12-12:45. Sorry about all the conflicts. Gotta love midterm week... |
| Hydration Study 2 (Wed. Group) | 10 | I am still at soccer. If you have a sample this morning, I won't be able to make it in the lab until after the test I'm proctoring at 11 |
| Hydration Study 1 (Wed. Group) | 11 | I am still at soccer. If you have a sample this morning, I won't be able to make it in the lab until after the test I'm proctoring at 11 |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 2 (Wed. Group) | 10 | All: If you need a form for me to sign because you are doing this study for extra credit, remember to bring that sheet so I can sign it! |
| Hydration Study 2 (Fri. Group) | 5 | All: If you need a form for me to sign because you are doing this study for extra credit, remember to bring that sheet so I can sign it! |
| Hydration Study 2 (Thurs. Group) | 4 | All: If you need a form for me to sign because you are doing this study for extra credit, remember to bring that sheet so I can sign it! |
| Hydration Study 1 (Wed. Group) | 11 | All: If you need a form for me to sign because you are doing this study for extra credit, remember to bring that sheet so I can sign it! |
| Hydration Study 1 (Thurs. Group) | 6 | All: If you need a form for me to sign because you are doing this study for extra credit, remember to bring that sheet so I can sign it! |
| Hydration Study 1 (Fri. Group) | 5 | All: If you need a form for me to sign because you are doing this study for extra credit, remember to bring that sheet so I can sign it! |
| Hydration Study 1 (Fri. Group) | 5 | Just another quick reminder to pee in your last cup tomorrow morning! I will be in the lab 9am-3:30pm. Please drop it off anytime then. |
| Hydration Study 2 (Fri. Group) | 5 | Just another quick reminder to pee in your last cup tomorrow morning! I will be in the lab 9am-3:30pm. Please drop it off anytime then. |
| Hydration Study 1 (Thurs. Group) | 6 | If you still have a sample to give to me today, please stop by the lab before 4pm today! |
| Hydration Study 1 (Wed. Group) | 11 | If you still have a sample to give to me today, please stop by the lab before 4pm today! |
| Hydration Study 2 (Thurs. Group) | 4 | If you still have a sample to give to me today, please stop by the lab before 4pm today! |
| Hydration Study 2 (Wed. Group) | 10 | If you still have a sample to give to me today, please stop by the lab before 4pm today! |
| Hydration Study 1 (Fri. Group) | 5 | Reminder to pee in your last cup tomorrow morning! I will be in the lab tomorrow from 9am-3:30pm so please drop it off then. |
| Hydration Study 2 (Fri. Group) | 5 | Reminder to pee in your last cup tomorrow morning! I will be in the lab tomorrow from 9am-3:30pm so please drop it off then. |
| Hydration Study 1 (Thurs. Group) | 6 | Reminder to pee in your cup this morning! |

| SENT TO | RECIPIENTS | MESSAGE |
|---|---|---|
| Hydration Study 2 (Wed. Group) | 10 | If you need your gift card still, please stop by my office D108 and grab it this week. Make sure I'm there cuz you need to sign for it. |
| Hydration Study 2 (Thurs. Group) | 4 | If you need your gift card still, please stop by my office D108 and grab it this week. Make sure I'm there cuz you need to sign for it. |
| Hydration Study 2 (Fri. Group) | 5 | If you need your gift card still, please stop by my office D108 and grab it this week. Make sure I'm there cuz you need to sign for it. |
| Hydration Study 1 (Fri. Group) | 5 | If you need your gift card still, please stop by my office D108 and grab it this week. Make sure I'm there cuz you need to sign for it. |
| Hydration Study 1 (Thurs. Group) | 6 | If you need your gift card still, please stop by my office D108 and grab it this week. Make sure I'm there cuz you need to sign for it. |
| Hydration Study 1 (Wed. Group) | 11 | If you need your gift card still, please stop by my office D108 and grab it this week. Make sure I'm there cuz you need to sign for it. |
| Hydration Study 2 (Thurs. Group) | 4 | I have the gift cards in the lab today with me. If you want, come pick up today from 9-3:30. Or we can wait till after spring break as well. |
| Hydration Study 2 (Fri. Group) | 5 | I have the gift cards in the lab today with me. If you want, come pick up today from 9-3:30. Or we can wait till after spring break as well. |
| Hydration Study 1 (Wed. Group) | 11 | I have the gift cards in the lab today with me. If you want, come pick up today from 9-3:30. Or we can wait till after spring break as well. |
| Hydration Study 2 (Wed. Group) | 10 | I have the gift cards in the lab today with me. If you want, come pick up today from 9-3:30. Or we can wait till after spring break as well. |
| Hydration Study 1 (Thurs. Group) | 6 | I have the gift cards in the lab today with me. If you want, come pick up today from 9-3:30. Or we can wait till after spring break as well. |
| Hydration Study 1 (Fri. Group) | 5 | I have the gift cards in the lab today with me. If you want, come pick up today from 9-3:30. Or we can wait till after spring break as well. |
| Hydration Study 1 (Fri. Group) | 5 | I will be in the lab from now until 3:30pm today. Please bring by your sample anytime during that! |
| Hydration Study 2 (Fri. Group) | 5 | I will be in the lab from now until 3:30pm today. Please bring by your sample anytime during that! |
| Hydration Study 1 (Fri. Group) | 5 | Reminder to pee in your cup this morning!!! |
| Hydration Study 2 (Fri. Group) | 5 | Reminder to pee in your cup this morning!!! |
| Hydration Study 1 (Fri. Group) | 5 | Reminder to pee in your cup this morning!!! |
| Hydration Study 2 (Fri. Group) | 5 | Reminder to pee in your cup this morning!!! |

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