

## ABSTRACT

### Dehydration in High School Girls Wrestling

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Little data currently exists for the female wrestling population as the sport is ever-growing. This study is to determine the effect of dehydration on mental toughness for high school female wrestlers. Nine athletes, ages 14–17 years old, underwent two measurements of hydration status which took place at the beginning and middle of the season, and one mental toughness questionnaire completed at the end of the season. The athletes were assigned a personal unique identifier, several non-invasive measures were captured to determine hydration, and the standardized MTQ-10 questionnaire was used to determine mental toughness. A negative correlation was found between the mental toughness attributes of feeling worthwhile, coping, and looking on the bright side to the hydration measure of urine color in the mid-season measurements. No other values were deemed statistically significant. The results provide preliminary evidence that hydration status affects mental toughness and additional research is recommended.

Dehydration in High School Girls Wrestling

by

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A Thesis

Approved by the Department of Health, Human Performance, and Recreation

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I would also like to acknowledge the wrestlers who participated in the project, for without them I would not have had the data necessary to complete this analysis. Wrestlers are known for their courage but being willing to be a subject of a research study takes a different kind of courage, and for that, I would like to express my gratitude and appreciation to those young women who stepped up to participate when I asked them. Similarly, I would like to thank the coaches who supported me and their wrestlers in participating in the study. Specifically, my gratitude goes out to the coaches of the



wrestling teams at Azle High School, Del Oro High School, El Dorado High School, Granite Bay High School, Inderkum High School, and McClatchy High School.

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## DEDICATION

To my loving parents, Jeannine and Frederick Fenton Jr., whose words of encouragement whenever I need it most and the endless examples of the value of hard work, have taught me to dream big, develop goals and objectives, and never give up.

## CHAPTER ONE

### Introduction

#### *Background*

Wrestling is one of the oldest forms of combat, tracing back 15,000 years to the early Egyptians and Greeks<sup>1</sup>. Many styles of wrestling exist; however, the style practiced in high school sports is known as Folkstyle. It is not necessarily known when Folkstyle wrestling originated since the sport of wrestling evolved over many years taking the various cultures that adapted and created the various forms. Although males have competed in regulated wrestling competitions since 1903 with the first dual meet taking place between Yale and Columbia University<sup>2</sup>, women's wrestling is much newer and continues to evolve. The first Worlds Championships for women's wrestling was in 1987<sup>3</sup>; however, to this day, only 36 states recognize and have sanctioned state championships for women's wrestling. This includes the State of California and the State of Texas, which will serve as the locations of this study<sup>4</sup>.

A key component of the sport of wrestling is that the athletes must "cut weight" to meet weight classifications. Cutting weight is fast weight loss prior to a sporting event, and for wrestling it is predominantly from excessive sweating and loss of water weight, change in diet such as restricted caloric intake, or increased exercise. High school wrestlers have been known to wear an abundance of warm clothing or sit in an extremely warm vehicle to sweat the fluid weight off, or repetitively spit to eliminate the fluid from their bodies in that manner. Girls wrestling at the high school level has 14 recognized

weight classifications depending on state rules and regulations. The weight classes consist of the following 101, 106, 111, 116, 121, 126, 131, 137, 143, 150, 160, 170, 189, and 235 pounds per California Interscholastic Federation (CIF)<sup>5</sup>. Cutting weight is regulated using the annual weight certifications process, where the athlete is given the lowest possible weight class that they can cut to in a safe manner. During the middle of the season, athletes are given a two-pound weight allowance as officials recognize that athletes, especially in high school, are still growing in both height and weight. The cutting process can be taxing on the body and may directly affect both physical and mental abilities.

#### *Statement of the Problem*

What is the effect of dehydration on the mental toughness of high school female wrestlers?

#### *Objectives*

The initial objectives of this research project per the International Review Board (IRB) approved on November 4, 2022, were to:

1. Examine the effects of dietary factors of female wrestlers' performance.
2. Identify how mental toughness may be affected by changes in dehydration status.

Subsequently on November 29, 2022, based on input and advice of the entire academic advising team, this research project was scaled back by eliminating the examination of dietary factors, focusing solely on the hydration aspect.

As a result, the primary objective of this research project is to identify how mental toughness may be affected by changes in hydration status.

### *Hypotheses*

H<sub>1</sub>: Mental toughness will be negatively affected as a result of dehydration from weight cutting by minimizing fluid intake or sweating.

H<sub>2</sub>: A correlation will exist between weight and mental toughness.

H<sub>3</sub>: A correlation will exist between BMI and mental toughness.

H<sub>4</sub>: A correlation will exist between urine specific gravity and mental toughness.

H<sub>5</sub>: A correlation will exist between urine color and mental toughness.

### *Rationale*

If a correlation is found between hydration and mental toughness, then a case can be made for the need to provide better techniques and overall increase safety for high school athletes meeting weight dependent sport demands. The increased focus on this population is warranted because minimal to no research articles highlight the physiological aspects of female wrestling, while this athlete population continues to grow. Additionally, hydration is a significant part of the wrestling season with cutting weight to meet match requirements, so ultimately this study is worth pursuing.

### *Delimitations*

The study will utilize the following parameters:

1. Twelve (12) high school female wrestlers (ages 13-19).
2. Subjects recruited by word of mouth or via email.
3. All baseline measurements assessed at the same point during the wrestling season.
4. All mid-season measurements assessed at the same point during the wrestling season.

5. The questionnaire distributed at the same time for all athletes to review and answer.

#### *Limitations*

1. All measurements obtained in field work and not in a controlled laboratory setting.
2. Athletes had differing day-to-day habits of nutrition and exercise.
3. Athletes had differing weight cutting philosophies and practices.

#### *Assumptions*

1. The laboratory equipment such as scale weight, manual blood pressure cuff, stethoscope, timer, Multistix 10 SG Reagent Strips, and skinfold calipers were properly functioning to produce the most valid and reliable measures. Also, the equipment had the proper calibration and instructions for use to minimize the amount of potential error.
2. The participants followed through with study visits and gave their best effort in answering the questionnaire.
3. All participants maintained their normal day-to-day habits regarding nutrition and exercise during the duration of the study.

### *Definition of Terms*

*Blood Pressure* - the pressure of blood circulating throughout the body and measured by a sphygmomanometer

*Body Mass Index (BMI)* - a measurement of a person's weight in pounds divided by the height in feet squared

*Capillary Refill* - the time it takes for the color to be perfused into the fingernail after use of pressure to blanch the capillary bed

*Diastolic Blood Pressure* - the second sound when assessing blood pressure and the force on the arteries when the heart rests between beats

*Heart Rate* - the frequency the heart contracts in one minute

*Mental Toughness (MT)* - a measure of resilience and confidence which are considered predictors of success

*Skin Elasticity* - the skin's ability to retake shape after being stretched to assess physical signs of hydration

*Skinfolds* - the pinching of the subcutaneous fat as a method of determining body fat

*Systolic Blood Pressure* - the first sound when assessing blood pressure is the force of blood on the arteries when the heart beats

*Urine Sample Color* - the range of color from clear to dark yellow or amber

*Urine Specific Gravity* - a urinalysis used to assess the kidney function and in determining a factor of diseases or hydration status

## CHAPTER TWO

### Review of Literature

#### *Women's Wrestling Studies*

From the Baylor University's One Search Library Online Database, and using the search terms women's wrestling, a total of 1,238 articles were obtained. However, the articles mainly focused on the sociocultural aspects of the sport as there is a stigma of women in a "combat" sport, or the integration of the sport into the NCAA/Equal Play as part of Title IX. Minimal to no research articles were about the physiological aspects related to women's wrestling, and no articles involved mental toughness in wrestling. After redefining the search terms to women's wrestling and hydration, a total of three articles were discovered. Of these three articles, only one related to the topic and it was about urine specific gravity and plasma osmolarity as a valid measurement of hydration status in both male and female collegiate athletes<sup>6</sup>. This indicates that the project is possible as well as the need for more research using different populations.

#### *Hydration Measures*

The most commonly used markers of hydration are plasma osmolarity, urine osmolarity, and urine specific gravity. However, the best way to measure hydration is considered to be body weight and urine specific gravity. Urine color is another reasonable method of obtaining hydration status<sup>7</sup>. Other non-invasive measures of hydration include capillary refill, skin elasticity and skinfolds.



### *Body Weight*

The changes in body weight are known to be the gold standard determining factor of hydration status<sup>8</sup>. As seen in the literature, body weight should be assessed in the morning, since weight tends to fluctuate throughout the day. For wrestling specifically, weigh-ins are conducted in the morning prior to competition<sup>9</sup>. Additionally, authors explain that body weight during strenuous exercise will affect hydration markers which results in a significant change in body weight over time<sup>8</sup>.

### *Urine Specific Gravity and Urine Sample Color*

According to the literature, urine specific gravity as well as urine color have great applicability in the field setting as a measure of hydration. As found in one study, urine specific gravity at high levels will assume greater health risks such as heat illness and is correlated to impaired performance<sup>10</sup>.

The Baylor Library Database has many articles which validate the effectiveness of urine sample color as an indicator of hydration. Researchers recognize that the color of urine as determined in the lab is a very subjective variable; however, models have been established that have helped to analyze the color quantitatively and objectively. The literature also mentions that in hydration studies they found a very high correlation between urine color and specific gravity<sup>11</sup>.

### *Capillary Refill*

Capillary refill has been used in medicine to determine perfusion and is usually found under documentation for a patient's external appearance of skin assessment. The typical capillary refill time is two seconds or less. Another article states that the usage of

capillary refill to be a measure of hydration, and yet the author Baraff has a slightly different opinion and does not believe it is a useful clinical sign. Most of the articles about capillary refill do not speak to the effectiveness of the measure but rather the measurement itself. Baraff states that the Trauma Scale has removed the element of capillary refill, and that ambient temperature has a profound effect on the capillary refill time as 69 percent of children did not experience a capillary refill time of greater than two seconds<sup>12</sup>.

### *Skin Elasticity*

The measurement of skin elasticity in the laboratory setting is performed by pinching the back of the hand and witnessing the skin go back to its original position in two seconds or less, similar to the capillary refill. Most of the articles regarding skin elasticity as a measure of hydration are related to facial skin care habits. Thus, based on the literature, it is not exactly clear how effective the measurement of skin elasticity is in determining the hydration status for research purposes.

### *Skinfolds*

Measuring skinfolds is a technique used to assess body fat by pinching the fat at different locations of the body. Dotson et. al. found in a research study that hydration status affects skinfolds as this body composition measurement should be executed after fasting<sup>13</sup>. Skinfolds is not considered a direct measurement of hydration status; however, it is an important measure of overall health and body composition as detailed by Esparza-Ros et.al<sup>14</sup>.

### *Differences in Hydration Between Genders*

Sommerfield et. al., explain in their research article that male and female hydration status is substantially different. As such, men typically sweat more than women likely because of a greater body mass and higher metabolic rates during exercise. The article touched on many different sports such as cycling, soccer, and wrestling. Also described in the article is that with a loss of 3-5 percent of body mass from acute exercise it will increase the concentration of urine specific gravity to be higher than normal. The researchers stated that the least invasive method for determining hydration status is to measure urine specific gravity and it is also inexpensive, fast, simple and accurate. Although, researchers still claim that the best way to detect hydration status in both genders is by measuring plasma osmolarity. The authors concluded, “dehydration to even 2-3% of BM [body mass] can have considerable effects on an athlete’s performance and overall well-being, so the use of field tests to monitor hydration status becomes warranted.” They stated, “Coaches and athletic trainers must continue to educate their athletes on safe weight loss methods in weight-classified sports”<sup>15</sup>.

### *Mental Toughness Assessment*

Mental toughness is best described as “stress tolerance and the ability to maximize performance”<sup>16</sup>. Specific characteristics that make up mental toughness include “the capability to deal with adversity, the ability to thrive under pressure, self-belief, control, resilience, persistence, and superior mental skills”<sup>16</sup>. In addition, some researchers believe that “mental toughness is critical for achieving success (Loehr, 1994) and appears to be developed through experience”<sup>17</sup>. In a 2012 research study on 54 male high school wrestlers, a direct correlation was found that age and season winning

percentage influences mental toughness<sup>17</sup>. However, no studies were found relating to other factors, such as dehydration, affecting mental toughness. Additionally, a downside to most mental toughness research previously published is they are almost always self-report or a ranking on a scale from 1-20<sup>18</sup>. Further research affirmed that the best and most appropriate way of measuring one's mental toughness (MT), via a confirmatory factor analysis, is through answering the standardized MTQ-10 questionnaire. The MTQ-10 is used to assess four "dimensions": challenge, commitment, control and confidence. In all, studies have found that the MTQ-10 to be a strong predictor of well-being and to be a "superior unidimensional measure of MT"<sup>16</sup>. Also, the evidence suggests that the MTQ-10 has higher factor loadings and better a data-model fit, and displays gender invariance at the "configural, metric, and scalar level"<sup>16</sup>.

## CHAPTER THREE

### Research Design and Methodology

#### *Conceptual Framework*

This conceptual framework is based on the literature review of previous studies to determine how the existing research problem will be explored. Thus, the research design is intended to determine the correlation between hydration and mental toughness. The initial research design was developed based on the preliminary literature review and was approved by the IRB on November 4, 2022. Based on the input and advice from the academic advising team and based on design issues discovered once data collection began, the research design was modified slightly in various places. The following provides details of the initial and final research design along with a description and reason for the change in design.

#### *Subject Selection and Recruitment*

##### *Inclusion Criteria*

- Female wrestlers ages 13-19 recruited from McLennan County, TX and Placer County, CA via email to high school coaches (initial design)
- Female wrestlers ages 13-19 recruited from Tarrant County, TX; El Dorado County, CA; Placer County, CA; and Sacramento County, CA (final design)
- Participants classified as “Low Risk” according to the Initial American College of Sports Medicine Risk Stratification Guidelines (initial design)

- Subjects that meet requirements to be able to participate in physical activity according to the Physical Activity Readiness Questionnaire (PAR-Q) (initial design)

*Summary of design changes.* Additional counties were added to expand potential participant pool due to low numbers of volunteers after initial requests for participants were made. Also, the ability to participate in physical activities based on the student athlete obtaining clearance to participate on the high school wrestling team was used rather than the PAR-Q since this study was not adding any additional physical requirements over and above participating in the sport itself. Similarly, the participant's risk classification was not considered.

#### *Exclusion Criteria*

- Subjects that have a family history or background of cardiovascular risks, cigarette smoking, a sedentary lifestyle or obesity (initial design)
- Subjects that do not meet PAR-Q requirements (initial design)
- Males will be excluded from the study as research around this subject is mostly involving male participants and data, and the purpose of this investigation is to gain a newer understanding of the sport from a different point of view. (initial and final design)

*Summary of design changes.* The family history and PAR-Q exclusions were eliminated because, instead, the ability to participate in physical activities was based on the student athlete obtaining clearance to participate on the high school wrestling team

since the study was not adding any additional physical requirements over and above participating in the sport itself.

### *Recruiting Participants*

Recruiting wrestlers to participate in this study was a multi-step process, which began with an onsite visit to the six high schools located around Baylor University in McLennan County, TX. Through these visits it was discovered that female wrestling was not popular in this area of the country as none of them had a female wrestling team. As a result, a different approach was needed to obtain study participants. This entailed creating a list of all the high schools in an expanded area around Placer County, CA, then researching their school websites to determine if they had a wrestling team, and if so, identifying the wrestling coach or the athletic director and their contact information. Next, the coaches and/or athletic directors were contacted to let them know about the study, and to ask them if they had female wrestlers, and if they would be willing to support the study. For those coaches who provided a letter of support, a meeting was set up to share the study information with the wrestlers and their parents, answer any questions they may have, and obtain consent or assent forms to participate in the study. Subsequently, for those wrestlers willing to participate in the study and who provided their signed consent/assent forms, research data was obtained as described in the Study Activities section. In addition to the coaches and wrestlers recruited through email and phone contacts, attendance at four tournaments in Northern California at the beginning of the season was used to make in-person contacts and recruit via face-to-face interactions. From the in-person communications, a school from Azle, TX showed support and

allowed their athlete to participate. Table 3.1 summarizes these participant recruitment efforts.

Table 3.1. Summary of Study Population and Wrestler Recruitment

| Recruitment Activity                                                          | California       |               |                   | Texas           |                | Total        |
|-------------------------------------------------------------------------------|------------------|---------------|-------------------|-----------------|----------------|--------------|
|                                                                               | El Dorado County | Placer County | Sacramento County | McLennan County | Tarrant County | All Counties |
| Number of schools identified in the county                                    | 5                | 13            | 44                | 6               | 1              | 69           |
| Number of schools with possible wrestling teams                               | 5                | 10            | 33                | 0               | 1              | 49           |
| Number of coaches contacted                                                   | 5                | 10            | 33                | 6               | 1              | 55           |
| Number of coaches willing to support the study                                | 1                | 4             | 5                 | 0               | 1              | 11           |
| Number of schools that participated in the study                              | 1                | 3             | 2                 | 0               | 1              | 7            |
| Number of female wrestlers on teams with coaches willing to support the study | 1                | 22            | 13                | 0               | 1              | 37           |
| Number of female wrestlers willing to participate who submitted signed forms  | 1                | 6             | 4                 | 0               | 1              | 12           |
| Number of female wrestlers completing all aspects of the study                | 1                | 4             | 3                 | 0               | 1              | 9            |

These recruitment efforts resulted in the participation of eight high schools and 12 wrestlers. However, due to varying reasons (e.g., mental health issues, physical injury, or no longer participating in the sport), only nine athletes completed the study.

*Summary of design changes.* As part of the initial IRB, McLennan County and Placer County were going to serve as the sample population. After more investigation,



McLennan County did not have any girl wrestling teams, and the number of wrestlers in Placer County may be limited, so the sampling changed to three counties in California (Placer, El Dorado, and Sacramento County), followed by adding Tarrant County, TX based on the interest of the coach and wrestler to participate in the study.

### *Participant Confidentiality*

Upon committing to participate and submitting signed consent/assent forms, the athlete was given a random, unique identifier that would follow them throughout the duration of the study. The random, unique identifier was used to provide privacy and confidentiality of the athlete's measurements and responses related to the study activities.

### *Study Activities*

#### *Hydration Testing*

The high school wrestling season is from the end of October/start of November to the end of February. At the beginning of the wrestling season, all wrestlers must perform a hydration test to determine the lowest weight classes that they can qualify for, and each athlete receives their individual results. The league mandated measures as well as some additional measures gathered at the beginning of the season for this study served as the baseline values for hydration. Since the wrestlers are given a two-pound weight allowance mid-season, another hydration test was performed. The same variables were measured for the mid-season hydration test as was gathered for the beginning of the season measurements. The following data was gathered for both beginning and mid-season measures:

- Bioelectrical Impedance Analysis (BIA) – The BIA is a method to estimate body composition, in particular the body fat and muscle mass, by using a weak electric current flow through the body. The league will obtain these body fat measures to determine the lowest possible weight the athlete can drop to, based on a safe body fat percentage for the athlete. (initial design)
- Body Mass Index (BMI) – The BMI calculated using the reported height and weight and an online BMI calculator to have a precise measure with an uncertainty to the tenth decimal point. (initial and final design)
- Height/Weight – The league obtains height and weight by the Detecto Eye- Level Beam Scale with Height Rod, which serves as a baseline measurement. A subsequent weigh-in at a mid-season tournament serves as the mid-season measurement. (initial and final design)
- Urine Sample Color – The league assesses the urine color of the sample that the athletes provide for their hydration test and rates the sample from clear to amber. This test will be used for the baseline measure and the athlete will provide a sample mid-season to be tested in the same fashion. (initial design)
- Urine Sample Color – Athletes provided a urine sample at the beginning of the season and again at mid-season for purposes of this study. Both urine samples assessed and rated from clear to amber. (final design)
- Urine Specific Gravity – The same urine sample provided for the urine sample color to be used to assess urine specific gravity based on the Multistix 10 SG Reagent Strip scale. (initial and final design)

- Physical Activity Readiness Questionnaire (PAR-Q) – Athletes to complete the PAR-Q form to participate in the study. (initial design)
- Heart Rate – Heart rate measured manually by taking the radial artery pulse. (initial and final design)
- Blood Pressure – Resting blood pressure measured manually with a sphygmomanometer on the upper arm and a stethoscope applied under the cuff running along the artery to listen for Korotkoff sounds. (initial and final design)
- Capillary Refill – Hydration tested by pressing down on the fingernail of the thumb and then releasing to determine if the coloring returns in more or less than two seconds. (initial and final design)
- Skin Elasticity – Hydration tested by pinching the back of the hand and then releasing to determine if the skin returns to its original position in more or less than two seconds. (initial and final design)
- 7-Point Skinfold Thickness – The skinfold thickness captured using skinfold calipers at the chest, mid axillary, abdomen, supra iliac, thigh, subscapular, and tricep. (initial and final design)

*Summary of design changes.* The initial and the final design consisted of the hydration tests being performed twice, once at the beginning of the season and once mid-season after the two-pound weight allowance. However, some of the components of the test were either eliminated, such as the BIA and the PAR-Q, or the method of collection changed slightly, such as with the tests related to the urine sample. The BIA was eliminated because the league weight certifier was unwilling to provide wrestler test results for purposes of this study and the PAR-Q was eliminated since it was no longer

deemed necessary as athletes had obtained clearance to participate on the high school wrestling team and this study was not adding any additional physical requirements over and above participating in the sport itself. The method for collecting urine samples changed because of a recent league change, discovered once data collection began, to no longer require urine samples. Since the urine sample was no longer needed by the league for hydration weight certification requirements, urine samples were collected from wrestlers solely for the purpose of this study.

### *Three-Day Dietary Analysis*

The initial research design included a three-day dietary analysis whereby study participants log their food intake for three days via the Cronometer app either on their phone or computer. Then after each day, the subjects submit a screenshot of the numerical values provided via a google form. The three-day dietary analysis to be conducted at the beginning of the season and then repeated post-season with variables such as total caloric intake, water/electrolytes, lipids, carbohydrates, and proteins to be assessed.

*Summary of design changes.* The three-day dietary analysis was eliminated from the final research design based on input and advice from the academic advising team to focus solely on hydration as young athletes may not be able to accurately log the amount of food that they consume.

### *Mental Toughness Questionnaire*

Based on the initial IRB, wrestlers were to complete six questionnaires throughout the season, each rating their mental toughness and the performance that they experienced

during a practice and a tournament at the beginning of the season, mid-season and at the end of the season. The custom google form questionnaires would be adapted from a DSM-5 questionnaire of quality of daily living and consist of a Likert scale format to capture their overall mental toughness and performance they experienced during that event.

The final research design consisted of one standardized mental toughness questionnaire, known as the MTQ-10, given to the wrestlers at the end of the season. The questionnaire consists of 10 statements and the athlete had to rank each statement on a Likert scale of either strongly disagree, disagree, neutral, agree, or strongly agree.

*Summary of design changes.* The format and timing of the mental toughness questionnaires changed from six customized surveys to capture mental toughness and performance throughout the wrestling season to one standardized mental toughness questionnaire at the end of the season based on the input and advice of the academic advising team. The standardized questionnaire was beneficial since it has proven test results.

### *Statistical Analysis*

This study is a randomized control pilot study on dehydration status and mental toughness in female wrestlers. The sample size consisted of 12 athletes; however, due to varying reasons (e.g., mental health, injury, or no longer participating in the sport) only 9 athletes completed the study.

The statistical analysis of the data obtained was conducted using IBM SPSS 26. The statistical significance for all tests was set at the  $p \leq 0.05$  level. Variables that were

collected and analyzed consisted of age, height, weight, BMI, urine color, urine specific gravity, blood pressure, heart rate, capillary refill, skin elasticity, 7-site skinfold thicknesses, and 10 statement responses from the MTQ-10 questionnaire. Correlations between test variables were determined by bivariate analysis either through Pearson, Spearman, or Phi Coefficients. One Sample Chi-Squared Tests were used to determine if the null hypothesis is rejected or failed to reject. Furthermore, descriptive analyses were used for pre to post measurements. Lastly, frequencies were used to see the occurrence of a particular measurement in the sample population.

## CHAPTER FOUR

### Results

#### *Study Sample Population*

Twelve female wrestlers submitted their signed forms and committed to participating in the study and parent permission form and were enrolled in the study. All 12 wrestlers completed the first hydration test at the beginning of the season, but only 9 wrestlers followed through with the subsequent study visits and completed the mid-season hydration testing and the mental toughness questionnaire at the end of the season.

#### *Demographics*

Demographics of the sample population were captured during the first hydration test at the beginning of the season and then again during the second hydration test at mid-season. In between these two tests, some wrestlers had birthdays; however, even though some of the ages changed, the average age of the wrestlers stayed the same at 15 years old. Table 4.1 displays the range of wrestler ages along with the frequency at each age for both the beginning-of-season and mid-season hydration tests.

Table 4.1. Participant Age

| Age (years) | Beginning-of-Season |            | Mid-Season |            |
|-------------|---------------------|------------|------------|------------|
|             | Frequency           | Percentage | Frequency  | Percentage |
| 14          | 4                   | 33.3       | 2          | 22.2       |
| 15          | 5                   | 41.7       | 5          | 55.6       |
| 16          | 3                   | 25.0       | 1          | 11.1       |
| 17          | 0                   | 0.0        | 1          | 11.1       |

## Hydration Test Results

### Anthropometric Measures

At the beginning of the season, athletes are required to do a weight certification in order to compete. This certification testing includes athletes' height and weight, which was used for the initial hydration testing for this study. The height was originally captured in the unit of inches by the league and these values were converted to the metric system value of centimeters for this study in order to be directly comparable to other scientific research. Table 4.2 displays the range of wrestler heights in centimeters from 152.4 cm to 172.7 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. Notably a quarter of the participants were 154.9 cm and another quarter were 167.6 cm tall in the beginning-of-season test; whereas, the measures were all unique values with only a grouping of a third of the participants 167.6 cm tall in the mid-season test.

Table 4.2. Participant Height

| Height (cm) | Beginning-of-Season |            | Mid-Season |            |
|-------------|---------------------|------------|------------|------------|
|             | Frequency           | Percentage | Frequency  | Percentage |
| 152.4       | 1                   | 8.3        | 1          | 11.1       |
| 154.9       | 3                   | 25.0       | 1          | 11.1       |
| 160.0       | 1                   | 8.3        | 1          | 11.1       |
| 165.1       | 1                   | 8.3        | 1          | 11.1       |
| 166.4       | 1                   | 8.3        | 0          | 0.0        |
| 167.6       | 3                   | 25.0       | 3          | 33.3       |
| 170.2       | 1                   | 8.3        | 1          | 11.1       |
| 172.7       | 1                   | 8.3        | 1          | 11.1       |

Athletes were then measured for weight on a league-approved scale in the units of pounds, and these values obtained were converted to the metric unit of kilograms for



comparability. Table 4.3 displays the range of wrestler weights in kilograms from 49.804 kg to 139.900 kg along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. Weights for both the beginning-of-season and mid-season tests were unique with only one duplicate of two participants weighing 54.431 kg in the beginning-of-season test.

Table 4.3. Participant Weight

| Weight (kg) | Beginning-of-Season |            | Mid-Season |            |
|-------------|---------------------|------------|------------|------------|
|             | Frequency           | Percentage | Frequency  | Percentage |
| 49.804      | 1                   | 8.3        | 0          | 0.0        |
| 49.895      | 0                   | 0.0        | 1          | 11.1       |
| 53.070      | 1                   | 8.3        | 0          | 0.0        |
| 53.524      | 1                   | 8.3        | 1          | 11.1       |
| 54.431      | 2                   | 16.7       | 0          | 0.0        |
| 61.235      | 0                   | 0.0        | 1          | 11.1       |
| 61.689      | 0                   | 0.0        | 1          | 11.1       |
| 63.049      | 1                   | 8.3        | 0          | 0.0        |
| 64.410      | 1                   | 8.3        | 0          | 0.0        |
| 64.864      | 1                   | 8.3        | 1          | 11.1       |
| 65.317      | 0                   | 0.0        | 1          | 11.1       |
| 71.395      | 1                   | 8.3        | 0          | 0.0        |
| 74.843      | 0                   | 0.0        | 1          | 11.1       |
| 89.811      | 1                   | 8.3        | 1          | 11.1       |
| 98.430      | 0                   | 0.0        | 1          | 11.1       |
| 100.560     | 1                   | 8.3        | 0          | 0.0        |
| 139.900     | 1                   | 8.3        | 0          | 11.1       |

The Body Mass Index (BMI) was obtained through an online calculator of BMI using the league's measures for height and weight as converted to metric measurements. Table 4.4 displays the range of wrestlers' BMI from 19.4 to 34.7 along with the frequency at each measurement for both the beginning-of-season and mid-season

hydration tests. This range of BMI indicates that no participants are underweight as all values are either in the healthy, overweight, or obese categories.

Table 4.4. Participant Body Mass Index (BMI)

| BMI  | Beginning-of-Season |            | Mid-Season |            |
|------|---------------------|------------|------------|------------|
|      | Frequency           | Percentage | Frequency  | Percentage |
| 19.4 | 1                   | 8.3        | 0          | 0.0        |
| 19.5 | 0                   | 0.0        | 1          | 11.1       |
| 21.8 | 0                   | 0.0        | 1          | 11.1       |
| 22.1 | 1                   | 8.3        | 0          | 0.0        |
| 22.6 | 1                   | 8.3        | 1          | 11.1       |
| 22.7 | 1                   | 8.3        | 0          | 0.0        |
| 22.9 | 1                   | 8.3        | 0          | 0.0        |
| 23.0 | 1                   | 8.3        | 1          | 11.1       |
| 23.1 | 1                   | 8.3        | 1          | 11.1       |
| 26.2 | 1                   | 8.3        | 0          | 0.0        |
| 26.3 | 1                   | 8.3        | 0          | 0.0        |
| 26.6 | 0                   | 0.0        | 1          | 11.1       |
| 27.2 | 0                   | 0.0        | 1          | 11.1       |
| 29.0 | 1                   | 8.3        | 0          | 0.0        |
| 30.1 | 1                   | 8.3        | 1          | 11.1       |
| 34.0 | 0                   | 0.0        | 1          | 11.1       |
| 34.7 | 1                   | 8.3        | 0          | 0.0        |

Table 4.5 summarizes the anthropometric data collected for height and weight and calculated for BMI and reflects the change in average height increasing from 162.9 cm to 164.3 cm, the average weight decreasing from 71.604 kg to 68.845 kg, and the average BMI remaining consistent with only a slight change from 25.2 to 25.3 between the beginning-of-season and mid-season hydration tests. These average BMI values are considered overweight; however, interestingly, these results indicate that as a group, the participants got taller and thinner while their BMI remained virtually the same throughout the season.

Table 4.5. Summary of Anthropometric Data

| Variable    | Beginning-of-Season |         |        |         | Mid-Season |        |        |         |
|-------------|---------------------|---------|--------|---------|------------|--------|--------|---------|
|             | Low                 | High    | Mean   | SD      | Low        | High   | Mean   | SD      |
| Height (cm) | 152.4               | 172.7   | 162.9  | ±7.0    | 152.4      | 172.7  | 164.3  | ±7.0    |
| Weight (kg) | 49.804              | 139.900 | 71.604 | ±26.526 | 49.895     | 98.430 | 68.845 | ±16.132 |
| BMI         | 19.4                | 34.7    | 25.2   | ±4.3    | 19.5       | 34.0   | 25.3   | ±4.6    |

### *Vital Signs*

Table 4.6 displays the range of wrestler systolic blood pressures in millimeters of mercury from 100 mmHg to 160 mmHg along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. Visibly several values occurred more than once in the beginning-of-season test but were all unique values in the mid-season test. Additionally, a healthy systolic blood pressure for adults is 120, with teenagers being about the same or just a bit lower based on age, thus indicating most of these wrestlers had an elevated systolic blood pressure.

Table 4.6. Participant Systolic Blood Pressure (SBP)

| SBP (mmHg) | Beginning-of-Season |            | Mid-Season |            |
|------------|---------------------|------------|------------|------------|
|            | Frequency           | Percentage | Frequency  | Percentage |
| 100        | 2                   | 16.7       | 0          | 0.0        |
| 106        | 0                   | 0.0        | 1          | 11.1       |
| 108        | 0                   | 0.0        | 1          | 11.1       |
| 112        | 1                   | 8.3        | 0          | 0.0        |
| 116        | 1                   | 8.3        | 1          | 11.1       |
| 118        | 1                   | 8.3        | 1          | 11.1       |
| 122        | 1                   | 8.3        | 1          | 11.1       |
| 126        | 2                   | 16.7       | 0          | 0.0        |
| 128        | 0                   | 0.0        | 1          | 11.1       |
| 130        | 1                   | 8.3        | 1          | 11.1       |
| 134        | 2                   | 16.7       | 0          | 0.0        |
| 140        | 1                   | 8.3        | 1          | 11.1       |
| 160        | 0                   | 0.0        | 1          | 11.1       |

Table 4.7 displays the range of wrestler diastolic blood pressures in millimeters of mercury from 60 mmHg to 100 mmHg along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. While the variation in values is evident, the diastolic blood pressure of 76 occurred a third of the time in the beginning-of-season test. Additionally, a healthy diastolic blood pressure for adults is 80, with teenagers being about the same or a just a bit lower based on age, thus indicating several of these wrestlers had an elevated diastolic blood pressure.

Table 4.7. Participant Diastolic Blood Pressure (DBP)

| DBP (mmHg) | Beginning-of-Season |            | Mid-Season |            |
|------------|---------------------|------------|------------|------------|
|            | Frequency           | Percentage | Frequency  | Percentage |
| 60         | 2                   | 16.7       | 0          | 0.0        |
| 64         | 1                   | 8.3        | 2          | 22.2       |
| 66         | 1                   | 8.3        | 0          | 0.0        |
| 70         | 1                   | 8.3        | 0          | 0.0        |
| 72         | 0                   | 0.0        | 2          | 22.2       |
| 76         | 4                   | 33.3       | 0          | 0.0        |
| 80         | 0                   | 0.0        | 2          | 22.2       |
| 82         | 0                   | 0.0        | 1          | 11.1       |
| 84         | 1                   | 8.3        | 0          | 0.0        |
| 86         | 1                   | 8.3        | 1          | 11.1       |
| 100        | 1                   | 8.3        | 1          | 11.1       |

Table 4.8 displays the range of wrestler heart rates in beats per minute from 72 bpm to 132 bpm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. As seen, heart rate values of 72, 84, and 96 were repeated in the beginning-of-season test, while values of 78 and 96 were repeated in the mid-season test. Additionally, a third of these wrestlers had an elevated heart rate if

they were completely at rest according to standard resting heart rate values between 60 to 100 beats per minute for both healthy adults and teens.

Table 4.8. Participant Heart Rate (HR)

| HR (bpm) | Beginning-of-Season |            | Mid-Season |            |
|----------|---------------------|------------|------------|------------|
|          | Frequency           | Percentage | Frequency  | Percentage |
| 72       | 2                   | 16.7       | 1          | 0.0        |
| 78       | 1                   | 8.3        | 2          | 22.2       |
| 84       | 2                   | 16.7       | 1          | 0.0        |
| 88       | 1                   | 8.3        | 1          | 0.0        |
| 96       | 2                   | 16.7       | 2          | 22.2       |
| 102      | 1                   | 8.3        | 0          | 0.0        |
| 108      | 1                   | 8.3        | 1          | 22.2       |
| 114      | 1                   | 8.3        | 0          | 11.1       |
| 120      | 1                   | 8.3        | 0          | 11.1       |
| 132      | 0                   | 0.0        | 1          | 11.1       |

Table 4.9 summarizes the vital signs collected for systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) and reflects the slight changes in average SBP increasing from 122 mmHg to 127 mmHg, the average DPG increasing from 75 mmHg to 78 mmHg, and the average HR decreasing from 93 bpm to 92 bpm between the beginning-of-season and mid-season hydration tests.

Table 4.9. Summary of Vital Signs

| Variable    | Beginning-of-Season |      |      |     | Mid-Season |      |      |     |
|-------------|---------------------|------|------|-----|------------|------|------|-----|
|             | Low                 | High | Mean | SD  | Low        | High | Mean | SD  |
| SBP (mmHg)) | 100                 | 140  | 122  | ±13 | 106        | 160  | 127  | ±17 |
| DBP (mmHg)  | 60                  | 100  | 75   | ±12 | 64         | 100  | 78   | ±11 |
| HR (bpm)    | 72                  | 120  | 93   | ±16 | 72         | 132  | 92   | ±19 |

### *External Appearance*

Capillary refill and skin elasticity tests were performed on the athletes during both the beginning-of-season and mid-season hydration tests; however, all measures received were less than two seconds for all tests.

### *Urine Samples*

Athletes provided a urine sample to be tested for color and specific gravity. Table 4.10 displays the range of wrestler urine color from light yellow to amber along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. These results indicate that most participants were fairly hydrated as indicated by light yellow or yellow urine samples.

Table 4.10. Participant Urine Sample Color

| Urine Color  | Beginning-of-Season |            | Mid-Season |            |
|--------------|---------------------|------------|------------|------------|
|              | Frequency           | Percentage | Frequency  | Percentage |
| Light Yellow | 3                   | 25.0       | 3          | 33.3       |
| Yellow       | 5                   | 41.7       | 2          | 22.2       |
| Dark Yellow  | 2                   | 16.7       | 3          | 33.3       |
| Amber        | 2                   | 16.7       | 1          | 11.1       |

Table 4.11 displays the range of wrestler urine specific gravity from 1.010 to 1.030 along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests. These results indicate that half the wrestlers were fairly hydrated with measures of 1.010 and 1.015 during the beginning-of-season test; whereas only a third were as hydrated during the mid-season test.

Table 4.11. Participant Urine Specific Gravity (USG)

| USG   | Beginning-of-Season |            | Mid-Season |            |
|-------|---------------------|------------|------------|------------|
|       | Frequency           | Percentage | Frequency  | Percentage |
| 1.010 | 5                   | 41.7       | 2          | 22.2       |
| 1.015 | 1                   | 8.3        | 1          | 11.1       |
| 1.020 | 0                   | 0.0        | 1          | 11.1       |
| 1.025 | 3                   | 25.0       | 2          | 22.2       |
| 1.030 | 3                   | 25.0       | 3          | 33.3       |

Table 4.12 summarizes the urine sample data collected for color and specific gravity and reflects the slight change in average specific gravity increasing from 1.019 to 1.022 between the beginning-of-season and mid-season hydration tests. This is an indicator that the athletes were slightly more dehydrated later in the season, although overall these measures indicate that, while some may be dehydrated, as a group the wrestlers are fairly hydrated based on urine color and urine specific gravity.

Table 4.12. Summary of Urine Sample Data

| Variable         | Beginning-of-Season |       |       |        | Mid-Season |       |       |        |
|------------------|---------------------|-------|-------|--------|------------|-------|-------|--------|
|                  | Low                 | High  | Mean  | SD     | Low        | High  | Mean  | SD     |
| Color            | Light               | Amber | N/A   | N/A    | Light      | Amber | N/A   | N/A    |
| Specific Gravity | 1.010               | 1.030 | 1.019 | ±0.009 | 1.010      | 1.030 | 1.022 | ±0.008 |

### *Skinfold Measures*

Table 4.13 displays the range of wrestler skinfold measurements in centimeters at the chest from 1.270 cm to 2.540 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.

Table 4.13. Participant Skinfold Measurements at the Chest

| Chest<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|------------------------|---------------------|------------|------------|------------|
|                        | Frequency           | Percentage | Frequency  | Percentage |
| 1.270                  | 4                   | 33.3       | 3          | 33.3       |
| 1.588                  | 0                   | 0.0        | 1          | 11.1       |
| 1.905                  | 1                   | 8.3        | 5          | 55.6       |
| 2.540                  | 7                   | 58.3       | 0          | 0.0        |

Table 4.14 displays the range of wrestler skinfold measurements in centimeters at the mid axillary from 1.270 cm to 3.810 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.

Table 4.14. Participant Skinfold Measurements at the Mid Axillary

| Mid Axillary<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|-------------------------------|---------------------|------------|------------|------------|
|                               | Frequency           | Percentage | Frequency  | Percentage |
| 1.270                         | 1                   | 8.3        | 0          | 0.0        |
| 1.905                         | 0                   | 0.0        | 3          | 33.3       |
| 2.540                         | 7                   | 58.3       | 5          | 55.6       |
| 3.175                         | 1                   | 8.3        | 0          | 0.0        |
| 3.810                         | 3                   | 25.0       | 1          | 11.1       |

Table 4.15 displays the range of wrestler skinfold measurements in centimeters at the abdomen from 1.270 cm to 5.080 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.



Table 4.15. Participant Skinfold Measurements at the Abdomen

| Abdomen<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|--------------------------|---------------------|------------|------------|------------|
|                          | Frequency           | Percentage | Frequency  | Percentage |
| 1.270                    | 1                   | 8.3        | 0          | 0.0        |
| 1.905                    | 0                   | 0.0        | 2          | 22.2       |
| 2.223                    | 0                   | 0.0        | 1          | 11.1       |
| 2.540                    | 6                   | 50.0       | 2          | 22.2       |
| 3.810                    | 4                   | 33.3       | 4          | 44.4       |
| 5.080                    | 1                   | 8.3        | 0          | 0.0        |

Table 4.16 displays the range of wrestler skinfold measurements in centimeters at the supra iliac from 1.270 cm to 4.445 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.

Table 4.16. Participant Skinfold Measurements at the Supra Iliac

| Supra Iliac<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|------------------------------|---------------------|------------|------------|------------|
|                              | Frequency           | Percentage | Frequency  | Percentage |
| 1.270                        | 4                   | 33.3       | 0          | 0.0        |
| 1.588                        | 0                   | 0.0        | 1          | 11.1       |
| 1.905                        | 1                   | 8.3        | 3          | 33.3       |
| 2.540                        | 5                   | 41.7       | 4          | 44.4       |
| 3.810                        | 1                   | 8.3        | 1          | 11.1       |
| 4.445                        | 1                   | 8.3        | 0          | 0.0        |

Table 4.17 displays the range of wrestler skinfold measurements in centimeters at the thigh from 2.540 cm to 5.715 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.

Table 4.17. Participant Skinfold Measurements at the Thigh

| Thigh<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|------------------------|---------------------|------------|------------|------------|
|                        | Frequency           | Percentage | Frequency  | Percentage |
| 2.540                  | 5                   | 41.7       | 5          | 55.6       |
| 3.810                  | 6                   | 50.0       | 4          | 44.4       |
| 5.715                  | 1                   | 8.3        | 0          | 0.0        |

Table 4.18 displays the range of wrestler skinfold measurements in centimeters at the sub-scapular from 1.270 cm to 3.810 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.

Table 4.18. Participant Skinfold Measurements at the Sub-Scapular

| Sub-Scapular<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|-------------------------------|---------------------|------------|------------|------------|
|                               | Frequency           | Percentage | Frequency  | Percentage |
| 1.270                         | 2                   | 16.7       | 0          | 0.0        |
| 1.588                         | 0                   | 0.0        | 1          | 11.1       |
| 1.905                         | 2                   | 16.7       | 3          | 33.3       |
| 2.540                         | 7                   | 58.3       | 4          | 44.4       |
| 3.810                         | 1                   | 8.3        | 1          | 11.1       |

Table 4.19 displays the range of wrestler skinfold measurements in centimeters at the tricep from 1.270 cm to 3.810 cm along with the frequency at each measurement for both the beginning-of-season and mid-season hydration tests.

Table 4.19. Participant Skinfold Measurements at the Tricep

| Tricep<br>Skinfold (cm) | Beginning-of-Season |            | Mid-Season |            |
|-------------------------|---------------------|------------|------------|------------|
|                         | Frequency           | Percentage | Frequency  | Percentage |
| 1.270                   | 1                   | 8.3        | 0          | 0.0        |
| 1.905                   | 0                   | 0.0        | 2          | 22.2       |
| 2.540                   | 9                   | 75.0       | 5          | 55.6       |
| 3.175                   | 1                   | 8.3        | 0          | 0.0        |
| 3.810                   | 1                   | 8.3        | 2          | 22.2       |

Table 4.20 summarizes the skinfold measures collected for chest, mid axillary, abdomen, supra iliac, thigh, sub-scapular, and tricep and reflects the subcutaneous fat on average had decreased for most location sites between the beginning-of-season and the mid-season measurements. Additionally, the two locations with the highest average thickness for both the beginning-of-season and mid-season were the abdomen and the thigh.

Table 4.20. Summary of Participant Skinfold Measures

| Variable     | Beginning-of-Season |       |       |        | Mid-Season |       |       |        |
|--------------|---------------------|-------|-------|--------|------------|-------|-------|--------|
|              | Low                 | High  | Mean  | SD     | Low        | High  | Mean  | SD     |
| Chest        | 1.270               | 2.540 | 2.064 | ±0.613 | 1.270      | 1.905 | 1.658 | ±0.309 |
| Mid Axillary | 1.270               | 3.810 | 2.805 | ±0.739 | 1.905      | 3.810 | 2.469 | ±0.589 |
| Abdomen      | 1.270               | 5.080 | 3.069 | ±1.007 | 1.905      | 3.810 | 2.928 | ±0.866 |
| Supra Iliac  | 1.270               | 4.445 | 2.328 | ±1.025 | 1.588      | 3.810 | 2.364 | ±0.657 |
| Thigh        | 2.540               | 5.175 | 3.440 | ±0.956 | 2.540      | 3.810 | 3.104 | ±0.669 |
| Sub-Scapular | 1.270               | 3.810 | 2.328 | ±0.681 | 1.588      | 3.810 | 2.363 | ±0.657 |
| Tricep       | 1.270               | 3.810 | 2.593 | ±0.572 | 1.905      | 3.810 | 2.681 | ±0.694 |

### *Mental Toughness Questionnaire Results*

The mental toughness questionnaire had a total of 10 statements in which the participants had to then rank from strongly disagree to strongly agree. Table 4.21 summarizes the participant responses for each of the questions. As seen, only 3 out of the 10 questions received strongly disagree responses, while 7 out of the 10 questions received multiple strongly agree responses. Thus, most of the responses fell between disagree and agree. These results caused the means for every question to be close to 3.00, which was the numerical number given to the neutral response. In fact, the responses to the feeling of remaining calm even under considerable pressure were on average exactly neutral between strongly disagree and strongly agree with a mean of 3.00. The question which response fell furthest from neutral towards disagree with a mean of 2.44 was the

question related to finding enthusiasm to do tasks. Similarly, the two questions which responses fell furthest from neutral towards agree with a mean of 3.89 were related to feeling worthwhile and looking on the bright side of life.

Table 4.21. Mental Toughness Questionnaire Responses

| Question                                                                                                         | Strongly<br>Disagree<br>(1) | Disagree<br>(2) | Neutral<br>(3) | Agree<br>(4) | Strongly<br>Agree<br>(5) | Mean |
|------------------------------------------------------------------------------------------------------------------|-----------------------------|-----------------|----------------|--------------|--------------------------|------|
| 1. Even when under considerable pressure I usually remain calm                                                   | 1                           | 2               | 3              | 2            | 1                        | 3.00 |
| 2. I tend to worry about things well before they actually happen                                                 | 1                           | 4               | 0              | 3            | 1                        | 2.89 |
| 3. I usually find it hard to summon enthusiasm for the task I have to do                                         | 0                           | 6               | 2              | 1            | 0                        | 2.44 |
| 4. I generally cope well with any problems that occur                                                            | 0                           | 2               | 0              | 6            | 1                        | 3.67 |
| 5. I generally feel that I am a worthwhile person                                                                | 0                           | 0               | 3              | 4            | 2                        | 3.89 |
| 6. I just don't know where to begin is a feeling I usually have when presented with several things to do at once | 0                           | 4               | 2              | 3            | 0                        | 2.89 |
| 7. I am generally able to react quickly when something unexpected happens                                        | 0                           | 2               | 1              | 5            | 1                        | 2.67 |
| 8. When I make mistakes, I usually let it worry me for days after                                                | 0                           | 5               | 2              | 2            | 0                        | 3.33 |
| 9. I generally feel in control                                                                                   | 1                           | 1               | 2              | 4            | 1                        | 3.56 |
| 10. I generally look on the bright side of life                                                                  | 0                           | 1               | 2              | 3            | 3                        | 3.89 |

#### *Hydration Measures Compared to Questionnaire Responses*

After running a bivariate correlation for the beginning-of-season hydration measures and questionnaire responses, the same was conducted for the mid-season hydration measures of hydration and questionnaire responses.

When using the bivariate correlation analysis and comparing the beginning-of-season hydration measures to the mental toughness responses:

- No correlations were found with urine color and urine specific gravity to mental toughness.
- No correlations were found between weight and mental toughness.
- No correlations were found between BMI and mental toughness.

When using the bivariate correlation analysis and comparing the mid-season hydration measures to the mental toughness responses:

- Feeling like a worthwhile person was negatively correlated to urine color,  $r = -0.845, p = 0.004$ .
- Being able to cope with problems that may occur was negatively correlated to urine color,  $r = -0.724, p = 0.027$ .
- Looking on the bright side of life was negatively correlated to urine color,  $r = -0.735, p = 0.024$ .
- No correlations were found between weight and mental toughness.
- No correlations were found between BMI and mental toughness.
- No correlations were found between urine specific gravity and mental toughness.

## CHAPTER FIVE

### Discussion

Based on the literature review, several variables were identified as markers for determining hydration status. These variables included weight, BMI, urine specific gravity and urine color. Since it is known that wrestlers cut weight to meet weight classifications, and a primary method to cut weight is through a loss of water weight, it was expected that wrestlers would be dehydrated. This study was intended to determine if that dehydrated state then affects mental toughness. As a result, a correlation between mental toughness and the four variables of weight, BMI, urine specific gravity, and urine color was anticipated to prove the effect of dehydration on mental toughness.

This study of female wrestlers during the 2022-2023 winter season was able to find a statistically significant correlation between urine color and mental toughness, thus proving one of the project's five hypothesis. Specifically, a negative correlation between mid-season urine sample color and the attributes of feeling worthwhile, coping, and looking to the bright side of life were found.

This study was not, however, able to find a statistically significant correlation between weight, BMI, or urine specific gravity and mental toughness. These results in themselves may lead someone to presume that there is no relation between dehydration and mental toughness, but that may not be the case. Upon further review of the data, it may not be so much a lack of a correlation between these hydration markers and mental toughness as it is whether the wrestlers were actually dehydrated. The study was based on

the premise that the wrestlers would have some significant level of dehydration due to cutting weight; however, based on the urine sample color data and the urine specific gravity data, as a group, the wrestlers in this study appeared to be more hydrated than dehydrated. Per the urine sample color results displayed in Table 4.10 most participants were fairly hydrated as indicated by the 66.7 percent with light yellow or yellow urine sample color for the beginning-of-season test and the 55.5 percent with light yellow or yellow urine sample color for the mid-season test. Similarly, per the urine specific gravity results displayed in Table 4.11, many of the participants were fairly hydrated as indicated by the 50 percent with 1.010 and 1.015 urine specific gravity for the beginning-of-season test and the 33.33 percent with 1.010 and 1.015 urine specific gravity for the mid-season test. In addition, in this drop of 16.67 percent not being as hydrated based on urine specific gravity between tests, the data reflected in Table 4.12 also indicates that the athletes were slightly more dehydrated later in the season with the change average urine specific gravity from 1.019 at the beginning-of-season test to 1.022 at the mid-season test. Furthermore, the statistically significant correlation between mid-season urine sample color and mental toughness supports the notion that the group may not have been dehydrated enough to impact the affect on mental toughness since the significant correlation was only found in the test results when more participants were dehydrated.

Since, based on the literature, urine specific gravity is considered the best indicator of hydration, a correlation is anticipated to exist between mental toughness and urine specific gravity. Based on the statistical analysis, urine specific gravity did not indicate that mental toughness is negatively correlated unlike the results achieved with urine color. Especially since when considered alone there is a Pearson correlation as

when urine color increases so does urine specific gravity ( $r = 0.694$ ,  $p = 0.012$ ). However, in this research study the null hypothesis that a correlation will exist between urine specific gravity and mental toughness was rejected, likely due to the small sample size, and no significance could be found. With that said, there is likely a correlation with urine specific gravity and mental toughness that was not proven through this study due to the sample size.

In summary, the inability to find a statistically significant correlation between weight, BMI, or urine specific gravity may be a result of the sample population either not being as dehydrated as anticipated or being too small to perform a statistical analysis. Either way warrants further investigation and research.



## CHAPTER SIX

### Conclusion

It is encouraging that one variable, urine color, indicates that with increased urine color there is a negative correlation to mental toughness in female high school wrestlers. As a result, this study serves as a good steppingstone for further research on this sport and specific population. Since only one objective was able to be assessed during the 2022-2023 wrestling season, more research is recommended to evaluate dietary factors of female performance, and through a bigger sample size, further evaluate female wrestlers hydrated state and its effects on their performance and mental toughness.

## APPENDICES

## APPENDIX A

### IRB Proposal

#### **Dehydration in High School Girls Wrestling**

|                         |                                                                                                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------------|
| PRINCIPAL INVESTIGATOR: | Jennae Fenton<br>1400 S 5 <sup>th</sup> St, Waco, TX 76706<br>(916)878-8091<br>Jennae.Fenton@gmail.com          |
| FACULTY ADVISOR:        | Dr. Brian Leutholtz<br>1400 S 5 <sup>th</sup> St, Waco, TX 76706<br>(254)710-4013<br>Brian_Leutholtz@baylor.edu |
| PROTOCOL VERSION:       | 08/29/2022                                                                                                      |

### Synopsis

|                                   |                                                                                                  |
|-----------------------------------|--------------------------------------------------------------------------------------------------|
| Title                             | Dehydration in High School Girls Wrestling                                                       |
| Study Duration                    | 1 Year                                                                                           |
| Study location(s)                 | Baylor University Marris McLean Gym<br>High Schools in McLennan County, TX and Placer County, CA |
| Objectives                        | See Below for Study Objectives                                                                   |
| Number of Subjects                | 100                                                                                              |
| Main Inclusion/Exclusion Criteria | See Below in Inclusion/Exclusion Criteria                                                        |

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## 1.0 BACKGROUND AND RATIONALE

According to *Athletic Scholarships*, wrestling is one of the oldest forms of combat, tracing back 15,000 years to early Egyptians and Greeks<sup>1</sup>. There are many styles of wrestling; however, the style practiced in high school sports is known as Folkstyle. It is not necessarily known when Folkstyle wrestling originated since the sport of wrestling evolved over many years taking the various cultures that adapted and created the various forms. Although males have competed in regulated wrestling competitions since 1903 with the first dual meet taking place between Yale and Columbia University<sup>2</sup>. Women's wrestling is much newer and continues to evolve. The first Worlds Championships for women's wrestling was in 1987<sup>3</sup>; however, to this day, 36 states recognize and have sanctioned state championships for women's wrestling. This includes the State of California and the State of Texas, which will serve as the locations of the study<sup>4</sup>. The Baylor Library One Search database was used with the search term "women's wrestling" and 1,333 articles were retrieved. Upon using the filters of peer-reviewed journals and articles dated between 2000-2022, then 249 articles were returned. Most of the articles that were found are about the cultural stigma in relation to gender and male-dominated sports or the initiation of women's wrestling in the NCAA. Minimal to no research articles were for the physiological aspects related to women's wrestling. Since lack of research on the physiological aspects of female wrestling, and hydration is a significant part of the wrestling season with cutting weight to meet match requirements, this study is worth pursuing. Not only did the principal investigator participate in women's wrestling during high school, but the principal investigator also has a background of studying hydration status. The goal of this research is to gain more knowledge of the effects of hydration on performance and mental toughness for female wrestlers.

## 2.0 STUDY OBJECTIVES

The primary objectives of this research project will be to 1) Examine the effects of dietary factors of female wrestlers' performance. 2) Identify how mental toughness may be affected by changes in dehydration status.

## 3.0 SUBJECT SELECTION & RECRUITMENT

### 3.1 INCLUSION CRITERIA

- One hundred females will be recruited from McLennan County, TX and Placer County, CA via email to high school coaches.
- Female Wrestlers Ages 13-19
- Minors are considered a "vulnerable population" that will be used in this study and is the best population group to assess the goals of the research because this age group participates in the sport.
- Participants classified as "Low Risk" according to the Initial ACSM Risk Stratification Guidelines.
- Subjects that meet requirements to be able to participate in physical activity according to Physical Activity Readiness Questionnaire (PAR-Q).

### **3.2 EXCLUSION CRITERIA**

- Subjects that have a family history or background of cardiovascular risks, cigarette smoking, a sedentary lifestyle or obesity.
- Subjects that do not meet PAR-Q requirements.
- Males will be excluded from the following study as research around this subject is mostly involving male participants and data, and the purpose of this investigation is to gain a newer understanding of the sport from a different point of view.

## **4.0 RESEARCH DESIGN & METHODS**

In this study, 100 female high school wrestling athletes will be recruited to participate. Subjects will initially partake in a dehydration test that is mandatory per the league to define weight classes. Subjects are to complete this requirement before participating in sanctioned competition. Measures that will be determined are scale weight, overall hydration, urine color. In addition to this test, the principal investigator will assess urine specific gravity, anthropometric measures via skinfolds, height, age, demographics, medical history. Then, subjects will be asked to write a log for the food intake that they have 3 days at the beginning of the wrestling season. The principal investigator will look towards variables such as total calorie intake, water/ electrolytes, lipids, carbohydrates, and proteins. After, the subjects will be given a link to a google form where they will answer a mental toughness questionnaire that has been adapted from a DSM-5 questionnaire of quality of daily living. This form will be completed preseason, midseason, and postseason before and after a single practice as well as preseason, midseason, and postseason before and after a tournament. Following the psychological aspect of this study, subjects will be asked to do another dehydration test at mid-season weight allowances, which will look for the same variables as before. Lastly, subjects will complete another 3-day dietary analysis as the season concludes to compare to the beginning of the season.

## **5.0 STUDY ACTIVITIES (if applicable)**

### **Study Visit 1- Hydration Testing**

The high school wrestling season is from end of October/start of November to the end of February. At the beginning of the wrestling season, all wrestling athletes must perform a hydration test to determine the lowest weight classes that they can qualify for, and each wrestler receives their individual results. For my study, I will ask for participants hydration testing records as conducted per the league requirements. This will serve as my baseline values of hydration and will also be considered Visit 1 of the study. During the hydration test, I will also be assessing some other variables that are not analyzed by the league.

### **Per the League**

**Bioelectrical Impedance Analysis (BIA):** The BIA is a method to estimate the subject's body composition, in particular the body fat and muscle mass, by using a very weak electric current flow through the body and measuring the weak voltage to determine the

impedance of the body.

**Height/Weight:** The league will obtain height and weight by the Detecto Eye- Level Beam Scale with Height Rod. This will serve as a baseline measure of weight and height.

**Urine Sample Color:** The league is most concerned about the urine color of the sample that the athletes provide. The league will assess if the urine is clear to very yellow.

#### **Per the Principal Investigator**

**Physical Activity Readiness Questionnaire (PAR-Q):** The principal investigator will have the subjects complete this form in order to participate in the study. Furthermore, the investigator will want to know any significant medical history that the subject may have.

**Heart Rate:** Heart rate will be measured manually by taking the radial artery pulse.

**Blood Pressure:** Resting blood pressure will be measured manually with a sphygmomanometer on the upper arm and a stethoscope applied under the cuff running along the artery to listen for Korotkoff sounds.

**Capillary Refill/ Skin Elasticity:** The investigator will assess hydration via these variables either by pinching the back of the hand or pressing down on the fingernail of the thumb. These two tests are synonymous in the measure of hydration; however, both will be performed on the subject.

**Urine Test:** The same urine sample as used by the league will be used to collect urine specific gravity. The investigator will assess urine specific gravity based on the Multistix 10 SG Reagent Strip scale.

**Skinfold Calipers:** The principal investigator will assess the skinfold thickness at multiple locations of body fat by pinching the skin with the device so that a prediction of the total body fat can be made.

#### **Study Visit 2- Three-Day Dietary Analysis**

**Cronometer Application:** The investigator will ask the subjects to log their meals via the Cronometer app either on their phone or computer. After each day the subjects will need to submit a screenshot of the numerical values provided. The dietary analysis will be captured for three days. Subjects will submit screenshots via a google form.

#### **Study Visit 3- Mental Toughness Questionnaire of Practice**

**Mental Toughness Questionnaire:** The investigator will instruct the subjects to complete a google form after a preseason practice. The google form questionnaire will consist of a Likert scale format about their overall mental toughness and performance they experienced during that particular practice. Throughout the season a total of three



questionnaires will be completed to capture mental toughness and performance for pre-season, mid-season, and post-season practices.

#### **Study Visit 4- Mental Toughness Questionnaire of a Tournament**

**Mental Toughness Questionnaire:** The procedure for this test is similar as above. The investigator will have the subjects complete a questionnaire for pre-season, mid-season, and post-season tournaments, capturing the mental toughness and performance experienced during each tournament.

#### **Study Visit 5- Hydration Testing**

**Hydration Testing:** Since athletes are given a two-pound weight allowance mid-season, another hydration test is necessary. For the mid-season hydration test it will be conducted in the same manner as at the beginning of the season and the same variables will be measured.

#### **Study Visit 6- Three-Day Dietary Analysis**

**Cronometer Application:** The same methods as above will be used to measure the post-season food intake.

### **6.0 RISKS & BENEFITS**

This is a low-risk research study and as such, the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during performance of routine physical or psychological examinations or tests. The subjects participating in the sport of wrestling are assuming more risk than the study itself. Since wrestling is a contact-sport athletes are prone to injury. However, most commonly, after practice or competition, athletes may experience delayed onset muscle soreness that will resolve on its own after a few days of recovery. Individuals who choose to participate in this study will not be monetarily reimbursed. They will receive individual participant results for the dietary analysis, body composition, and hydration status following the completion of the study. The results will be provided and explained in layman terms.

### **7.0 STATISTICAL ANALYSIS**

Statistical analysis will be conducted using IBM SPSS 26. Statistical significance for all tests will be set at the  $\leq 0.05$  level. The total sample size needed is 100 subjects. Some specific data variables being collected are body composition via Bioelectrical Impedance Analysis, urine specific gravity, calorie intake, heart rate, capillary refill, and skin elasticity. Significant differences between variables will be determined by a repeated-measures ANOVA. T-tests will be used to determine significant differences and distribution. Descriptive analysis will be used for pre to post measurements. Frequencies will help explain changes over the testing and data collection.

## **8.0 DATA SECURITY & PRIVACY/CONFIDENTIALITY**

Data collected in relation to this study will be kept confidential by assigning each participant a random, unique identifier. Hard copy records will be under lock and key. Electronic data will be kept on password-protected computers found in the laboratory. Data collected on these computers will be moved onto an encrypted USB drive to the Principal Investigators computer which is also password protected. The researchers will not discuss participant information with anyone other than with the subjects or members of the research team (Principal Investigator and Faculty Advisor). All records of the research study will remain confidential and stored in a locked cabinet in the Principal Investigator's Office, and only they will have access to the key that opens the cabinet.

In the event that it is needed to report risk of harm to self or others, the researchers are required to take the necessary actions. This may include, but is not limited to, notifying the participant's doctor, therapist, or other individual.

## **9.0 DATA & SAFETY MONITORING**

Data will be captured and used for the sole objectives of the study and will be kept strictly confidential. Data will be recorded and stored in hard-copy and on lab computers using a coding system to assign each participant with a random unique-ID to maintain participant privacy. The data that is recorded with pen and paper will be maintained in separate file folders for each participant labeled with the unique-ID. The data that is collected on lab computers for a single session will be downloaded to and stored on an encrypted USB drive and thereafter will be deleted from the computer's hard drive. As part of the consent process, participants will acknowledge with their initials and signature that their personal hardcopy file and electronic data will be held for three years after the study for auditing purposes. Data that identifies specific participants will not be reported. All reports will contain only aggregate or personally non-identifiable data.

Subjects will be monitored throughout the duration of the study. This is a low-risk research study and as such, the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during performance of routine physical or psychological examinations or tests; however, if anything occurs requiring medical attention, the participant will be recommended to contact their physician or 911 will be called, whichever is more appropriate. Participants of this study are informed that they can withdraw from the study at any time and for any reason. No penalty will result in discontinuing participation. The researcher also reserves the right to exclude a participant if the researcher believes it would be in the best interest of the subject, does not meet an inclusionary criterion, and if the subject cannot make a required study visit. For those participants who choose to withdraw or are excluded, the data captured prior to discontinuance will be kept confidential and will be stored and disposed of in the same manner outlined above for all other participants.

## 10.0 REFERENCES

1. The History Of Wrestling. Accessed August 30, 2022.  
<https://www.athleticscholarships.net/history-of-wrestling.htm>
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[https://en.wikipedia.org/w/index.php?title=Collegiate\\_wrestling&oldid=1103562003](https://en.wikipedia.org/w/index.php?title=Collegiate_wrestling&oldid=1103562003)
3. Curby D, Jomand G. The Evolution of Women's Wrestling: History, Issues and Future. *Int J Wrestl Sci.* 2015;5:2-12. doi:10.1080/21615667.2015.1040536
4. High School State Executive Association Updates. Wrestle Like A Girl. Accessed August 30, 2022. <https://wrestlelikeagirl.org/hsseau>

## APPENDIX B

### Consent Form

Baylor University  
Health, Human Performance and Recreation

#### Consent Form for Research

PROTOCOL TITLE: Dehydration in High School Girls Wrestling  
PRINCIPAL INVESTIGATOR: Jennae Fenton

#### **Invitation to be Part of a Research Study**

You are invited to be part of a research study. This consent form will help you choose whether or not to participate in the study. Feel free to ask if anything is not clear in this consent form.

#### **Why is this study being done?**

The purpose of this study is to learn more about dehydration and the effects it could have on the performance and mental toughness of a female wrestler.

#### **What will happen if I take part in this research study?**

If you agree to take part in this study, you will:

- Task One: Hydration Testing – Complete the League mandatory urine test and provide the urine sample to both the League and to the Principal Investigator, allowing us to use it for analysis - About 2 Hours.
- Task Two: Three-Day Dietary Analysis – Keep a log of foods eaten on Cronometer application/website and send it to the Principal Investigator, allowing us to use it for analysis - 30-minute span over three days.
- Task Three: Mental Toughness During Practice Questionnaire – Complete a total of three surveys depicting before and after practice experiences and send them to the Principal Investigator, allowing us to use them for analysis - 20 minutes x3 for pre, mid, and post season.
- Task Four: Mental Toughness During Tournament Questionnaire – Complete a total of three surveys depicting before and after tournament experiences and send them to the Principal Investigator, allowing us to use them for analysis - 20 minutes x3 for pre, mid, and post season.
- Task Five: Hydration Testing, Mid-Season Check – Provide the Principal Investigator with a urine sample similar to the one completed at the beginning of the season, allowing us to use it for analysis - About 2 Hours.
- Task Six: Three-Day Analysis – Keep a log of foods eaten on Cronometer and send it to the Principal Investigator, allowing us to use it for analysis - 30-minute span over three days.

Some of the questions in the questionnaire may be considered sensitive. For example, as a measure of dehydration status the questionnaire will ask when they had their last menstrual period.

#### **How long will I be in this study and how many people will be in the study?**

Version date: 10/23/2022

Page 1 of 4

Participation in this study will last the duration of the wrestling season from October to February. About 100 subjects will take part in this research study.

#### **What are the risks of taking part in this research study?**

We don't believe there are any risks from participating in this research. The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during performance of routine physical or psychological examinations or tests. Those participating in the sport of wrestling are assuming more risk than the study itself. Since wrestling is a contact-sport, athletes are prone to injury. However, most commonly, after practice or competition, athletes may experience delayed onset muscle soreness that will resolve on its own after a few days of recovery. Any of these typical affects of wrestling will not change as a result of participating in this study.

#### **Are there any benefits from being in this research study?**

You will benefit from being in this study because you will be provided with results for a dietary analysis, body composition, and hydration status. This information can be helpful for future wrestling seasons as well as overall health.

#### **How Will You Protect my Information?**

A risk of taking part in this study is the possibility of a loss of confidentiality. Loss of confidentiality includes having your personal information shared with someone who is not on the study team and was not supposed to see or know about your information. The researcher plans to protect your confidentiality.

We will keep the records of this study confidential by assigning each participant a random, unique identifier. Hard copy records will be under lock and key. Electronic data will be kept on password-protected computers found in the laboratory. Data collected on these computers will be moved onto an encrypted USB drive to the Principal Investigators computer which is also password protected. The researchers will not discuss participant information with anyone other than with the subjects or members of the research team (Principal Investigator and Faculty Advisor). All records of the research study will remain confidential and stored in a locked cabinet in the Principal Investigator's Office, and only they will have access to the key that opens the cabinet. We will make every effort to keep your records confidential. However, there are times when federal or state law requires the disclosure of your records.

The following people or groups may review your study records for purposes such as quality control or safety

- Representatives of Baylor University and the BU Institutional Review Board
- Federal and state agencies that oversee or review research (such as the HHS Office of Human Research Protection or the Food and Drug Administration)

The results of this study may also be used for teaching, publications, or presentations at professional meetings. If your individual results are discussed, your identity will be protected by using a code number or pseudonym rather than your name or other identifying information.

**Is it possible that I will be asked to leave the study?**

The researcher may take you out of this study without your permission. This may happen because:

- The researcher thinks it is in your best interest
- You can't make the required study visits
- Other administrative reasons

**Your Participation in this Study is Voluntary**

Taking part in this study is your choice. You are free not to take part or to withdraw at any time for any reason. No matter what you decide, there will be no penalty or loss of benefit to which you are entitled. If you decide to withdraw from this study, the information that you have already provided will be kept confidential. You cannot withdraw information collected prior to your withdrawal.

**Contact Information for the Study Team and Questions about the Research**

If you have any questions about this research, you may contact:

Jennae Fenton

Phone: (916)878-8091

Email: [jennae.fenton@gmail.com](mailto:jennae.fenton@gmail.com)

Or

Dr. Brian Leutholtz

Phone: (254)710-4013

Email: [Brian\\_Leutholtz@baylor.edu](mailto:Brian_Leutholtz@baylor.edu)

**Contact Information for Questions about Your Rights as a Research Participant**

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

Baylor University Institutional Review Board

Office of the Vice Provost for Research

Phone: (254)710-3708

Email: [irb@baylor.edu](mailto:irb@baylor.edu)

**Your Consent**

**SIGNATURE OF SUBJECT:**

By signing this document, you are agreeing to be in this study. We will give you a copy of this document for your records. We will keep a copy with the study records. If you have any questions

about the study after you sign this document, you can contact the study team using the information provided above.

*I understand what the study is about and my questions so far have been answered. I agree to take part in this study.*

\_\_\_\_\_  
Signature of Subject

\_\_\_\_\_  
Date

## APPENDIX C

### Assent Form

Baylor University  
Health, Human Performance and Recreation

#### Assent Form for Research

PROTOCOL TITLE: Dehydration in High School Girls Wrestling  
PRINCIPAL INVESTIGATOR: Jennae Fenton

#### **What is a Research Study?**

Research studies help us to learn new things and test new ideas. People who work on research studies are called researchers. During research studies, the researchers collect a lot of information so that they can learn more about something.

#### **What is this study about?**

We are doing this study because we would like to learn more about dehydration and the effects it could have on the performance and mental toughness of a female wrestler. We are asking you to join this study because you are an overall healthy female high school wrestler.

#### **What will I do if I am in this research study?**

If you decide to be in this study, we will ask you to:

- Complete the league's required hydration testing at the beginning and an additional hydration testing in the middle of the season. In addition to the league's mandatory analysis performed by them, as the principal investigator, I will analyze both urine samples for this study.
- Partake in a three-day dietary analysis at the beginning and the middle of the season by using the Cronometer application/website to log the foods eaten in total for the day.
- Answer a mental toughness questionnaire before and after practice at the beginning, middle, and end of the season
- Answer a mental toughness questionnaire before and after a tournament at the beginning, middle and end of the season

This study will take the length of the wrestling season from October to February with a total of 6 visits and there will be 100 subjects in this study.

#### **Can anything bad happen to me while I am in this study?**

This is a low-risk research study and as such, the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during a performance of routine physical or psychological examinations or tests. Those participating in the sport of wrestling are assuming more risk than the study itself. Since wrestling is a contact-sport, athletes are prone to injury. However, most commonly, after practice or competition, athletes may experience delayed onset muscle soreness that will resolve on its own after a few days of recovery. Any of these typical affects of wrestling will not change as a result of participating in this study.



**Will being in this research study help me?**

By participating in this study, you will receive your results for dietary analysis, body composition, and hydration status. This information can be helpful for future wrestling seasons as well as overall health.

**What else should I know?**

You do not have to be in this study. It is entirely up to you. Also, you can say "yes" now and change your mind later. No one will be upset if you do not want to do this. All you have to do is tell us you want to stop.

We will limit the use of your information that we collect to people who have a need to review this information. We cannot promise to keep everything a secret, but we will keep your name and your information private. Your responses may be used for a future study by us or we may share your responses with other researchers. When reporting on this research, your information will either be unidentifiable to you or will be reported in aggregate with others.

If you tell us that someone is hurting you or that you might hurt yourself or someone else, the law requires us to let other people know so they can help you.

**Who do I talk to if I have questions?**

You can ask any questions at any time. You can ask now or later. Just tell the researcher when you see them, or ask your parent or another adult to contact:

Jennae Fenton  
Phone: (916)878-8091  
Email: jennae.fenton@gmail.com

**Statement of Assent**

If you want to be in the study, write your name below.

\_\_\_\_\_  
Signature of Subject

\_\_\_\_\_  
Date

## APPENDIX D

### Parent/Guardian Permission Form

Baylor University  
Health, Human Performance and Recreation

#### Parent/Guardian Permission Form for Research

PROTOCOL TITLE: Dehydration in High School Girls Wrestling  
PRINCIPAL INVESTIGATOR: Jennae Fenton

#### **Invitation to be Part of a Research Study**

Your child is invited to be part of a research study. This consent form will help you choose whether or not to let your child participate in the study. Feel free to ask if anything is not clear in this consent form.

#### **Why is this study being done?**

The purpose of this study is to learn more about dehydration and the effects it could have on the performance and mental toughness female wrestler.

#### **What will happen if my child takes part in this research study?**

If you agree to allow your child to take part in this study, your child will:

- Task One: Hydration Testing – Complete the League mandatory urine test and provide the urine sample to both the League and to the Principal Investigator, allowing us to use it for analysis - About 2 Hours.
- Task Two: Three-Day Dietary Analysis – Keep a log of foods eaten on Cronometer application/website and send it to the Principal Investigator, allowing us to use it for analysis - 30-minute span over three days.
- Task Three: Mental Toughness During Practice Questionnaire - Complete a total of three surveys depicting before and after practice experiences and send them to the Principal Investigator, allowing us to use them for analysis - 20 minutes x3 for pre, mid, and post season.
- Task Four: Mental Toughness During Tournament Questionnaire - Complete a total of three surveys depicting before and after tournament experiences and send them to the Principal Investigator, allowing us to use them for analysis - 20 minutes x3 for pre, mid, and post season.
- Task Five: Hydration Testing, Mid-Season Check – Provide the Principal Investigator with a urine sample similar to the one completed at the beginning of the season, allowing us to use it for analysis - About 2 Hours.
- Task Six: Three-Day Dietary Analysis - Keep a log of foods eaten on Cronometer and send it to the Principal Investigator, allowing us to use it for analysis - 30-minute span over three days.

Some of the questions in the questionnaire may be considered sensitive. For example, as a measure of dehydration status the questionnaire will ask when they had their last menstrual period.

**How long will my child be in this study and how many people will be in the study?**

Participation in this study will last the duration of the wrestling season from October to February. About 100 subjects will take part in this research study.

**What are the risks of taking part in this research study?**

We don't believe there are any risks from participating in this research. The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during performance of routine physical or psychological examinations or tests. Those participating in the sport of wrestling are assuming more risk than the study itself. Since wrestling is a contact-sport athletes are prone to injury. However, most commonly, after practice or competition, athletes may experience delayed onset muscle soreness that will resolve on its own after a few days of recovery. Any of these typical affects of wrestling will not change as a result of participating in this study.

**Are there any benefits from being in this research study?**

Your child will benefit from being in this study because they will be provided with results for a dietary analysis, body composition, and hydration status. This information can be helpful for future wrestling seasons as well as overall health.

**How Will You Protect my child's Information?**

A risk of taking part in this study is the possibility of a loss of confidentiality. Loss of confidentiality includes having your child's personal information shared with someone who is not on the study team and was not supposed to see or know about your child's information. The researcher plans to protect your child's confidentiality.

We will keep the records of this study confidential by assigning each participant a random, unique identifier. Hard copy records will be under lock and key. Electronic data will be kept on password-protected computers found in the laboratory. Data collected on these computers will be moved onto an encrypted USB drive to the Principal Investigators computer which is also password protected. The researchers will not discuss participant information with anyone other than with the subjects or members of the research team (Principal Investigator and Faculty Advisor). All records of the research study will remain confidential and stored in a locked cabinet in the Principal Investigator's Office, and only they will have access to the key that opens the cabinet. We will make every effort to keep your child's records confidential. However, there are times when federal or state law requires the disclosure of your child's records.

The following people or groups may review your child's study records for purposes such as quality control or safety:

- Representatives of Baylor University and the BU Institutional Review Board
- Federal and state agencies that oversee or review research (such as the HHS Office of Human Research Protection or the Food and Drug Administration)

The results of this study may also be used for teaching, publications, or presentations at professional meetings. If your child's individual results are discussed, your child's identity will be protected by using a code number or pseudonym rather than your child's name or other identifying information.

#### **Is it possible that my child will be asked to leave the study?**

The researcher may take your child out of this study without your permission. This may happen because:

- The researcher thinks it is in your child's best interest
- Your child can't make the required study visits
- Other administrative reasons

#### **Your Child's Participation in this Study is Voluntary**

Allowing your child to take part in this study is your choice. You are free not to allow your child to take part or to withdraw your child at any time for any reason. No matter what you decide, there will be no penalty or loss of benefit to which you or your child are entitled. If you decide to withdraw your child from this study, the information that your child has already provided will be kept confidential. You cannot withdraw information collected prior to your child's withdrawal.

#### **Contact Information for the Study Team and Questions about the Research**

If you have any questions about this research, you may contact:

Jennae Fenton

Phone: (916)878-8091

Email: [jennae.fenton@gmail.com](mailto:jennae.fenton@gmail.com)

Or

Dr. Brian Leutholtz

Phone: (254)710-4013

Email: [Brian\\_Leutholtz@baylor.edu](mailto:Brian_Leutholtz@baylor.edu)

#### **Contact Information for Questions about Your Rights as a Research Participant**

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

Baylor University Institutional Review Board

Office of the Vice Provost for Research

Phone: (254)710-3708

Email: [irb@baylor.edu](mailto:irb@baylor.edu)

#### **Your Permission**

Name of child (please print): \_\_\_\_\_

**SIGNATURE OF PARENT(S)/GUARDIAN FOR CHILD:**

By signing this document, you are agreeing to your child's participation in this study. Make sure you understand what the study is about before you sign. We will give you a copy of this document for your records. We will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

*I understand what the study is about and my questions so far have been answered. I agree for my child to take part in this study.*

\_\_\_\_\_  
Signature of Parent/Guardian

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Parent/Guardian

\_\_\_\_\_  
Date

## APPENDIX D

### Hydration Test Data Sheet

#### Hydration Test Data Sheet

Personal Identification Number \_\_\_\_\_ Age \_\_\_\_\_

Height \_\_\_\_\_ Weight \_\_\_\_\_ BMI \_\_\_\_\_

Blood Pressure \_\_\_\_\_ Heart Rate \_\_\_\_\_

Capillary Refill < 2 sec > 2 sec Skin Elasticity < 2 sec > 2 sec

Comments \_\_\_\_\_

Urine Sample Color Clear Light Yellow Yellow Dark Yellow Amber Brown Red

Comments \_\_\_\_\_

Urine Specific Gravity 1.000 1.005 1.010 1.015 1.020 1.025 1.030

#### Skinfolds

Chest \_\_\_\_\_ Mid Axillary \_\_\_\_\_ Abdomen \_\_\_\_\_

Supra Iliac \_\_\_\_\_ Thigh \_\_\_\_\_

Subscapular \_\_\_\_\_ Tricep \_\_\_\_\_

#### BIA

Comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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