ATHLETE KNOWLEDGE AND USE OF POST-EXERCISE REHYDRATION DRINKS

A THESIS

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THESIS APPROVAL

Graduate Athletic Training Education

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INTRODUCTION

It is imperative for athletes to rehydrate as efficiently as possible after strenuous exercise. Many athletes participate in multiple practices per day; some of these practices are spaced within three hours of each other. Due to energy demands, the proper rehydration drink is critical when athletes need to recover for another session. There has been a plethora of research done in recent years, which aim to test the efficiency of recovery utilizing many types of drinks. Since the creation of fluid replacement drinks, they have been the standard for all athletes; however, the post-exercise rehydration market is burgeoning. Currently, post-exercise rehydration drinks include: carbohydrate-electrolyte replacement drinks (fluid replacement), carbohydrate-protein replacement, milk, and even pickle juice. Before attempting to evaluate athlete knowledge concerning these drinks, it is important to establish a base of knowledge from which clinicians can draw answers.

Due to their inclusion in every study of rehydration drinks, it can be concluded that fluid replacement drinks are among the first choices of rehydration drinks. Fluid-

replacement drinks typically consist of: 0g fat, 0g protein, 15g carbohydrate, 115mg sodium, and 31mg potassium.[1,2]

The electrolytes contained in fluid replacement drinks have led to it being called a better post-exercise rehydration drink than plain water.[1] As a result, many companies have created rehydration drinks (ie. Gatorade, Powerade, Vitamin Water, FRS, etc…). Most drinks, however, contain a near identical chemical make-up. As a result, preferences for taste and school affiliation will often determine what is consumed. Recently, fluid replacement drink companies have churned out new "additive" products for their drinks. These are packets of nutrient powders that can be added to any drink. Used in climates of intense heat, these are becoming more commonplace as they gain widespread acceptance. The electrolytes often added are Sodium, Potassium, Calcium, and Magnesium. The theory behind these new additives is that simple fluid replacement drinks may not always be enough to fulfill hydration needs.

Due to athletic demands, new rehydration drinks are always being produced. One newer type of drink is a carbohydrate-protein drink. These drinks have a very different nutrient makeup than fluid-replacement drinks: 4g protein, 1g fat, 16g carbohydrate, 127mg sodium, and 16mg

potassium per serving. However, clinical trials have shown no increased effects (muscle protein synthesis, strength gains, cycle time to exhaustion, etc…) over fluid-replacement drinks.[2] The ideology behind infusing protein into these drinks is to increase muscle recovery after exercise. The typical protein type found in these drinks is whey protein. Support for this theory has been provided by research.[3] In one clinical trial, weight-lifters had an increase in muscle protein uptake at a higher level with 10g whey protein and 21g carbohydrate than a drink with carbohydrate only. The positive protein balance observed among the participants in the whey protein group was hypothesized to lead to greater hypertrophy and, in effect, strength gains.

Recently, milk has entered the discussion of post-exercise rehydration drinks. The reason for this is that milk contains all the nutrients thought to be important in a post-exercise rehydration drink.[4] Milk can be processed and altered in many different ways. For example, there is whole milk, 2% milk, skim milk, chocolate milk, strawberry milk, and soy milk; all of these contain different nutrients. In a direct comparison, chocolate 2% milk appears to show the greatest benefit to athletes.[3] The nutrient makeup of typical chocolate 2% milk is: 8g

protein, 5g fat, 27g carbohydrate, 159mg sodium, 446mg potassium. However, the reasons for the positive results have not been thoroughly studied. Common theories accounting for this include: slower digestion of proteins, increased circulation of fatty acids within the blood, less urine production post-exercise, and increased amount of protein.[2-5]

While researching post-exercise rehydration drinks, it is important not to lose sight of the main objective: general health of the athlete. Athletes need to be educated on basic nutrition concepts and rehydration drinks so they may make informed decisions on what they are ingesting. While numerous studies have examined athlete knowledge concerning basic nutrition, none have examined knowledge solely based on rehydration.[7-12] Therefore; there is a gap in knowledge that needs to be explored. Athletes must be tested on knowledge and usage of post-exercise rehydration drinks.

This study will attempt to answer the following questions: 1) What do athletes know about post-exercise rehydration and 2) Does post-exercise rehydration drink consumption and knowledge vary between gender and sport?

METHODS

The primary purpose of this study is to: review current literature on post-exercise rehydration drinks, test athlete knowledge of post exercise rehydration drinks, and evaluate the usage of post exercise rehydration drinks. The following section will include the following subsections: research design, subjects, instruments, procedures, hypotheses, and data analysis.

Research Design

This research is a descriptive research design. The independent variables will be: gender, division of institute, and sport played. The dependent variables will be the knowledge score as measured by the number of questions answered correctly in that section of the survey and the type of drink used. The knowledge score will be a numerical value ranging from 0 to 19, 19 being a perfect score.

Subjects

The subjects that will be used for this study will be volunteer male and female athletes from California University of Pennsylvania and High Point University. All athletes 18 years of age and older at these institutions will be provided the opportunity to participate. The study will be approved by the Institutional Review Board at California University of Pennsylvania (Appendix C1) prior to any data collection. The cover letter to the athlete (Appendix C2) and survey (Appendix C6) will be distributed electronically. Each participant's identity will remain confidential and will not be included in the study.

Preliminary Research

The survey was created by the primary researcher in consultation with thesis committee members. After review by the committee, a pilot study of the survey was given to a random group of athletes in order to determine reliability.

Instruments

The survey (Appendix C6) was created and distributed using Survey Monkey. The survey consisted of demographic questions and a knowledge assessment section. Questions were created using established rehydration protocols from the American College of Sports Medicine and National Athletic Trainers' Association. The survey was broken up into three sections: demographic information, use of post-exercise rehydration, and athlete knowledge. If athletes do not regularly consume a post-exercise rehydration drink, defined as a drink consumed within an hour of physical activity in order to aid in recovery, they will skip the section dealing with use of post-exercise rehydration drinks and proceed from demographic information to knowledge. The knowledge questions were developed by the researcher. All questions include answers which are backed by empirical evidence. The questions test knowledge in the following areas: nutrients in sweat, nutrients considered electrolytes, types of post-exercise rehydration drinks, dehydration, and fluid-replacement protocols.

Procedure

The athletic director at each institution will be emailed a cover page outlining the research. They will then be asked to return a letter of permission to use their school's athletes as test subjects. Following approval by the California University of Pennsylvania's Institutional Review Board, the athletic director will be forwarded an email which will contain a cover letter and link to the survey, created on www.surveymonkey.com. A follow-up email will be sent out with four days remaining of data collection.

Hypotheses

The following hypotheses were based on previous research and the researcher's intuition based on a review of the literature:

Hypothesis 1: Post-exercise rehydration drink knowledge will vary significantly based on sport.

Hypothesis 2: Post-exercise rehydration drink knowledge will not vary based on gender.

Hypothesis 3: Post-exercise rehydration drink usage will vary significantly between sports.

Hypothesis 4: Post-exercise rehydration drink usage will differ significantly between genders.

Data Analysis

All data will be analyzed by PASW Statistics 18 for Windows at an alpha level of 0.05. An ANOVA was used to test post-exercise rehydration drink knowledge and sport. A chi-square was used to test: post-exercise rehydration drink usage and sport, post-exercise rehydration drink usage and gender. A T-Test was used to test post-exercise rehydration drink knowledge and gender.

RESULTS

The purpose of this study was to review the literature of post-exercise rehydration drinks and determine athlete knowledge and use of post-exercise rehydration drinks. The following section contains the data collected through the study and is divided into three subsections: Demographic Information, Hypotheses Testing, and Additional Findings.

Demographic Information

The participants were collegiate athletes at High Point University (n = 41) and California University of Pennsylvania (n = 58). Out of the 109 returned surveys, 99 were usable for data collection. Of the 99, there were 29 males and 70 females. The breakdown of respondents for each sport is indicated in Table 1. Ages of the participants ranged from 18 to 23 (Table 2).

Table 1. Participants per Team

Sport	Frequency	Percentage
Volleyball	5	5.1
Tennis	3	3.0
Golf	9	9.1
Soccer	20	20.2
Swimming	12	12.1
Track and Field	33	33.3
Cross Country	17	17.2
Total	99	100

Table 2. Age of Participants

Age	Frequency	Percentage
18	16	16.2
19	32	32.3
20	25	25.3
21	17	17.2
22	8	8.1
23	1	1.00
Total	99	100.0

Hypothesis Testing

The following hypotheses were tested in this study. All hypotheses were tested with a level of significance set at $\alpha \leq 0.05$. An ANOVA was used to test for differences between post-exercise rehydration drink knowledge and sport. A chi-square was used to test for a relationship between post-exercise rehydration drink usage and sport as well as post-exercise rehydration drink usage and gender. A T-test was used to test for a significant difference in

post-exercise rehydration drink knowledge depending upon gender.

Hypothesis 1: Post-exercise rehydration drink knowledge will vary significantly based on sport.

Conclusion: A one-way ANOVA was used to compare knowledge score means and sport, no significant difference was found ($F(6,92) = 1.934$, $p > .05$), shown below in Table 3.The overall mean score for all participants was MEAN (SD).

Table 3. One-Way ANOVA between Knowledge Score and Sport Played

Variables	**Sum of Squares**	**df**	**Mean Square**	**F**	**P**
Between Groups	47.568	6	7.928	1.934	.084
Within Groups	377.180	92	4.100		
Total	424.747	98			

Hypothesis 2: Post-exercise rehydration drink knowledge will not vary based on gender.

Conclusion: Findings supported the hypothesis as no significance difference between drink knowledge and gender. An independent-samples *T*-test was calculated comparing the mean score on the knowledge based portion of the study and the gender of the participant. No significant difference was found ($t(29) = .268$, $p > .05$). The mean of the males (*m*

= 14.14, *sd* = 2.133) was not significantly different from the mean of the females (*m* = 14.01, *sd* = 2.075), as shown in Table 4.

Table 4. T-Test between Drink Knowledge and Gender

Gender	N	Mean	Standard Deviation	Standard Error Mean	t	P
Male	29	14.14	2.133	.396	.268	.790
Female	70	14.01	2.075	.248		

Hypothesis 3: Post-exercise rehydration drink usage will vary significantly between sports.

Conclusion: Participants usage of post-exercise rehydration drinks by sport can be found in Table 10. A chi-square test of independence was calculated comparing post-exercise rehydration drink usage and sport played; no significant relationship was found ($X^2(6) = 7.786$, $p > .05$), as shown in Table 5.

Table 5. Chi-square Comparison of PERD Usage and Sport

Variable	N	df	Chi-square value	Sig
Sport and PERD Usage	99	6	7.786	.254

Hypothesis 4: Post-exercise rehydration drink usage

will differ significantly between genders.

Conclusion: Rehydration drink usage by gender can be found in Table 6. Findings did not support the hypothesis as no significance difference between drink knowledge and gender. A chi-square test of independence was calculated comparing gender and PERD use, ($X^2(1) = .357$, $p > .05$), as shown in Table 6.

Table 6. Chi-Square Comparing PERD Usage and Gender

Variable	**N**	**df**	**Chi-square value**	**Sig**
Gender and PERD Usage	99	1	.357	.567

Additional Findings

Additional tests were conducted to determine PERD usage. Of the 99 surveyed, 82 reported they consumed a PERD. Usage amount is shown in Table 7.

Table 7. Times Per Week PERD is Consumed

Days Per Week	Frequency	Percentage
1	10	12.2
2	6	7.3
3	19	23.2
4	11	13.4
5	17	20.7
6	19	23.2
Total	82	100.0

When asked what they consumed for a PERD, ten types were reported, as seen in Table 8. The most commonly used drink was water, followed by Gatorade and chocolate milk

Table 8. Types of PERDs Used

Type	Frequency
Gatorade	37
Powerade	20
Accelerade	1
Muscle Milk	8
Chocolate Milk	36
Water	61
Propel	1
Protein Shake	2
GENr8	1

It is interesting to note water came in as the number one drink when it is not considered a PERD. This will be discussed in the discussion section. The responses can be divided into four categories, as shown in Table 9.

Table 9. Post-Exercise Rehydration Drink Category

Type	**Frequency**
Fluid-replacement	58
Carbohydrate-protein	12
Water	61
Milk	36
Total	**167**

DISCUSSION

The purpose of this study was to determine athlete knowledge and use of post-exercise rehydration drinks. It is hoped that these findings will help guide athletic trainers as they provide nutritional counseling and advice to their patients. The following section is divided into three subsections: Discussion of Results, Conclusions, and Recommendations.

Discussion of Results

The primary purpose of this study was two-pronged: to evaluate the effect of several factors on athlete knowledge of post-exercise rehydration drinks and to determine if athletes consumed a post-exercise rehydration drink.

Based on the review of literature, the researcher concluded that usage would differ between sports; however, no significance difference in PERD usage was found between sports. This could be due to a number of factors. A possibility for the findings could be due to the sports that returned the survey. The amount of PERD usage by team is shown in Table 10.

Table 10. Post-Exercise Rehydration Use by Team

Team	Number Yes (%)	Number No (%)	Total (%)
Volleyball	5 (100%)	0 (0%)	5 (100.0%)
Tennis	1 (33.3%)	2 (66%.7%)	3 (100.0%)
Golf	8 (88.9%)	1 (11.1%)	9 (100.0%)
Soccer	16 (80.0%)	4 (20.0%)	20 (100.0%)
Swimming	11 (91.7%)	1 (8.3%)	12 (100.0%)
Track & Field	28 (84.8%)	5 (15.2%)	33 (100.0%)
Cross Country	13 (76.5%)	4 (23.5%)	17 (100.0%)
Total	82 (82.8%)	17 (17.2%)	99 (100.0%)

As the table shows, volleyball reported the highest amount of PERD usage, 100.0%, while tennis reported the lowest, 33.3%. The results show a trend toward using PERDs as all teams except tennis reported higher than 50% usage. Had there been more respondents in volleyball or tennis, significant differences may have been found.

While no significant differences were found between teams and knowledge score, interesting trends were noticed. The highest individual score was a 19, or perfect, belonging to a cross country athlete. The lowest score was a 9 which belonged to both a tennis and swimming athlete. The lowest overall team score belonged to tennis (*m* =

12.00, *sd* = 2.648), while the highest was cross country (*m* = 15.18, *sd* = 2.215). Interestingly, the second lowest score was volleyball (*m* = 12.80, *sd* = 2.168) who also reported the highest amount of PERD usage. While it is important to note the two lowest scores also had the lowest responses, it can be inferred that PERD usage is not dependent on knowledge.

The researcher also hypothesized that usage would differ between gender. Rationale for this was based on prior research which indicated males used protein drinks and other muscle enhancing products more than females.[8,13,14] While both studies found dietary supplement use to be similar, it was thought that only protein drink use would be a strong predictor for PERD use.

Research has found significant differences in knowledge between genders when testing overall nutritional knowledge.[9] In the study, females scored higher on areas dealing with vitamins, minerals, and health related disorders. When it came to protein and carbohydrates for strength gains, however, males scored higher than females. As a result the researcher hypothesized that nutritional knowledge would not have significant difference between genders. Support for this was found as there was no significant difference. Interestingly, males scored higher

(though not significantly) than females, (m = 14.14, sd = 2.133) and (m = 14.01, sd = 2.075), respectively. These findings are not consistent with other research.[9,11] Reasons for this could be due to this survey only looking at PERD knowledge and not overall health knowledge.

To this researcher's knowledge, post-exercise rehydration drink knowledge has not been studied across multiple sports. When hypothesizing that PERD knowledge would have significant difference between sports, studies using general nutrition knowledge was used.[9] Support for this argument was not found as there were no significant differences between sport played and knowledge score. Possible explanations for this are: the sports who returned surveys were not varied enough (all focusing on aerobic exercises rather than anaerobic activity) or that nutritional knowledge does not translate well to PERD knowledge.

While team means for knowledge score were all above 50%, some questions were answered incorrectly more than 50% of the time. The question answered correctly the least was question 7. Question 7 asked, "At what percent body weight loss does dehydration START to impact performance, A) 1-2% B) 3-4%, C) 5-6%, D) 7-8%, E) Greater than 8%"? The correct

answer, 1-2%, was selected 30.3% of the time, as shown in Table 11.

Table 11. Dehydration's Impact on Performance

Choice	Frequency	Percentage
1-2%	30	30.3
3-4%	33	33.3
5-6%	18	18.2
7-8%	13	13.1
>8%	5	5.1
Total	99	100.0

It is unclear why the second choice, 3-4%, was selected more often than the correct choice, 1-2%.

Another question participants scored poorly on was question 13. Question 13 asked, "Which of these does NOT dehydrate you faster than normal, A) Caffeine B) Alcohol C) Ephedra D) Sugar"? The correct answer, sugar, was selected only 39.4%, as seen Table 12.

Table 12. Which of these does NOT dehydrate you faster?

Choice	Frequency	Percentage
Caffeine	6	6.1
Alcohol	7	7.1
Ephedra	47	47.5
Sugar	39	39.4
Total	99	100.0

These results are interesting in that they show a lack of nutritional knowledge among athletes. A reason for this could be due to the negative press ephedra has garnered. It

is possible that athletes assumed ephedra was the answer because it is illegal in sports. Whatever the reason, it shows a lack of knowledge by the participants.

When asked if water was an effective PERD, participants reported it was at a rate of 67.7%, as shown in Table 13.

Table 13. Water is NOT an Effective PERD.

Answer	Frequency	Percentage
True	20	20.2
False	67	67.7
I don't know	12	12.1
Total	82	100.0

Recently, it has been reported that water alone is not enough for athletes to get back into positive fluid balance and may lead to further dehydration by decreasing blood osmolality.[1,16,17]

Participants also had trouble selecting the correct electrolyte out of four possibilities, as shown in Table 14.

Table 14. What is considered an electrolyte?

Nutrient	Frequency	Percentage
Calcium	40	40.4
Hydrogen	24	24.2
Oxygen	13	13.1
Lithium	22	22.2
Total	99	100.0

The correct answer, calcium, was answered correctly just 40.4% of the time (n = 40). This shows a lack in both general nutrition and PERD knowledge.

While the aforementioned questions showed a lack of PERD knowledge, there were some which were answered correctly almost universally. Only one question was answered correctly 100.0% of the time, question 14. Question 14 was, "If I am not thirsty, I shouldn't drink anything, A) True, B) False, C) I don't know". All participants answered false. This is an important finding as it shows the athlete's awareness of needing to regularly consume fluids while exercising. Four other questions yielded a correct response rate greater than 90.0%, questions 4, 5, 10 and 12, shown in Table 15.

Table 15. Questions Answered Correctly >90.0%

Question	Frequency of Yes	Percentage of Yes
Question 4	94	94.9
Question 5	96	97.0
Question 10	97	98.0
Question 12	98	99.0

a. Question 4, "Which of these is NOT a symptom of heat illness?"
b. Question 5, "When should a PERD drink be consumed after exercise?"
c. Question 10, What determines if a drink is a good PERD?"
d. Question 12, "Everyone sweats at the same rate."

Conclusions

While certain questions showed a lack in athlete knowledge concerning PERDs, it was encouraging to see all teams and gender scoring above 50%, in fact, the lowest team score was a 63% (Tennis) while the highest was an 80% (Cross country). This study did not find significant differences between knowledge and gender or knowledge and sport. Furthermore, no significant differences were found between PERD use and gender or PERD use and sport played.

This research is important for athletic trainers specifically for a number of reasons. With the high percentage of athletes using PERDs, it is important for athletic trainers to keep up-to-date on PERD information. Athletic trainers see athletes more than dieticians, doctors, and most other medical professionals. Therefore, they are in the optimal position to educate athletes as to their needs and the effect PERDs can have. This provides an opportunity to be the focal point toward helping athletes stay hydrated, reducing the risk of heat illness. Athletic trainers are also at most, if not all, practices for their assigned sports. This is most important during the summer when the heat index climbs and athletes are at a greater risk for heat illness. Athletic trainers up-to-date with

current PRED research will be able to better serve their athletes as to what to drink, when to drink, and why to drink, possibly saving lives every year.

Also of note, particularly for an athletic trainer is that many athletes considered water to be an effective PERD. With this logic, if athletic trainers are not conscientious, athletes may be drinking only water while exercising in hot climates. This causes a problem due to water lowering sodium levels in the body, causing more harm than good.[17] Athletes need to know: what they should be drinking, the proper amount to drink and the right time to drink the rehydration drink. As mentioned, athletic trainers are in the best position to help athletes with these decisions.

This study provides a basis for which other research can draw upon. The results of this research are a benefit to the medical community in that it shows athletes are consuming PERDs at a high rate, (82%). However, the data also shows that athletes consider water to be an effective PERD; as more evidence points to the contrary, it is important to make sure the athletes know this.

Recommendations

While athletes continue to consume PERDs, more research should be performed to discern what is the optimal PERD as well as how to pass that knowledge onto the athletes. One possibility to help in this effort would be a study comparing the effectiveness of the top five PERDs used by athletes today on anaerobic and aerobic capacity. Athletes could be divided up into two groups, aerobic or anaerobic based activities. Those groups can then have sub-groups of: control, fluid-replacement, carbohydrate-protein replacement, 2% chocolate milk. A 12-week clinical study could then be undertaken to ascertain which drink provides the most benefit for each group of athletes.

This study showed that while athletes have a general sense of PERDs, their knowledge is still limited. A study should be conducted to assess the optimal way to distribute information to athletes. A pre-test survey could be administered to a group of athletes. After which, they could be put into one of several groups that distribute knowledge a different way (brochure, meeting, podcast, etc…). A month later, a post-test would be administered to see which group scores better post-test.

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APPENDICES

APPENDIX A

Review of Literature

REVIEW OF LITERATURE

Athletes lose more than just water when they sweat while working out. Therefore, it is imperative for them to replenish with more than simply water after working out. The choice of what to drink post-exercise can have profound effects on an athlete's well-being and ability to perform later in the day. With all the conflicting messages about rehydration drinks, athletes can make drink choices on partial or false information. As a result, athletes may be under-performing. Also, many athletes participate in multiple practices per day; some of these practices are spaced within mere hours of each other. Due to energy demands, proper rehydration is critical when athletes need to recover for another session, and often, water alone is not enough.[1,2] There has been a plethora of research done in recent years which aims to test the efficiency of recovery in many types of drinks. [1-14]

This literature review aims to explain the benefits of various drinks and why some may be better than others. The topics for this literature review will be discussed in the following sections: why a post-exercise rehydration drink is needed, nutritional demands of athletes, current

rehydration drinks on the market, and athlete knowledge of post-exercise rehydration drinks.

Benefits of Post-exercise Rehydration Drinks

Sweating is a natural body function in response to the increase in core temperature that accompanies exercise. Athletes are no exception; quite the contrary, they sweat more than the average person[15,16]. As such, they must off-set this loss of water and nutrients utilized by exercise by taking in more than the average person[17]. This sweat loss can lead to heat illness and dehydration[18,19]. Therein lies the need for a post-exercise rehydration drink. Athletes need a post-exercise rehydration drink in order to: prevent dehydration, get back the nutrients they lose in sweat, return to positive fluid balance, and perform to their optimal capacity.

Dehydration

Dehydration is a rampant problem plaguing athletes, especially during double sessions in late summer. There are two (2) types of dehydration: exercise-induced dehydration (dehydration brought on by exercise) and hypohydration (dehydration before exercising). [20] It has been reported

that athlete performance is negatively affected when they lose ~2% body mass due to perspiration [19, 20, 3, 8, 21, 22, 13, 23, 14, 24, 25]. Dehydration is defined as: a urine specific gravity of >1.020[18, 19]. Dehydration can be combated with proper pre-hydration; however, during multiple bouts of exercise per day, practices start early and, as a result, it may not always be feasible to properly pre-hydrate. As a result, athletes must rehydrate after exercise. This need exponentially increases when another bout of exercise is to follow in a short time. Athletes are suggested to consume enough fluid as to ensure not more than 2% body mass is lost [18, 19]. It has been reported that properly rehydrating is possible without the use of a post-exercise rehydration drink for athletes who do not have another session of exercise within 12 hours because that athlete will be back in positive fluid balance after eating regular meals.[23] However, for those with another bout in the same day, this is not the case. Starting a session of exercise dehydrated and negative fluid balance leads to an outset of decreased performance in addition to making the dehydration worse[26]. Furthermore, the more dehydrated an athlete gets, the more their performance decreases.[27]

Starting Exercise Hypohydrated

It has been reported that up to 66% of athletes appear hypohydrated at the outset of exercise.[2] Hypohydration can have a significant impact on exercise capability. Some of these factors are: increase heart rate, increase blood pressure, and core temperature.[28-29] The ability of athletes to return to positive fluid balance between multiple exercise periods is critical to maintaining a high intensity of activity during a second session. As a result, finding the right post-exercise rehydration drink is mandatory for proper care of athletes. Furthermore, research indicates that additional strain is put on the cardiovascular system to maintain exercise ability while hypohydrated.[42]

Returning to Fluid Balance

In a study to determine the effectiveness of multiple post-exercise rehydration drinks on returning athletes to positive fluid balance was comprised of seven physically active males who completed a max VO2 test, familiarization test, and two experimental tests. Sweat was collected from the athletes and measured for electrolyte content. The first experimental test ended when participants lost 1.8% body mass. The participants were given 30 minutes rest

before drinking the selected beverage (1% milk or fluid-replacement drink) in an amount that was 150% their sweat loss. After three hours of rest, the participant's fluid levels were measured and then put through a second test to test time to exhaustion. At the end of the three hour recovery it was found that the athletes ingesting the carbohydrate-electrolyte drink were euhydrated (neutral fluid balance) while the patients consuming milk were in positive fluid balance when compared to water alone.[3,21,22,30] This is an important study because it could help in providing a basis for post-exercise drink volume. However, without being in a laboratory setting, knowing the amount of sweat loss MAY prove difficult.

Nutritional Needs of Athletes

Nutritional needs of athletes are far greater than those of the general population. Athlete must consume more fat, carbohydrates, proteins, vitamins, and minerals than typical guidelines stipulate.[17] A general population diet consists of: 45-55% carbohydrate (or 3-5 grams/kg/day, 10-15% protein, and 25-35% fat.[18] For carbohydrate recommendations, athletes involved on high volume of exercise, defined as 2-3 hours per day, 5-6 times per week,

have a diet that should consist of: 55-65% carbohydrate (5-8 grams/kg/day).[18] These levels of carbohydrates should be sufficient to restore muscle and liver glycogen stores. For protein, needs of athletes increase from .8-1.0 kg/body weight/day to 1.5-2.0 kg/body weight/day.[17] The additional nutrient needs of athletes extends to hydration as well.

Nutrients in Sweat

As athletes sweat, they lose valuable electrolytes along with water. The most important nutrients to exercise hydration are Sodium (Na^+), Potassium (K^+), and Chloride (Cl^-).[16, 22] These electrolytes must also be supplemented with water while rehydrating. Along with the previously mentioned electrolytes, Calcium (Ca^{2+}), Magnesium (Mg^{2+}), and Iron (Fe) are also lost in sweat.[22] Sodium is of most importance as it has been show to impact exercise capacity along with dehydration.[1]

Current research indicates that sweat rates are correlated with body mass, sport, and environmental conditions.[16] It is important to note the differences when forming hydration protocols and strategies for athletes.[22]

Current Post-Exercise Rehydration Drinks

The market for post-exercise rehydration drinks is ever-expanding. New companies and new products are constantly entering the field of post-exercise rehydration drinks.

Fluid-Replacement Drinks

The use of fluid replacement drinks has become commonplace due to the relationship between fatigue and carbohydrate availability.[3] Fluid replacement drinks appear in commercials, magazines, on billboards, and sponsor athletic events. As a result, it may be concluded that fluid replacement drinks are the most popular form of post-exercise rehydration drinks. Fluid-replacement drinks typically consist of: 0g fat and protein, 15g carbohydrate, 115mg sodium, and 31mg potassium.[11] The electrolytes contained in fluid replacement drinks have led to it being called a better post-exercise rehydration drink than plain water.[18] As a result, many companies have created their own drinks to compete in the market. Most, however, are nearly identical in terms of nutrient make-up. This makes taste preference and school affiliation the determining factor in what is consumed. Recently, fluid replacement drink

companies have churned out new "additive" products for their drinks. These are packets of nutrient powders that can be added to any drink. The electrolytes often added are Sodium, Potassium, Calcium, and Magnesium.

Carbohydrate-Protein Drinks

Due to athlete demands, new rehydration drinks are always being produced. One newer type of drink is a carbohydrate-protein drink. These drinks have a very different nutrient makeup than fluid-replacement drinks: 4g protein, 1g fat, 16g carbohydrate, 127mg sodium, and 16mg potassium. However, clinical trials have shown no increased effects over fluid-replacement dinks.[4] The ideology behind infusing protein into these drinks is to increase muscle recovery after exercise. The typical protein type found in these drinks is whey protein. Support for this theory was provided in a study of weight-lifters. The study found an increase in muscle protein uptake at a higher level with 10g whey protein and 21g carbohydrate when compared to carbohydrate only.[12] The addition of protein hypothesized to lead to greater hypertrophy and, in effect, strength gains.

Milk

Recently, milk has entered the discussion of post-exercise rehydration drinks. Milk is nutrient dense in all areas athletes demand.[8] Milk can be processed and altered in many different ways. For example, there is whole milk, 2%, skim, chocolate, and strawberry; all of these contain different nutrients. In a direct comparison, chocolate 2% milk appears to show the greatest benefit to athletes due to its nutrient makeup: 8g protein, 5g fat, 27g carbohydrate, 159mg sodium, 446mg potassium. However, the reasons for the positive results have not been thoroughly studied. Common theories accounting for this include: slower digestion of proteins, increased circulation of fatty acids within the blood, less urine production post-exercise, and increased amount of protein.[3,4,11,31]

Research Trials of Current Rehydration Drinks

Clinical trials were performed to test time to exhaustion, fat-free soft tissue mass, fluid balance, and nutrient balance. Among these trials, milk performed on par or better than leading fluid-replacement drinks as well as carbohydrate-protein drinks. On average, milk and fluid-replacement drinks performed equally on time to exhaustion tests. Milk performed the best among fat-free

soft tissue mass increase, fluid balance, and nutrient balance. Because of the recent success, imitators are trying to recreate the nutrients found in milk. However, a key component taken out is lactose. The reason for this subtraction is to allow these beverages to be consumed by even those who are lactose intolerant.

A study to determine milk's effectiveness on lean mass tissue gains from progressive resistive exercise was undertaken. In this study, 56 novice weightlifters participated in a weight-lifting program which lasted 12 weeks and resulted in 20 sessions of: pushing exercises, pulling exercises, and leg exercises.[31] The drinks tested were: commercially available carbohydrate drink, soy beverage, and skim milk. The quantity taken of each was 500mL directly after finishing the workout and 1 hour post-exercise. One repetition max was determined pre-workout and compared to post-exercise at 12 weeks. Milk showed better results in all categories tested, which were: Body weight, Fat mass, fat- and bone- free mass, and bone mineral content. Type II muscle fiber cross-sectional area gains were significantly higher in milk than both other drinks while type I muscle fiber was not statistically different between soy and milk, but both were significantly higher than the carbohydrate beverage. Lean mass tissue

showed greatest improvement within those who ingested milk. Also, in 1 repetition maximal leg strength, milk provided greater gains in leg press, knee extension, and hamstring curls by a significantly higher margin. The study provided by Hartman gives support to the effects milk has in promoting maximal strength and lean mass tissue increases.

Many athletes participate in multiple exercise bouts per day for part of their season. As a result, it is hard for many to become adequately rehydrated before the second stint of exercise. Therefore, the ability to perform at an optimal level decreases. Due to the strong support in other areas, milk (1% chocolate milk in this study) was tested against other leading drinks (carbohydrate-protein and fluid-replacement) in endurance tests. The study being examined, conducted by Karp et al., quantifies endurance as time to voluntary exhaustion while maintaining a cycling speed congruent with 70% VO2 max. This study had nine male cyclists undergo a glycogen depleting trial consisting of alternating 2-min periods of high intensity followed by low intensity work followed 4 hours later by a stint of cycling at 70% VO2 max until exhaustion. This protocol was completed by all nine athletes on 3 occasions which were spaced a week apart. After the data was compared, milk was shown to produce significantly superior numbers in time to

exhaustion and total work produced than a leading carbohydrate-replacement drink. There was no significant difference in both categories between milk and a fluid-replacement drink. The amount of work produced by the cyclists after ingesting the chocolate milk was 57% higher than after consuming the carbohydrate-replacement drink while there was a 48% increase in work produced after the consumption of a fluid-replacement drink when compared to a carbohydrate-replacement drink.[4]

Sweat loss rate is important because athletes lose both water and nutrients. On average, milk can have ten times the amount of sodium and potassium as fluid-replacement and carbohydrate-replacement drinks, respectively. In a study comparing five types of milk (whole, 2%, 1%, skim, and 2% chocolate), two types of fluid-replacement drinks (Gatorade Thirst Quencher and Gatorade Endurance), and a carbohydrate-replacement drink (Accelerade), chocolate milk was shown to hold more nutrients.[11] This nutrient density becomes beneficial for the athlete due to the ability to replenish nutrients in-between workouts.

The ways in which milk helps exercise are immense. However, it is the why which often alludes researchers. There is no one reason why milk has so many properties

conducive to exercise. Some of the reasons include: fat content, amino acid type, carbohydrates, and vitamins. No other drink compares to milk's wide range of nutrients. It is within this area further research is required to ascertain the wide range of benefits milk provides.

A possible obstacle in getting athletes to drink milk is the fear they (the athletes) will gain weight. Other hydration drinks do not contain the lipid component of milk. However, it could be this lipid component that makes milk such a good drink. The lipid composition in milk ranges from milk to milk depending if it's whole, skim, or in-between. However, regardless of type, the main lipid is saturated fatty acid. Two of these fatty acids are capric and lauric acid. In clinical research, these two fatty acids have been shown to inhibit the Cyclooxygenase enzyme.[32] Cyclooxygenase creates prostanoids that aid in the inflammatory process and cause pain. Therefore, capric and lauric acid act as Cox I and Cox II inhibitors. This can delay or even negate minor pains associated with exercise. Because they (capric and lauric acid) do not have a strong effect, this pain masking is not deemed detrimental.

Addressing the issue of milk causing an increase in body fat among athletes, a study was done to examine the effects of dairy products on weight management[33]. Their

results found that a diet high in calcium increased lipolysis and led to 26-39% reductions in body weight than diets with suboptimal calcium intake. Furthering research in this realm found significant increases in body weight loss among diets high in dairy products.[33] In a 24-week study of obese individuals, participants in the control group (low-calcium diet) lost 6.4% of their body weight while participants in the high dairy product group lost 10.88%, diets high in calcium but not from dairy reported an 8% loss. Furthermore, fat loss from the participants went up by 38% in high calcium diets and 64% in diets high in dairy. These findings indicate that there are other nutrients in milk that attribute to fat loss than just calcium.

Another nutrient milk has that not all sport drinks have is protein. Recently, companies have mimicked milk's ratio of proteins to fats (Muscle Milk). The main types of proteins in milk are casien (80%) and whey (20%). Whey protein receives the commercial coverage and has appeared in many drinks and powders for increase strength gains. However, casein protein may be just as valuable to the body as whey protein.

While whey protein is lauded as the most important type, research has been found that amino acid uptake was

only significantly affected when both proteins were consumed.[34] The reasons for these findings were the amino acid levels found within muscles after a rest period of four hours. Whey protein led to higher levels of leucine while casein protein led to higher levels of phenylalanine. Leucine is an essential amino acid that increases the synthesis of muscle protein. Phenylalanine is also an essential acid needed to create proteins in the body.

Milk has many nutrients not found in other drinks. Some nutrients may not seem important at first glance; however, after delving further into the physiology of them, there may be a place in athletics. Two such nutrients are Folate and B_{12}. Folate, or folic acid, plays a key role in the metabolism of amino acids.[35] As amino acids are the building blocks for cells, and especially muscles, an increase folate consumption due to milk may help athletes recover faster. Vitamin B_{12} plays an essential role in the body as it helps with folate metabolism.[36] As previously stated, folate aids in amino acid metabolism, however, without being metabolized itself, folate can do very little to help the body. Therefore, vitamin B_{12} is an essential component in amino acid metabolism as a result of its impact on folate.

A major worry for athletes, and especially student-athletes, is coming down with a cold or other illness. Due to the intense strain put on their bodies, and occasionally the climate they play in, athletes are more susceptible to illness than the general public. One nutrient responsible for immune system function is Zinc.[37] Milk can commonly have 18-25% of daily requirements of zinc. This is vastly different from other sport drinks which generally have none. It can thus be hypothesized that milk will help athletes stay healthy during their times of intense exercise.[38]

The thyroid gland plays a pivotal role in regulating metabolic rate and growth. To do this, the thyroid gland needs Iodine to create triiodothyronine and thyroxine.[38] If the thyroid gland has sufficient amount of Iodine, it functions properly and regulates a healthy metabolic rate. This is imperative for athletes because a stable metabolism can increase fat loss and stimulate nutrient absorption.

A common complaint and possible obstacle with milk is the prevalence of lactose intolerant individuals. Lactose is a disaccharide formed by galactose and glucose.[39] It plays an essential role in the digestion and absorption of other sugars. Lactose is not found in every type of milk. As a result, different types of milk can be experimented

with to determine if there is a suitable kind. Furthermore, with the advances in modern science, lactose can be taken out of bovine milk and replaced with other sugars. If mass production of a milk with lactose taken out, it could solve the problem for lactose intolerant individuals.

Athlete Knowledge

Athlete knowledge of nutrition is an essential component to their ability to perform optimally. However, as seen in previous research, their knowledge is inadequate and often comes from unreliable sources.[40-43] Fad diets, nutritional recommendations on nutrition labels, and most articles on common literature do not translate to athlete nutritional needs. This knowledge base needs to be addressed in order to provide comprehensive care to athletes. Athletes who perform multiple bouts of exercise per day are at an increased rate of nutritional deficit.[43] These athletes need special recommendations concerning their nutritional intake. Athletes who perform multiple bouts per day constitute a wide range of athletic teams, especially with sports with extensive pre-season work, including: soccer, football, basketball, baseball. Most of these sessions occur under conditions of elevated heat.[44] As

a result, many athletes begin workouts hypohydrated.[43,45] Current research into the field of athlete knowledge of nutrition focuses mostly on general nutrition guidelines and needs. As such, there is a lack of research work in athlete knowledge specific to rehydration drinks.

Summary

While there may be an adequate amount of research examining the effects of hydration, little is known about what athletes do with this knowledge. Research indicates that milk may be the optimal rehydration drink, although not by a margin significant enough to dissuade the use of any other type of drink. In conclusion, there potentially is still a gap between what the medical community knows and what athletes know. In an attempt to help bridge this gap, this thesis was performed.

APPENDIX B

The Problem

The Problem

Statement of the Problem

The purpose of this study is to determine athlete knowledge concerning post-exercise rehydration drinks. This is important because athletes' consumption of post-exercise drinks is on the rise. By evaluating athlete knowledge and use, recommendations can be made in regards to future education of athletes. If athletes are educated in post-exercise rehydration drinks, they will be able to make educated decisions when someone else is not around to facilitate their decision of what to drink. Lastly, it is beneficial for athletes to know what the best post-exercise rehydration drink is.

Definition of Terms

The following definitions of terms will be defined for this study:

1) Post-exercise Rehydration Drink – A drink consumed after exercise that is a meant to facilitate rehydration.[48]

2) Athlete – A person who is trained or skilled in exercises, sports, or games requiring physical strength, agility, or stamina.[49]

3) Carbohydrate-Protein Drink – A drink consumed after exercise that contains carbohydrates and protein, usually in a 4:1 ratio.[1]

4) Fluid Replacement Drink/Carbohydrate-Electrolyte Drink – A drink consumed after exercise that contains carbohydrates and electrolytes.[1]

5) Hypohydration – Dehydration at the onset of physical activity.[5]

6) Euhydration – Neutral fluid-balance.[5]

Basic Assumptions

The following are basic assumptions of this study:

1) The subjects will be honest when they complete their demographic sheets.

2) The subjects will answer the knowledge questions to the best of their ability.

Limitations of the Study

The following are basic assumptions of this study:

1) Only athletes older than 18 were used as participants.

2) A true sample was not received due to only surveying two schools.

3) Low response rate could have skewed the data

Significance of the Study

With the recent push by coaches and healthcare professionals alike to have athletes use post-exercise rehydration drinks, athlete knowledge is often overlooked. Rather than handing athletes a specific drink, athletes should be instructed on proper rehydration drinks. This way, they can make educated decisions on their own.

APPENDIX C

Additional Methods

APPENDIX C1

Institutional Review Board –

California University of Pennsylvania

California University of Pennsylvania

Proposal Number

Date Received

PROTOCOL for Research Involving Human Subjects

Institutional Review Board (IRB) approval is required before beginning any research and/or data collection involving human subjects

(Reference IRB Policies and Procedures for clarification)

Project Title ***Athlete Knowledge of Post Exercise Rehydration Drinks***

Researcher/Project Director ***Joshua Gregoire***

Phone # ***207-423-3607*** ***E-mail Address*** ***gre3047@calu.edu***

Faculty Sponsor (if required) ***Dr. Robert Kane***

Department ***Health Science***

Project Dates ***02/07/11*** ***to*** ***02/06/2012***

Sponsoring Agent (if applicable) ***None***

Project to be Conducted at *California University*

Project Purpose: ☒ ***Thesis*** ☐ ***Research*** ☐ ***Class Project*** ☐ ***Other***

Keep a copy of this form for your records.

Approved, September 12, 2005 / (updated 02-09-09)

Please attach a typed, detailed summary of your project AND complete items 2 through 6.

1. *Provide an overview of your project-proposal describing what you plan to do and how you will go about doing it. Include any hypothesis(ses)or research questions that might be involved and explain how the information you gather will be analyzed. For a complete list of what should be included in your summary, please refer to Appendix B of the IRB Policies and Procedures Manual.*

   This study is to determine athlete knowledge of post exercise rehydration drinks (PERDs). The athletic director at each institute will be emailed the survey link and cover letter stating the purpose of the research. They will then be asked to deseminate the email to all athletes. The athletes who consent to participating will be taken to the survey on www.surveymonkey.com.
   This study has three (3) hypotheses:
   1. Post-exercise rehydration drink knowledge and use will vary based on sport.

   2. Post-exercise rehydration drink knowledge and use will not vary based on gender.

   3. Post-exercise rehydration drink knowledge and use will vary based on division of sport played.
   The survey will ask demographic information about age, sport played, and division of institution. Following the demographic information, the athletes will be asked a series of questions that test their knowledge in areas specifically related to PERDs.
   Once the surveys have been completed, SPSS 17.0 will be used to analyze the data. A T-test will be used to analyze knowledge score and gender. An ANOVA will be used to analyze knowledge score and division of institution, and sport played.

2. *Section 46.11 of the Federal Regulations state that research proposals involving human subjects must satisfy certain requirements before the IRB can grant approval. You should describe in detail how the following requirements will be satisfied. Be sure to address each area separately.*

   a. *How will you insure that any risks to subjects are minimized? If there are potential risks, describe what will be done to minimize these risks. If there are risks, describe why the risks to participants are reasonable in relation to the anticipated benefits.*

      There are no inherent risks in participating for this research.

   b. *How will you insure that the selection of subjects is equitable? Take into account your purpose(s). Be sure you address research problems involving vulnerable populations such as children, prisoners, pregnant women, mentally disabled persons, and economically or educationally disadvantaged persons. If this is an in-class project describe how you will minimize the possibility that students will feel coerced.*

      All athletes over the age of 18 will be sent the email. There is no grade or reward attached that would coerce the athlete into participating.

   c. *How will you obtain informed consent from each participant or the subject's legally authorized representative and ensure that all consent forms are appropriately documented? Be sure to attach a copy of your consent form to the project summary.*

      The athletes will be prompted upon entering the survey that it is for research purposes and they may stop at anytime without penalty. Furthermore, their cooperation in taking the survey is their consent to use the data for research purposes.

   d. *Show that the research plan makes provisions to monitor the data collected to insure the safety of all subjects. This includes the privacy of subjects' responses and provisions for maintaining the security and confidentiality of the data.*

The survey does not ask for names, nor does it ask ethnicity or specific institution; therefore, protecting the rights of privacy for the subjects.

3. *Check the appropriate box(es) that describe the subjects you plan to use.*

☒ *Adult volunteers*	☐ *Mentally Disabled People*
☒ *CAL University Students*	☐ *Economically Disadvantaged People*
☒ *Other Students*	☐ *Educationally Disadvantaged People*
☐ *Prisoners*	☐ *Fetuses or fetal material*
☐ *Pregnant Women*	☐ *Children Under 18*
☐ *Physically Handicapped People*	☐ *Neonates*

4. *Is remuneration involved in your project?* ☐ *Yes or* ☒ *No. If yes, Explain here.*

5. *Is this project part of a grant?* ☐ *Yes or* ☒ *No If yes, provide the following information:*

   Title of the Grant Proposal _____

   Name of the Funding Agency _____

   Dates of the Project Period _____

6. *Does your project involve the debriefing of those who participated?* ☐ *Yes or* ☒ *No*

   If Yes, explain the debriefing process here.

7. *If your project involves a questionnaire interview, ensure that it meets the requirements of Appendix___in the Policies and Procedures Manual.*

California University of Pennsylvania Institutional Review Board
Survey/Interview/Questionnaire Consent Checklist (v021209)

This form MUST accompany all IRB review requests

Does your research involve ONLY a survey, interview or questionnaire?
☒ **YES**—Complete this form
☐ **NO**—You MUST complete the "Informed Consent Checklist"—skip the remainder of this form

Does your survey/interview/questionnaire cover letter or explanatory statement include:

☒ (1) Statement about the general nature of the survey and how the data will be used?

☒ (2) Statement as to who the primary researcher is, including name, phone, and email address?

☒ (3) FOR ALL STUDENTS: Is the faculty advisor's name and contact information provided?

☒ (4) Statement that participation is voluntary?

☒ (5) Statement that participation may be discontinued at any time without penalty and all data discarded?

☒ (6) Statement that the results are confidential?

☒ (7) Statement that results are anonymous?

☒ (8) Statement as to level of risk anticipated or that minimal risk is anticipated? (NOTE: If more than minimal risk is anticipated, a full consent form is required—and the Informed Consent Checklist must be completed)

☒ (9) Statement that returning the survey is an indication of consent to use the data?

☒ (10) Who to contact regarding the project and how to contact this person?

☒ (11) Statement as to where the results will be housed and how maintained? (unless otherwise approved by the IRB, must be a secure location on University premises)

☒ (12) Is there text equivalent to: "Approved by the California University of Pennsylvania Institutional Review Board. This approval is effective nn/nn/nn and expires mm/mm/mm"? (the actual dates will be specified in the approval notice from the IRB)?

☒ (13) FOR ELECTRONIC/WEBSITE SURVEYS: Does the text of the cover letter or explanatory statement appear before any data is requested from the participant?

☒ (14) FOR ELECTONIC/WEBSITE SURVEYS: Can the participant discontinue participation at any point in the process and all data is immediately discarded?

California University of Pennsylvania Institutional Review Board
Informed Consent Checklist (v021209)

This form MUST accompany all IRB review requests

Does your research involve ONLY a survey, interview, or questionnaire?
☒ **YES**—DO NOT complete this form. You MUST complete the "Survey/Interview/Questionnaire Consent Checklist" instead.
☐ **NO**—Complete the remainder of this form.

1. **Introduction** (check each)
   ☐ (1.1) Is there a statement that the study involves research?
   ☐ (1.2) Is there an explanation of the purpose of the research?

2. **Is the participant.** (check each)
   ☐ (2.1) Given an invitation to participate?
   ☐ (2.2) Told why he/she was selected.
   ☐ (2.3) Told the expected duration of the participation.
   ☐ (2.4) Informed that participation is voluntary?
   ☐ (2.5) Informed that all records are confidential?
   ☐ (2.6) Told that he/she may withdraw from the research at any time without penalty or loss of benefits?
   ☐ (2.7) 18 years of age or older? (if not, see Section #9, Special Considerations below)

3. **Procedures** (check each).
   ☐ (3.1) Are the procedures identified and explained?
   ☐ (3.2) Are the procedures that are being investigated clearly identified?
   ☐ (3.3) Are treatment conditions identified?

4. **Risks and discomforts**. (check each)
   ☐ (4.1) Are foreseeable risks or discomforts identified?
   ☐ (4.2) Is the likelihood of any risks or discomforts identified?
   ☐ (4.3) Is there a description of the steps that will be taken to minimize any risks or discomforts?
   ☐ (4.4) Is there an acknowledgement of potentially unforeseeable risks?
   ☐ (4.5) Is the participant informed about what treatment or follow up courses of action are available should there be some physical, emotional, or psychological harm?
   ☐ (4.6) Is there a description of the benefits, if any, to the participant or to others that may be reasonably expected from the research and an estimate of the likelihood of these benefits?
   ☐ (4.7) Is there a disclosure of any appropriate alternative procedures or courses of treatment that might be advantageous to the participant?

5. **Records and documentation**. (check each)
   ☐ (5.1) Is there a statement describing how records will be kept confidential?
   ☐ (5.2) Is there a statement as to where the records will be kept and that this is a secure location?
   ☐ (5.3) Is there a statement as to who will have access to the records?

6. For research involving more than minimal risk (check each),

☐ (6.1) Is there an explanation and description of any compensation and other medical or counseling treatments that are available if the participants are injured through participation?

☐ (6.2) Is there a statement where further information can be obtained regarding the treatments?

☐ (6.3) Is there information regarding who to contact in the event of research-related injury?

7. Contacts.(check each)

☐ (7.1) Is the participant given a list of contacts for answers to questions about the research and the participant's rights?

☐ (7.2) Is the principal researcher identified with name and phone number and email address?

☐ (7.3) FOR ALL STUDENTS: Is the faculty advisor's name and contact information provided?

8. General Considerations (check each)

☐ (8.1) Is there a statement indicating that the participant is making a decision whether or not to participate, and that his/her signature indicates that he/she has decided to participate having read and discussed the information in the informed consent?

☐ (8.2) Are all technical terms fully explained to the participant?

☐ (8.3) Is the informed consent written at a level that the participant can understand?

☐ (8.4) Is there text equivalent to: "Approved by the California University of Pennsylvania Institutional Review Board. This approval is effective nn/nn/nn and expires mm/mm/mm"? (the actual dates will be specified in the approval notice from the IRB)

9. Specific Considerations (check as appropriate)

☐ (9.1) If the participant is or may become pregnant is there a statement that the particular treatment or procedure may involve risks, foreseeable or currently unforeseeable, to the participant or to the embryo or fetus?

☐ (9.2) Is there a statement specifying the circumstances in which the participation may be terminated by the investigator without the participant's consent?

☐ (9.3) Are any costs to the participant clearly spelled out?

☐ (9.4) If the participant desires to withdraw from the research, are procedures for orderly termination spelled out?

☐ (9.5) Is there a statement that the Principal Investigator will inform the participant or any significant new findings developed during the research that may affect them and influence their willingness to continue participation?

☐ (9.6) Is the participant is less than 18 years of age? If so, a parent or guardian must sign the consent form and assent must be obtained from the child

- ☐ Is the consent form written in such a manner that it is clear that the parent/guardian is giving permission for their child to participate?
- ☐ Is a child assent form being used?
- ☐ Does the assent form (if used) clearly indicate that the child can freely refuse to participate or discontinue participation at any time without penalty or coercion?

☐ (9.7) Are all consent and assent forms written at a level that the intended participant can understand? (generally, 8th grade level for adults, age-appropriate for children)

California University of Pennsylvania Institutional Review Board
Review Request Checklist (v021209)

This form MUST accompany all IRB review requests.
Unless otherwise specified, ALL items must be present in your review request.

Have you:

☒ (1.0) FOR ALL STUDIES: Completed ALL items on the Review Request Form?
Pay particular attention to:

- ☒ (1.1) Names and email addresses of all investigators
  - ☒ (1.1.1) FOR ALL STUDENTS: use only your CalU email address)
  - ☒ (1.1.2) FOR ALL STUDENTS: Name and email address of your faculty research advisor
- ☒ (1.2) Project dates (must be in the future—no studies will be approved which have already begun or scheduled to begin before final IRB approval—NO EXCEPTIONS)
- ☒ (1.3) Answered completely and in detail, the questions in items 2a through 2d?
  - ☒2a: NOTE: No studies can have zero risk, the lowest risk is "minimal risk". If more than minimal risk is involved you MUST:
    - ☐ i. Delineate all anticipated risks in detail;
    - ☐ ii. Explain in detail how these risks will be minimized;
    - ☐ iii. Detail the procedures for dealing with adverse outcomes due to these risks.
    - ☐ iv. Cite peer reviewed references in support of your explanation.
  - ☒ 2b. Complete all items.
  - ☒ 2c. Describe informed consent procedures in detail.
  - ☒ 2d. NOTE: to maintain security and confidentiality of data, all study records must be housed in a secure (locked) location ON UNIVERSITY PREMISES. The actual location (department, office, etc.) must be specified in your explanation and be listed on any consent forms or cover letters.
- ☒ (1.4) Checked all appropriate boxes in Section 3? If participants under the age of 18 years are to be included (regardless of what the study involves) you MUST:
  - ☐ (1.4.1) Obtain informed consent from the parent or guardian—consent forms must be written so that it is clear that the parent/guardian is giving permission for their child to participate.
  - ☐ (1.4.2) Document how you will obtain assent from the child—This must be done in an age-appropriate manner. Regardless of whether the parent/guardian has given permission, a child is completely free to refuse to participate, so the investigator must document how the child indicated agreement to participate ("assent").
- ☒ (1.5) Included all grant information in section 5?
- ☒ (1.6) Included ALL signatures?

☐ (2.0) FOR STUDIES INVOLVING MORE THAN JUST SURVEYS, INTERVIEWS, OR QUESTIONNAIRES:

- ☐ (2.1) Attached a copy of all consent form(s)?
- ☐ (2.2) FOR STUDIES INVOLVING INDIVIDUALS LESS THAN 18 YEARS OF AGE: attached a copy of all assent forms (if such a form is used)?
- ☐ (2.3) Completed and attached a copy of the Consent Form Checklist? (as appropriate—see that checklist for instructions)

☒ (3.0) FOR STUDIES INVOLVING ONLY SURVEYS, INTERVIEWS, OR QUESTIONNAIRES:

- ☒ (3.1) Attached a copy of the cover letter/information sheet?
- ☒ (3.2) Completed and attached a copy of the Survey/Interview/Questionnaire Consent Checklist? (see that checklist for instructions)
- ☒ (3.3) Attached a copy of the actual survey, interview, or questionnaire questions in their final form?

☒ (4.0) FOR ALL STUDENTS: Has your faculty research advisor:

- ☒ (4.1) Thoroughly reviewed and approved your study?
- ☒ (4.2) Thoroughly reviewed and approved your IRB paperwork? including:
  - ☒ (4.2.1) Review request form,
  - ☒ (4.2.2) All consent forms, (if used)
  - ☒ (4.2.3) All assent forms (if used)
  - ☒ (4.2.4) All Survey/Interview/Questionnaire cover letters (if used)
  - ☒ (4.2.5) All checklists
- ☒ (4.3) IMPORTANT NOTE: Your advisor's signature on the review request form indicates that they have thoroughly reviewed your proposal and verified that it meets all IRB and University requirements.

☒ (5.0) Have you retained a copy of all submitted documentation for your records?

Project Director's Certification
Program Involving HUMAN SUBJECTS

The proposed investigation involves the use of human subjects and I am submitting the complete application form and project description to the Institutional Review Board for Research Involving Human Subjects.

I understand that Institutional Review Board (IRB) approval is required before beginning any research and/or data collection involving human subjects. If the Board grants approval of this application, I agree to:

1. Abide by any conditions or changes in the project required by the Board.
2. Report to the Board any change in the research plan that affects the method of using human subjects before such change is instituted.
3. Report to the Board any problems that arise in connection with the use of human subjects.
4. Seek advice of the Board whenever I believe such advice is necessary or would be helpful.
5. Secure the informed, written consent of all human subjects participating in the project.
6. Cooperate with the Board in its effort to provide a continuing review after investigations have been initiated.

I have reviewed the Federal and State regulations concerning the use of human subjects in research and training programs and the guidelines. I agree to abide by the regulations and guidelines aforementioned and will adhere to policies and procedures described in my application. I understand that changes to the research must be approved by the IRB before they are implemented.

Professional Research

Project Director's Signature

Department Chairperson's Signature

Student or Class Research

Joshua Gregoire
Student Researcher's Signature

Supervising Faculty Member's Signature if required

Department Chairperson's Signature

ACTION OF REVIEW BOARD (IRB use only)

The Institutional Review Board for Research Involving Human Subjects has reviewed this application to ascertain whether or not the proposed project:

1. provides adequate safeguards of the rights and welfare of human subjects involved in the investigations;
2. uses appropriate methods to obtain informed, written consent;
3. indicates that the potential benefits of the investigation substantially outweigh the risk involved.
4. provides adequate debriefing of human participants.
5. provides adequate follow-up services to participants who may have incurred physical, mental, or emotional harm.

☐ Approved[_____] ☐ Disapproved

Chairperson, Institutional Review Board

Date

Approved, September 12, 2005 / (updated 02-09-09)

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Joshua Gregoire** successfully completed the NIH Web-based training course "Protecting Human Research Participants".

Date of completion: 06/10/2010

Certification Number: 461946

Institutional Review Board

California University of Pennsylvania
Psychology Department LRC, Room 310
250 University Avenue
California, PA 15419
instreviewboard@cup.edu
instreviewboard@calu.edu
Robert Skwarecki, Ph.D., CCC-SLP,Chair

Mr. Gregoire,

Please consider this email as official notification that your proposal titled "Athlete Knowledge of Post Exercise Rehydration Drinks" (Proposal #10-047) has been approved by the California University of Pennsylvania Institutional Review Board as submitted, with the following stipulations:

- **A screening question or statement indicating that participants must be 18 years of age or older must be present in the consent form and/or questionnaire.**

- **A statement indicating where the results will be housed and maintained must be added to the consent form.**

Once you have made this revision, you may immediately begin data collection. You do not need to wait for further IRB approval. [At your earliest convenience, you must forward a copy of the revised consent form for the Board's records].

The effective date of the approval is 02-23-2011 and the expiration date is 02-22-2012. These dates must appear on the consent form .
Please note that Federal Policy requires that you notify the IRB promptly regarding any of the following:

(1) Any additions or changes in procedures you might wish for your study (additions or changes must be approved by the IRB before they are implemented)
(2) Any events that affect the safety or well-being of subjects
(3) Any modifications of your study or other responses that are necessitated by any events reported in (2).
(4) To continue your research beyond the approval expiration date of 02-22-2012 you must file additional information to be considered for continuing review. Please contact instreviewboard@cup.edu
Please notify the Board when data collection is complete.
Regards,
Robert Skwarecki, Ph.D., CCC-SLP, Chair, Institutional Review Board

APPENDIX C2

Cover Letter to Participant

Dear Participants:

My name is Joshua Gregoire and I am a master's degree candidate at California University of Pennsylvania. One of the requirements for a master's degree is the completion of a thesis and for this I am requesting your help. As of late, the beverage industry has expended numerous funds in the area of post-exercise rehydration drinks (PERDs for short). Information about various PERDs is on television, in magazines, and talked about among coaches. I am conducting this study to find out what you, the athletes, know about PERDs as well as how frequently you use them. Your responses will be anonymous, but it is hoped that the results of this study will be published for the medical community to see, in an effort to expand upon the research. Your responses will be housed in a secure location by surveymonkey.com, accessible only to the researcher. The survey should not take longer than 10 minutes for you to complete. The effective date of the approval is 02-23-2011 and the expiration date is 02-22-2012.

If you wish to participate in the study, please follow the link https://www.surveymonkey.com/s/G5TCF97

Thank you,

Joshua Gregoire, ATC, NASM-PES

Graduate Assistant Athletic Trainer

California University of Pennsylvania

APPENDIX C3

Cover Letter to Athletic Director

January 5, 2011

Dear Mr. Craig Keilitz:

Hello, my name is Joshua Gregoire and I am a Graduate Athletic Trainer working with California University's Cross Country, Tennis, Track and Field teams as well as a 2010 graduate of High Point University. I am seeking my Masters of Science degree in Athletic Training. A requirement for this degree is the completion of a thesis by performing research. The title of my study is: Athlete Knowledge of Post-Exercise Rehydration Drinks.

Athletes need to be bigger and stronger to perform better each and every year. As a result, many are taking supplements to aid in this goal. Recent research has not examined the current use and knowledge of these specific aids. Most of the time, athletes take supplements based on recommendations made by friends and family; I am aiming to examine the causes of use, amount of use, and information concerning the use of rehydration drinks.

I am asking athletes to fill-out a survey on their own time online. This survey will ask demographic information such as: what sport do you play, what year in school are you, and what division is your school? They will then be asked to answer questions concerning their use of PERDs. Lastly, they will be asked a series of questions to discern their knowledge of these drinks.

I am writing seeking your approval to use High Point University athletes for participation in my study.

In conclusion, I would like to thank you for your time, cooperation, and consideration with this matter

Sincerely,

Joshua Gregoire, BS
California University of Pennsylvania
Graduate Assistant Athletic Trainer

APPENDIX C4

Response Letter from Athletic Director

January 6, 2011

Dear Mr. Joshua Gregoire:

Thank you for writing and expressing your desire to conduct research in pursuit of your Master's degree.

I grant you permission to conduct survey-based research related to post-exercise rehydration with the athletes at High Point University. Understand that our institution permission and individual athlete participation is voluntary and can be free withdrawn without cause.

Sincerely,

Craig Keilitz
Athletic Director

APPENDIX C5

Liaison Letter

January 6, 2011

Dear Mr. Joshua Gregoire:

Thank you for writing and expressing your desire to conduct research in pursuit of your Master's degree. Your proposed research project would be beneficial to the field of athletic training.

I am willing to voluntarily support your research agenda by serving as a liaison with High Point University's Department of Athletics. Please understand that High Point University's participation is contingent upon approval by Mr. Craig Keilitz, Athletic Director.

I wish you the best of luck throughout your research.

Sincerely,

Dan Tarara MS, ATC, LAT
Director, Athletic Training Education Program

HIGH POINT UNIVERSITY
833 MONTLIEU AVENUE, HIGH POINT, NORTH CAROLINA 27262 (336) 841-9000
WWW.HIGHPOINT.EDU

APPENDIX C6

Survey

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

1. Welcome

Dear Participants:

My name is Joshua Gregoire and I am a master's degree candidate at California University of Pennsylvania. One of the requirements for a master's degree is the completion of a thesis, for this I am requesting your help. As of late, the beverage industry has expended numerous funds in the area of post-exercise rehydration drinks (PERDs for short). Information about various PERDs is on television, in magazines, and talked about among coaches. I am conducting this study to find out what you, the athletes, know about PERDs as well as how frequently you use them. The results of this study will be anonymous, but (excluding your individual information) will be published for the medical community to see, in an effort to expand upon the research. The results are housed by surveymonkey.com in a secure location, inaccessible to view. Data collection has been approved from 02-23-2011 with an expiration date of 02-22-2012.

The questionnaire consists of 22-27 questions depending on answers, and will take about 10 minutes to complete. The questions are multiple choice, true/false, and demographic information. There is minimal risk involved to you as confidentiality will be maintained. There will be no way of tracking who answered what to each question. You may stop at any time and your answers will be disregarded, you simply have to exit the browser. Your help in this survey is completely voluntary. Choosing not to complete the survey will not affect you. There is nothing to sign, taking the survey serves as your consent.

It is my hope to compare the data between gender, sport teams, and age to find out more about PERD use and knowledge.

If you have any concerns or questions please feel free to contact me via email at gre3047@calu.edu or by phone at (207) 423-3607.

Thank you for your time and help.

Joshua Gregoire, BS
California University of Pennsylvania
250 University Avenue
California, PA 15419
Gre3047@calu.edu
(207) 423-3607

Robert H. Kane, JR EdD, LPT, ATC
Program Director, Athletic Training Education Program
250 University Avenue
California, PA 15419
kane@calu.edu
(724) 263-4966

Approved by California University of Pennsylvania Internal Review Board. This approval is effective 02/07/11 and expires 02/06/2011.

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

2. Demographic Information

This page serves to determine what sport you play, what division your school is, and other basic information for the studies purpose. This information is not enough to determine your identity.

*** 1. Are you 18 years or older?**

- ◯ Yes
- ◯ No

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

3.

*** 1. What is your main sport?**

- ◯ Football
- ◯ Baseball
- ◯ Softball
- ◯ Volleyball
- ◯ Basketball
- ◯ Tennis
- ◯ Golf
- ◯ Soccer
- ◯ Swimming
- ◯ Track and Field
- ◯ Cross Country
- ◯ Wrestling
- ◯ Other

Other (please specify)

*** 2. What division is your school in?**

- ◯ NCAA Division 1
- ◯ NCAA Division 2
- ◯ NCAA Division 3
- ◯ Other

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

*** 3. What year in school are you?**

- ◯ Freshman
- ◯ Sophomore
- ◯ Junior
- ◯ Senior
- ◯ Graduate Year 1
- ◯ Graduate Year 2

*** 4. What is your age?**

- ◯ 18
- ◯ 19
- ◯ 20
- ◯ 21
- ◯ 22
- ◯ 23
- ◯ 24
- ◯ 25

*** 5. What is your gender?**

- ◯ Male
- ◯ Female

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

4. Post-Exercise Rehydration Drink Consumption

The purpose of this portion of the survey is to determine how much, if at all, you drink a post-exercise rehydration drink.

*** 1. Do you regularly drink something within an hour after working out?**

- ◯ Yes
- ◯ No

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

5. Answered Yes to "Do you regularly consume a PERD"?

*** 1. How many times per week do you drink a post-exercise rehydration drink?**

- ◯ Once per week
- ◯ Twice per week
- ◯ Three times per week
- ◯ Four times per week
- ◯ Five times per week
- ◯ More than Five times per week

*** 2. What do you drink the most of following exercise? Please select all that apply.**

- ☐ Gatorade
- ☐ Powerade
- ☐ Accelerade
- ☐ Muscle Milk
- ☐ Milk
- ☐ Chocolate Milk
- ☐ Water

Other (please specify)

*** 3. Why do you drink this particular drink?**

- ◯ It was given to me
- ◯ It tastes good
- ◯ I was told it was good for me
- ◯ Saw it advertised somewhere
- ◯ I have knowledge of what to drink

Other (please specify)

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

6. If answered, "It was given to me"

*** 1. If answered, "it was given to me", who provided the drink?**

- ◯ Strength & Conditioning Coach
- ◯ Head/Assistant Coach
- ◯ Athletic Trainer
- ◯ Nutritionist
- ◯ Friend/Teamate
- ◯ Parent

Other (please specify)

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

7. Athlete Knowledge

This section of the survey serves to test your knowledge of post-exercise rehydration drinks. Please answer as best you can. Answers to these questions will in no way get traced back to you.

*** 1. If you drink water while working out, you do not need a post exercise rehydration drink.**

- ◯ True
- ◯ False
- ◯ I don't know

*** 2. Water is NOT an effective post exercise rehydration drink.**

- ◯ True
- ◯ False
- ◯ I don't know

*** 3. Which of these is an electrolyte?**

- ◯ Calcium
- ◯ Hydrogen
- ◯ Oxygen
- ◯ Lithium

*** 4. Which of these is NOT a symptom of heat illness?**

- ◯ Dizziness
- ◯ Nausea
- ◯ Frustration
- ◯ Chills

*** 5. When should a post exercise rehydration drink be consumed after exercise?**

- ◯ 30 min - 1 hour
- ◯ 1 hour - 2 hour
- ◯ 2 hour - 3 hour
- ◯ 3 hour - 4 hour

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

*** 6. Which drink is considered the most effective post exercise rehydration drink out of the ones listed?**

- ◯ Water
- ◯ Soda
- ◯ Fruit Juice
- ◯ Gatorade

*** 7. At what percent body weight loss does dehydration START to impact performance?**

- ◯ 1-2%
- ◯ 3-4%
- ◯ 5-6%
- ◯ 7-8%
- ◯ Greater than 8%

*** 8. Which of these is an important nutrient in sweat?**

- ◯ Protein
- ◯ Fat
- ◯ Salt
- ◯ Oxygen

*** 9. It is good for a post-exercise rehydration drink to contain caffeine.**

- ◯ True
- ◯ False
- ◯ I don't know

*** 10. What determines if a drink is a good post-exercise rehydration drink?**

- ◯ If the company behind it is a known brand
- ◯ Advertisements suggest it
- ◯ If it has a professional athlete endorsing it
- ◯ Nutrients it contains

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

* **11. Feeling thirsty is the first sign of dehydration.**

- ◯ True
- ◯ False
- ◯ I don't know

* **12. Everyone sweats at the same rate**

- ◯ True
- ◯ False
- ◯ I don't know

* **13. Which of these does NOT dehydrate you faster than normal?**

- ◯ Caffeine
- ◯ Alcohol
- ◯ Ephedra
- ◯ Sugar

* **14. If I am not thirsty, I shouldn't drink anything.**

- ◯ True
- ◯ False
- ◯ I don't know

* **15. Which of these conditions can dehydration contribute to? Please choose all that apply.**

- ☐ Cramps
- ☐ Heat Stroke
- ☐ Death
- ☐ Fatigue
- ☐ None of the Above

Athlete Knowledge and Use of Post Exercise Rehydration Drinks

* **16. Weighing yourself before and after activity is a good way to see how much sweat you lost.**

- ◯ True
- ◯ False
- ◯ I don't know

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ABSTRACT

TITLE: ATHLETE KNOWLEDGE AND USE OF POST-EXERCISE REHYDRATION DRINKS

RESEARCHER: Joshua P. Gregoire

ADVISOR: Robert Kane, EdD, PT, ATC

DATE: April 2011

RESEARCH TYPE: Master's Thesis

CONTEXT: Current research indicates that athletes use supplements at a high rate. Literature has not examined if this trend correlates to post-exercise rehydration drink knowledge.

OBJECTIVE: The purpose of this study was to: test athlete knowledge of post exercise rehydration drinks and evaluate the usage of post exercise rehydration drinks. The study was a descriptive design survey.

SETTING: The survey was distributed via email and taken online at the participants' convenience on www.surveymonkey.com.

PARTICIPANTS: The convenient sample of 99 athletes out of a possible 311 took the online survey at their convenience after being sent a link and cover letter. The response rate was 31.8%.

INTERVENTIONS: The independent variables used were sport played and gender of participants. After obtaining consent from the athletic director, athletes were sent the survey and asked to respond at their leisure. At the end of the survey window, each response was given a knowledge score based on the number of questions answered correctly

MAIN OUTCOME: The dependent variable used was the knowledge score given based on the number of

questions answered correctly on the survey. PSAW 19.0 for Windows was used for all data statistics with an alpha level of <.05. one-way ANOVA was used to compare knowledge score means and sport. An independent-samples *T*-test was calculated comparing the mean score on the knowledge based portion of the study and the gender of the participant. A chi-square test of independence was calculated comparing post-exercise rehydration drink usage and sport played. A chi-square test of independence was calculated comparing gender and PERD use.

RESULTS: The research found: no significant differences between athlete knowledge sport played, ($F(6,92) = 1.934$, $p = .084$), no significant differences found between PERD knowledge and gender ($t(29) = .268$, $p = .790$), no significant relationship between PERD usage and sport played ($X^2(6) = 7.786$, $p = .254$), and no significant differences between gender and PERD usage ($X^2(1) = .357$, $p = .567$).

CONCLUSIONS: Of note was the findings of athlete knowledge based on gender as males scored higher than did females, but not significantly better ($m = 14.14$, $sd = 2.133$) and ($m = 14.01$, $sd = 2.075$), respectively. This research indicates that 80% of athletes use post-exercise rehydration drinks on a regular basis.