INVESTIGATION OF INDIANA TENNIS COACHES' KNOWLEDGE OF DISORDERED EATING AND NUTRITION AND THEIR CONFIDENCE IN SUCH KNOWLEDGE

Brian P. Reagan

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Rafael Bahamonde, Ph.D., Chair

Doctoral Committee

Anastasia Morrone, Ph.D.

David Pierce, Ph.D.

December 11, 2015

Matt Beekley, Ph.D.

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It is well documented that a variety of sports coaches lack nutrition knowledge. However, few studies explore their knowledge of appropriate weight loss methods, macronutrient intake, or disordered eating. Unfortunately, both college and high school coaches disseminate inaccurate nutrition and weight loss counsel to their respective athletes who are just as unknowledgeable. Further, there is little research, which only focuses on coaches of a specific sport (e.g. tennis).

Thus, the primary purpose of this study was to assess high school tennis coaches' knowledge of macronutrients and disordered eating (e.g. symptoms and prevention). Other purposes included identifying confidence in knowledge and any differences between the participating coaches' knowledge and demographic variables. To address these purposes, the 27-question Nutrition and Eating Disorders in Tennis ("NET") Survey was created (and validated). The study design involved a one-time, voluntary assessment of the Indiana coaches' demographic variables, knowledge, sources of knowledge, and level of confidence (e.g. Not At All or Very Confident).

Overall, the results revealed that the coaches lacked knowledge. The average score was 70.6%, which was below the criterion for adequate knowledge. Furthermore, the coaches lacked adequate knowledge in three of the five knowledge domains: Treatment and Prevention of Disordered Eating (63.6% ± 22.9%), Disordered Eating Signs and Symptoms (60.0% ± 21.7%), and Macronutrients (57.0% ± 22.4%). The latter was further substantiated through the responses to scenario questions (Part 3). Specifically, the tennis coaches demonstrated a significant knowledge deficiency of carbohydrates, energy needs, and appropriate scope of practice. There was no significant difference between coaches' education level, gender, or type and knowledge.

However, there was in experience; the more years coached, the lower the scores. Moreover, there was a trend of overconfidence in the most missed questions. This dissertation's data can provide basis for coaches' educational programs.

Rafael Bahamonde, Ph.D., Chair

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LIST OF ABBREVIATIONS, ACRONYMS, AND SYMBOLS

AMDR	Acceptable Macronutrient Distribution Range (e.g. Carbohydrates = 55-65%)
AN	Anorexia Nervosa
AND	Academy of Nutrition and Dietetics
APA	American Psychiatric Association
BMI	Body Mass Index
BN	Bulimia Nervosa
DE	Disordered Eating
DRI(S)	Dietary Reference Intake(s)
DSM – V	Diagnostic and Statistical Manual of Mental Disorders, 5th edition (2013)
DWCB	Disordered Weight Control Behaviors
ED(s)	Eating Disorder(s) (e.g. Anorexia Nervosa & Bulimia Nervosa)
EDNOS	Eating Disorder Not Otherwise Specified
EFI	Erroneous Food Intake
FHA	Functional Hypothalamic Amenorrhea
IHSAA	Indiana High School Athletic Association
IHSTCA	Indiana High School Tennis Coaches Association
kcal (kcals)	Kilocalorie(s)
LES	Lean-Emphasized Sport
LMM	Lean Muscle Mass
NCAA	National College Athletic Association
NCYS	National Council of Youth Sport
NET	Nutrition & Eating Disorders in Tennis (Survey Acronym)
NGBS	National Governing Body of Sport
OSFED	Other Specified Feeding or Eating Disorder
RDA	Recommended Dietary Allowance

RD or RDs	Registered Dietitian(s)
RMR	Resting Metabolic Rate
SCT	Social Cognitive Theory (also known as Social Learning Theory)
SKNS	Sport Nutrition Knowledge Survey
TEE	Total Energy Expenditure
USTA	United States Tennis Association

CHAPTER ONE: INTRODUCTION

1.1 Introduction

"Far too many children, particularly girls, are growing up afraid to eat, afraid to gain weight, and afraid to eat normally (Robert-McComb, 2001)."[1] This poignant quote exemplifies the well-documented irrational fears of food and weight gain that are the signature motivation for *Disordered Weight Control Behaviors*, (DWCB), methods of weight control or management deemed abnormal.[1-3] DWCB is an umbrella term for a spectrum of potentially harmful behaviors with objective of weight maintenance and/or some degree of weight loss.[2-4] Those most extreme behaviors serve as some of the clinical diagnostic criteria for *eating disorders* (e.g. anorexia nervosa and bulimia nervosa).[2-6] The phrase Disordered Eating (DE) will hereafter refer, collectively, to eating disorders as well as any DWCB that do not meet the criteria to be diagnosed as an eating disorder. While DE occurs in both genders, it appears considerably more frequently in females.[1,2,7-9]

Adolescence is consistently recognized as the time period where DE is most likely to originate.[1-3,6,9,10] One's body image is highly impressionable during this heightened time of development and change.[2,7] Most notable are the inherent physical changes of puberty (e.g. accelerated growth and weight gain) that modifies an adolescent's appearance.[1,3,4,6,7,11] It is these physical changes most associated with a poor body image, a negative esteem about one's body.[1-4,6,7,11,12] This is significant since body dissatisfaction has been frequently reported as the single strongest predictor of eating disorders, especially among adolescent females.[3,6,7,13-18]

Body dissatisfaction and the potential development of DE is of grave concern due to the associated health consequences. The most serious and chronicled consequences are those associated with Anorexia Nervosa (AN) and Bulimia Nervosa (BN).[1,3,6,11,18-20] Consequences range from the psychological to physiological, acute to chronic, and benign to life – threatening.[1,3,5,6,18-21] At the core of health concerns is kcalorie (kcal) restriction.[6,20,22-24]

Restrictive energy intakes and accompanying deficiencies are responsible for health issues ranging from menstruation irregularities to DE.[1,5,6,8,21-26]

While a complete presentation of an adolescent's nutritional needs are beyond the scope of this dissertation, the importance of appropriate kcal and macronutrient intake must be emphasized. The energy demands, and thus, carbohydrate intake to support an adolescent's physical maturation are considerable.[6,21,26] Moreover, a large number of adolescents participate in sports, which renders additional nutritional demands to that of adolescence.[6,21,24,26-29] Daily macronutrient and energy intake needs increase because of performance and *training activities* (i.e. practice and conditioning).[21,26]

Unfortunately, it has consistently been reported that restrictive diets are a common practice among adolescents and athletes, especially the female population.[6,10-12,23,24,30-33] And the afore-mentioned macronutrients and energy are deficient in kcal restrictive diets.[6,23,26,34-37] Contrary to popular belief, consumption of too many kcals among adolescents, especially athletes, is not a reality.[6,23,26,37] Yet misinformation that preaches adolescents need to lose weight in order to be healthy, runs rampant.[1,24,37,38] Two key sources of information for athletes, media and coaches, are replete with misinformation.[1,24,37-43]

Generally, college athletes lack knowledge of energy requirements and macronutrient recommendations and functions.[3,27,39,41,43,44] Thus, it reasonable to deduce that adolescent athletes would not be expected to be any more knowledgeable of the same. This presents a problem as adolescents are not equipped to recognize incorrect weight loss and/or dietary intake recommendations.[3,27,39,41,43,44] Despite being beyond their scope of practice, the literature consistently reports that coaches are typically an athlete's first resource for nutrition information.[1,27,41,42] The information, whether correct or not, is likely to be heeded as coaches are highly influential figures in their respective athletes' actions and beliefs, especially among adolescents.[1,27,39,42,45]

Unfortunately, college and high school coaches have been identified as a large population that disseminates inaccurate nutrition and weight loss counsel to their respective athletes.[1,3,39-42,46] It has been reported that coaches deliver incorrect, cliché instructions to lose weight, which demonstrates their lack of knowledge of respective athlete and nutritional needs.[42,47,48] The most likely consequence of this distribution of misinformation is DWCB, potential triggers of eating disorders and the accompanying health consequences.[1,2,7,42]

This emerges as a dangerous concern for high school athletes. High school coaches "inherit" athletes at an age which (1) is highly influenced by coaches and (2) have most recently experienced (or still experiencing) the adolescence characteristics implicated with the advent of DE.[1,2,7] The potential for DE is greatest with what is commonly referred to as Lean-Emphasized Sports (LES), any sport that potentially provides a potential advantage for individuals with a relatively smaller body and/or lower body weight.[3,19] Commonly touted LES are those that require quickness and/or emphasize aesthetics.[3,19] With the inherent speed of modern tennis game and the glamorization of tight fitting tennis apparel, tennis can be categorized as LES. Unfortunately, there is limited research of high school coaches' knowledge of disordered eating and limited inquiry in the context of a specific sport such as tennis. The inherent characteristics of this increasingly fast sport place additional demands on an adolescent, which are imperative for a coach to know in light of the afore-mentioned risks of DE.

1.2 Statement of Purpose

The primary purpose of this study was to assess high school tennis coaches' knowledge of (1) Macronutrients and Energy, (2), Etiology of DE, (3) Identifying Signs and Symptoms of DE, (4) Tennis Coaches' Scope of Practice, and (5) Treatment and Prevention of DE. A survey was created by modifying any existing instruments from the literature as, to date, no survey is specific to all of these topics on the same instrument. The survey was administered to Indiana high school tennis coaches. Tennis was selected due to its classification as a *Lean-Emphasized Sport* and because adolescent tennis coaches have not specifically been singled out for

investigation.[3,6] Finally, secondary purposes were to identify (a) any differences between coaches' knowledge (e.g. score on assessment) and demographic variables (e.g. education and experience) and (b) any relationship between coaches' behavior and knowledge. For example, for the latter, are coaches' with less knowledge more likely to recommend weight loss?

1.3 Research Questions

1. What are the differences, if any, between *Indiana high school tennis coaches' demographic variables and assessed knowledge?
2. What is the extent of *Indiana high school tennis coaches' knowledge of disordered eating?
3. What is the extent of *Indiana high school tennis coaches' knowledge ofmacronutrients?
4. What is level of confidence in *Indiana high school tennis coaches' knowledge of disordered eating and macronutrients?
5. What is the relationship between *Indiana high school tennis coaches' behavior and knowledge?

   *Head / assistant high school tennis coaches of any Indiana High School Boys or Girls tennis program that coaches any time Spring 2014 to Spring 2016.

1.4 Hypotheses

1. Set 1 (Research Question 1)

   Research Hypothesis 1a: There is a significant difference between Indiana high school tennis coaches' education and assessed knowledge.

   Research Hypothesis 1b: There is a significant difference between Indiana high school tennis coaches' experience (i.e. years coached) and assessed knowledge.

   Research Hypothesis 1c: There is a significant difference between the gender of team coached and ^^^assessed knowledge.

2. Set 2 (Research Question 2)

   Research Hypothesis 2a: Indiana high school tennis coaches lack ^sufficient knowledge of disordered eating etiology as assessed in Domain 2 of the NET Survey.

   Research Hypothesis 2b: Indiana high school tennis coaches lack ^sufficient knowledge of disordered eating signs and symptoms as assessed in Domain 3 of the NET Survey.

   Research Hypothesis 2c: Indiana high school tennis coaches lack ^sufficient knowledge of disordered eating treatment as assessed in Domain 5 of the NET Survey.

3. Set 3 (Research Question 3)

   Research Hypothesis 3: Indiana high school tennis coaches lack ^sufficient knowledge of macronutrient and Calorie needs and recommendations as assessed in Domain 1 of the NET Survey.

4. Set 4(Research Question 4)

   Research Hypothesis 4a: Indiana high school tennis coaches are ^^confident in their knowledge of disordered eating etiology (i.e. Domain 2).

   Research Hypothesis 4b: Indiana high school tennis coaches are ^^confident in their knowledge of disordered eating signs and symptoms (i.e. Domain 3).

   Research Hypothesis 4c: Indiana high school tennis coaches are ^^confident in their knowledge of disordered eating treatment (i.e. Domain 5).

   Research Hypothesis 4d: Indiana high school tennis coaches are ^^confident in their knowledge of macronutrient and Calorie needs and recommendations (i.e. Domain 1).

5. Set 5 (Research Question 5)

   Research Hypothesis 5: There is a significant relationship between Indiana high school tennis coaches' ^^^assessed knowledge and ^^^^behavior.

^Sufficient knowledge was operationally defined as a mean score of 80% or greater.
^^Confidence was operationally defined as a mean confidence score of at least 3.
^^^In terms of percent correct and percent incorrect in total.
^^^^As inferred from response scores on Part III of NET Survey

1.5 Significance of the Study

Socrates once declared that "The truest wisdom is knowing what you don't know." So, first, this study can identify what "we don't know" about what "coaches don't know" about DE. It is well established that college coaches lack the requisite knowledge and education to appropriately inform and counsel their respective athletes on basic nutrition.[41,42,48-50] However, there is a dearth of studies involving the knowledge of high school coaches. Most of the limited research is on college coaches and only, then, on basic nutrition. Likewise, to date, there is limited investigation of specific knowledge of DE in any level of coaching. Since most people's values and beliefs are established in early childhood and adolescence, it is more important that coaches at that level are knowledgeable compared to college coaches.[10] By the time an athlete transitions to college sports, a college coach's lack of knowledge is likely irrelevant.[7,10,51] The literature repeatedly affirms that the best prevention of DE is education as early as possible.[1,7,51,52]

Furthermore, no studies specifically investigating any type of nutritional knowledge of high school or college tennis coaches were unearthed in the literature review. Thus, this research can begin filling the void of limited research on specific sports nutrition and coaches' knowledge of DE (vs. basic nutrition). Ultimately, information gleaned from this study can be used to inform the content of educational programs (e.g. workshops, certifications) for both middle school and high school coaches.

1.6 Operational Definitions

The following are the definitions used for this study:

Acceptable Macronutrient Distribution Range (AMDR)

This is the phrase for the science based recommendations (i.e. in ranges) for each of the macronutrients. Central to this study is the AMDR of carbohydrates, which should be the bulk of intake as reflected in the 55% - 65% recommendation for the general population. It is not uncommon for athletes to need more than the upper range for training activities.[26, 59]

Adolescent(s):

A youth in the process of developing (e.g. physically, emotionally) into an adult. It has been used to refer to middle school students (5^{th}-8^{th} grade) through early (9^{th}-10^{th}) high school. Likewise, it is the period of life that ranges between 11 and 21 years. For this study, age 10-16 is the age range for adolescents unless otherwise noted.[7,28,37]

Anorexia Nervosa:

This is a specific eating disorder officially recognized by the American Psychiatric Association that is diagnosed with the following criteria:[5]

(A) Restriction of energy intake relative to requirements, leading to a significantly low body weight in the context of age, sex, developmental trajectory, and physical health. Significantly low weight is defined as a weight that is less than minimally normal (body mass index ≤to 17 kg/m^2) or, for children and adolescents, less than that minimally expected.

(B) Intense fear of gaining weight (or becoming fat) or persistent behavior that interferes with weight gain, even though at a *significantly low weight.

(C) Disturbance (a) in the way in which one's body weight or shape is experienced, (b) undue influence of body weight or shape on self-evaluation, or (c) persistent lack of recognition of the seriousness of the current low body weight.

Amenorrhea:

This refers to the absence of a menstrual cycle. It can occur as a natural physiological response to pregnancy or menopause.[19] Or it can be unintentionally induced through stress or excessive exercise which is associated with Functional Hypothalamic Amenorrhea defined below.[21,24]

Binge Eating:

This is the abbreviated form of the American Psychiatric Association's coined phrase "episode of binge eating," which the organization defines as "eating, (1) in a discrete period of time, an amount of food that is definitely larger than most individuals would eat in a similar period of time

under similar circumstances" and (2) that is accompanied by a sense of lack of control of the quantity consumed or the ability to cease consumption."[5] (p. 345).

Body Dissatisfaction:

Collectively, body dissatisfaction refers to negative thoughts and esteem about one's body. It is associated with having a poor body image.[19,53] It is an abbreviated form of Body Image Dissatisfaction.

Body Image:

Quite simply, this refers to one's perception of his/her physical appearance and any positive and/or negative feelings towards his/her body shape and size.[19]

Bulimia Nervosa:

This is a specific eating disorder officially recognized by the ^American Psychiatric Association that is diagnosed with the following criteria:[5]

(A) Recurrent episodes of binge eating.

(B) Recurrent inappropriate compensatory behaviors in order to prevent weight gain.

(C) On average, both binge eating and compensatory behaviors occur concurrently at least once a week for three months.

Compensatory Behaviors (for weight loss):

Any of a number of misguided, inappropriate actions taken to lose weight and/or prevent weight gain that ultimately negatively impact one's health. The most well – documented are self-induced vomiting, extreme physical activity (e.g. excessive exercise), laxative use not in accordance with labeling, fasting, and diuretics.[2,5]

Competitiveness:

This refers to any degree of a desire to win in interpersonal situations.[55]

Disordered Eating (DE):

This phrase collectively refers to eating disorders as well as any DWCB behavior(s) that do not meet the criteria to be diagnosed as an eating disorder.

Disordered Weight Control Behaviors (DWCB):

Disordered Weight Control Behaviors (DWCB) is an umbrella term for a spectrum of abnormal and potentially harmful eating behaviors performed to lose or maintain weight.[2,3]

These behaviors range from the relatively inconsequential to more life – threating (e.g. starvation) behaviors. Some of the most severe behaviors serve as diagnostic criteria for eating disorders (see definition that follows).[2,3]

Eating Disorder:

Eating disorders consists of the most severe DWCB behaviors and attitudes, which impart distinct consequences, especially health.[2,3,5,6] The American Psychiatric Association (APA) defines an eating disorder as an enduring disturbance of eating or eating-related behavior that (a) results in changes in food consumption or absorption of nutrients (b) significantly harms physical and/or psychosocial health and/or functioning, and (c) meets its established diagnostic criteria.[5]

Energy Availability

The amount of energy available for other body processes and/or activities once the energy for physical activity (e.g. exercise) has been accounted for; it is calculated by subtracting exercise energy expenditure from dietary energy intake. This term is associated with Functional Hypothalamic Amenorrhea and is often discussed in the context of the kcal restriction as characteristic of Anorexia.[24]

Energy Deficiency:

Energy deficiency refers to a negative balance between the amount of energy consumed (i.e. kcal intake) and the amount of energy expended during physical activity (i.e. kcals burned).[21,24] That is, kcal requirements for the physical activity exceeds the dietary energy intake (i.e. low energy availability)

Extreme Physical Activity

This term refers to any type and quantity of physical activity that results in energy deficiency. It is a relative term that describes activity that is beyond what is needed to attain benefits. (i.e. There is

some degree of diminishing return). Excessive exercise is the classic example of this umbrella term and is often associated with disordered eating and a common practice among those with Anorexia Nervosa.[2,5,19,56,57]

Functional Hypothalamic Amenorrhea (FHA):

Functional Hypothalamic Amenorrhea refers to the unexpected cessation of menstrual cycle.[24] That is, it is not associated with normal female experiences that cause a pause in menstruation like pregnancy, lactation, and menopause.[21,24] FHA involves the disruption of gonadotropin-releasing hormone (GnRH) that ultimately stops menstruation.[21] This disruption originates from 3 primary sources: stress, weight loss, or exercise.

Females who engage in physical activities that have kcal requirements beyond their respective dietary energy intake (i.e. low energy availability) are at risk of this type of amenorrhea. This differs from Primary Amenorrhea, which is characterized by the menstrual cycle not ever occurring because of developmental problems (e.g. genetic disease).[21,24,25]

Internalized Appearance:

This refers to the product of adopting society's ideals of appearance to form personal goals and standards of appearance.[58] Body dissatisfaction often emerges from internalized appearance as the perceived ideals are typically not possible.[11,58]

Kilocalorie:

The standard unit of measure for the amount of energy burned or contained within foods. Technically speaking, it is the amount of heat energy it takes to raise the temperature of 1000 grams of water 1 °C.[21,59] While kilocalorie is also officially distinguished as Calorie with capital C, the terms calorie and caloric are referring to kilocalorie in this dissertation. (i.e. They are to be considered synonyms).

Lean-Emphasized Sport:

This refers to any sport that potentially provides a potential advantage for individuals with a relatively smaller body or lower body weight.[3,19] Commonly touted lean-emphasized sports are those requiring quickness (e.g. tennis) or emphasizing aesthetics (e.g. ballet or gymnastics).[3,19] It is important to emphasize that lean doesn't imply more muscle mass as it increases body weight; lean implies less body mass, overall, and thus body weight (i.e. lighter) relative to those participating in sports categorized as non-lean-emphasized sports.[3,19]

Normal Eating:

Normal eating is synonymous with eating simply to satisfy hunger, without influence of weight concerns.[19] Furthermore, normal eating also involves stopping of eating once hunger subsides with the assumption that one follows guidelines of variety and quantity.[19]

Other Specified Feeding or Eating Disorder (OSFED):

This is a category of eating disorders defined by the APA that is reserved for any case where the symptoms that cause clinically significant distress or impairment in social, occupational, or other important areas of functioning, but do not satisfy the full diagnostic criteria of any other eating disorder (e.g. Anorexia Nervosa or Bulimia Nervosa).[5] Furthermore, OSFED is not a synonym to disordered eating as OSFED meets some of the criteria for an eating disorder, while disordered does not necessarily do.[5]

It is important to note that this category was previously labeled Eating Disorder Not Otherwise Specified (EDNOS) by the APA.

Perfectionism:

The definition employed by Kamryn Eddy (2008) is used in this dissertation: Perfectionism is conceptualized as high personal standards for achievement accompanied by negative self-evaluation upon failure to meet those standards.[56]

Positive Feedback:

Positive feedback refers to any behavior that reinforces a behavior with the intent of encouraging it to occur again.[19]

Purging Behaviors:

Also known as purging, the American Psychiatric Association defines this as the collective term of any inappropriate compensatory behaviors (e.g. self-induced vomiting, extreme physical activity, diuretics aimed at preventing weight gain.[5]

Recommended Dietary Allowance:

The evidence-based amount of a nutrient believed to meet the needs of most (97%) individuals in a given population.[26,59]

Resting Metabolic Rate:

This term is the name given to the minimum amount of energy (i.e. kcals) expended in a non-fasting state needed to keep a resting, person alive in a warm and quiet environment [Heart Beating, Lungs, etc.] It is related to Basal Metabolic Rate, which is more specific as it represents energy expended in 12 hours in a fasting state. Either RMR or BMR are a major third of total energy expended in a day. The other two components of total energy expenditure (TEE) are physical activity kcals and the thermal effect of food (aka energy expended during digestion).[59]

Self-Concept:

This term refers to the way an individual thinks about or describes his- or herself in any dimension (e.g. physical or social).[11]

Self-Esteem:

Self-esteem refers to the degree to which one feels positively about one's self-concept.[60]

Self-Oriented Perfectionism:

This term refers to the ". . . tendency to expect perfection from oneself and the motivation to attain perfectionistic standards."[18]

Scope of Practice:

This phrase collectively refers to one's appropriate (i.e. qualified based on education and credentials) career roles and responsibilities.

Social Comparison:

This term is used in context of development of body image and self-concept. The behavior of comparing oneself to others' bodies is associated with body dissatisfaction among females.[11]

1.7 Delimitations

This study is delimited to:

1. Indiana high school tennis coaches.
2. Coaches employed during the 2014-2016 calendar year.
3. The data was collected during the academic school year to maximize rate of return with the assumption that each coach would be more likely to participate if not "off-work" (i.e. out of season).

1.8 Limitations

The following limitations may influence the data in this study:

1. The instrument (Survey) is of a self-report nature.
2. The survey was delivered via email, which created the risk of not being seen and/or sent to junk mail.
3. Only individuals with computer internet access could participate in this study.
4. A data base of coaches (and contact email) can never be 100% confirmed as there is likely a vacancy (e.g. employee turnover). The data base was just a "snapshot" of all coaches at time prior to data collection.
5. Not all schools maintained their respective website with current information and/or not all Athletic Directors provided requested information (e.g. coaches' names and respective contacts.)

6. There were no controls in place to prevent the coaches from getting assistance in answering the questions on instrument. (e.g. Since unsupervised, could look up answers.)
7. Participation in this study was voluntary. This may bias the results of the study toward individuals who have an interest in taking the survey. Their interest in the survey may indicate they have a higher amount of knowledge compared to those who did not, which in turn may introduce bias.

1.9 Basic Assumptions

This study (e.g. formation of hypotheses) was conducted based on the following assumptions:

General Framework / Philosophy

1. A coach is deemed part of an athlete's peer group.
2. With little data for high school and middle school coaches, it is assumed that the information of college coaches, are representative of high school and middle school coaches, who generally have less experience, education, and / or training.

Methods

1. The instruments from which the survey used in this study was modified from are valid and reliable.
2. Subject's confidentiality will be protected throughout the data collection process.
3. Information (e.g. coaches' names / emails) gleaned from website is current and accurate.
4. Coaches will be more likely to participate in study when in "work-mode" versus summer vacation. Thus, the survey was disseminated during the academic year.
5. Each subject will provide accurate information on self-report components of survey.
6. Each subject will answer multiple choice questions of survey on own, without assistance (e.g. internet, book, other person).
7. Each subject is capable to comprehend the questions and provide (i.e. appropriately use the computer) his/her intended answer.
8. Accurate data management and analysis will occur.

CHAPTER TWO: REVIEW OF LITERATURE

2.1 Review of Literature

> In today's western society young women are faced with enormous pressure to be thin. Thinness has become equated with health, beauty, success, control, and power (Augestad & Flanders, 2002). Society's ideal body shape has become increasingly thin over the past few decades, and this is linked to high rates of body dissatisfaction, especially among adolescents (Rainey, McKeown & Sargent, 1998). Body image dissatisfaction among adolescents has received a lot of attention because it is considered a risk factor for depression, low self-esteem, and eating disorders.[11]

This quote serves as an ideal introduction to the review of literature as it contains several of the key words that consistently appear in a literature review of U.S. coaches' nutrition knowledge and disordered eating. For example, "body dissatisfaction," "adolescents," "body image," and "eating disorders" relate to most of the pertinent topics outlined below. Most importantly, the above excerpt captures the essence of one of the "take-home" messages from this review of literature: various factors (e.g. pubescence, body dissatisfaction, media influence) results in adolescence being a time period especially susceptible to the advent of DE.[1,3,4,6,7,11,38,39,61-63] The following sections chronicles this in the following sections in more detail: (1) Disordered Eating, (2) Adolescence & Disordered Eating, (3) The Media & Adolescents, (4) Adolescents & Sport Participation, (5) Coaches' Knowledge, (6) Theoretical Framework.

2.2 Disordered Eating

Authors use a variety of terms to describe DWCB, a spectrum of potentially harmful behaviors performed to lose or maintain weight. Furthermore, DWCB is viewed as a stark opposite to *normal eating,* simply eating to satisfy hunger, without influence of weight concerns and involves the termination of eating once hunger is satisfied.[19] To minimize confusion, this dissertation operates with the previously presented definition of disordered eating (i.e. collectively ED and DWCB).

Fortunately, universal definitions exist for eating disorders in general as well as the specific types (e.g. AN or BN). However, Zemke (2008) reports a common theme in the literature: like disordered eating, the meaning of eating disorders is misunderstood.[3]

> Eating disorders is a commonly misused term used to describe any level of disturbed eating habits or unhealthy weight loss behaviors. [Actually] Strict behavioral and psychological criteria must be met prior to the diagnosis of an eating disorder.[3]

Thus, when mentioning eating disorders, this dissertation is referring to the definition provided by the American Psychiatric Association (APA): an eating disorder is an enduring disturbance of eating or eating-related behavior that (a) results in changes in food consumption or absorption of nutrients (b) significantly harms physical and/or psychosocial health and/or functioning and satisfies stringent diagnostic criteria.[5,6] The APA establishes the specific diagnostic criteria for eating disorders, which is delineated in the 5th edition (2013) of the Diagnostic and Statistical Manual of Mental Disorders (DSM – V).[5] There are a total of six disorders that the organization identifies as *Feeding and Eating Disorders*; the APA definitions are frequently used as operational definitions in the literature.[5,6] Unless otherwise stated, the abbreviated term, *eating disorders,* will be used and refers to those recognized by the APA, two of which are pertinent to this dissertation: AN and BN.

2.2.1 Prevalence of Disordered Eating

Disordered weight control behaviors and eating disorders (again, collectively, disordered eating, DE) are not new phenomenon. Distinct examples abound in the annals of history.[3,19,40,64] For example, Glover (2006) reports that self-executed weight management practices date back to at least the Middle Ages.[19] She elaborates that, "In ancient times, self-starvation occurred in the form of ritual fasting for brief periods, usually 1 to 3 days . . ."[19] The earliest known record of AN appeared in a seminal report by the English physician, Richard Morton, in 1694.[3] Considering the stringent diagnostic criteria for eating disorders, it is no surprise that DWCB is consistently more

prevalent than eating disorders.[2] Recently, Wang et al. reported that the former is 20 times more common than latter.[2]

Furthermore, it is well documented that DWCB and eating disorders are more prevalent among females of any age compared to male counterpart.[1-3,6-9,24,25,64-66] For example, a prevalence rate of females suffering from AN and BN as high as 85% to 90% has been reported.[1] However, worth noting, is that disordered eating and eating disorders appear in males more frequent than previously reported.[3,6] Zemke (2008) elaborates:

> For example, 20 years ago, research suggested that for every one male with anorexia nervosa or bulimia nervosa, there were 10-15 females with one of these diseases. However, current research suggests that there is one anorexic male for every four anorexic females and one bulimic male for every 8-11 females.[3]

Moreover, the literature conveys that adolescents comprises the largest proportion of those developing DE.[1,7,18,20,57,58,61,62,67] It has been reported that as high as 20% of adolescent females who exhibit serious disordered eating behaviors (e.g. extreme kcal restriction and extreme physical activity) do not meet the qualifications for a diagnosis of any eating disorder.[18,65,66] More recent estimates illustrate this trend has only increased: 53% to 56% of 9th grade females reported DWCB behaviors.[3] Regarding eating disorders, it is estimated that at least 10% of adolescents have full-blown, AN and the majority of individuals who do develop this eating disorder saw their behaviors originating in adolescence.[3,11,15,20,67] For BN, a 17-year longitudinal study by Kotler et al. (2001) that found the presence of BN during early and late adolescence correlates with a 9- and 20-fold increased risk, respectively of exhibiting BN in adulthood.[3,68] While a detailed synopsis of these eating disorders is beyond this literature review, it is important to present the gold standard characteristics of AN and BN.

2.2.2 Identifying Signs and Symptoms

Knowledge of the characteristics and types of ED is imperative. "Most individuals with an eating disorder share certain personality traits and characteristics."[11] This is especially apparent for anorexics and bulimics. First, the label *nervosa*, which translates to nervous, is an

indication of the signature shared characteristic, an irrational fear of foods' effects.[5,6,21] This hallmark of both AN and BN is rooted in a dissatisfaction of body image.[6,11] Several authors have recognized body dissatisfaction as the key predictor of development of eating disorders.[1,3,4,7,11,53,61,63] Furthermore, most anorexics and bulimics possess a low self-esteem and feelings of hopelessness that drive their respective behaviors.[1,4,5,11]

Nonetheless, AN and BN are different eating disorders comprised of their unique characteristics. Most notable is the manner in which how he or she responds to the irrational fears of weight gain. Anorexics engage in various degrees of starvation while bulimics perform purging behaviors in order to ward off weight gain.[6,21,59] Furthermore, anorexics engage in what has been dubbed Extreme Physical Activity (e.g. excessive exercise), while the physical activity of the bulimics is similar to that of the general population.[6,19,21,59] Thus, behaviors of anorexics results in severely low body weight, which has been quantified in various way. For example, weight loss of 25% of original body weight or less than 85% of what is expected (e.g. ideal body weight) have been used.[5,19] For clarity, the following, most current APA (2013) description of significantly low body weight will be employed in this dissertation: a BMI $\leq$ to 17 kg/m^2. In contrast, bulimics are typically around their ideal body weight as they do absorb at least some kcals through their purging behaviors.[5,59] The most highly reported purging behavior is self – induced vomiting.[5,6,19]

2.2.3 Consequences of Disordered Eating

The fact that the girls were engaging in these behaviors at all is cause for alarm, as even as the infrequent practice of any of these behaviors [DWCB]can lead to serious health consequences.[1]

Eating disorders and its antecedents are regarded as one of the principal public health concerns for young females in western countries, especially the United States.[8,11,19] While DWCB is deemed less serious than eating disorders, the former can still render significant health consequences, especially in females.[1,3,5,19,33] Consequences range from relatively inconsequential (e.g. constipation) to severe health issues. [1,3,5,6,18-21] Energy deficiency is the classic consequence

of kcal restriction, a shared characteristic of anorexics and bulimics.[6,11,23-25] Adolescents are especially prone to energy deficiency because of the additional energy needs associated with natural growth and development changes in this period of life.[6,21,24,25,59]

Despite their unique differences, AN and BN possess similar physiological and psychological consequences. For AN, energy deficiency is of paramount concern because of the extremely low energy availability for vital body processes. Anorexics typically squander any energy on extreme physical activity (e.g. excessive exercise).[6,24,25] Besides energy deficiency, binging and purging behaviors present another serious issue, electrolyte imbalance.[3,5,6,19,59] Electrolyte imbalance accompanies self-induced vomiting. [3,5,6,19,59] It is well documented that a potassium deficiency ensues and increases the risk of heart attacks and damaged heart tissue.[3,5,6,19,59]

Other documented consequences of AN and BN include clinical depression, higher levels of anxiety (relative to population) and personality disorders (e.g. obsessive – compulsive disorder).[5,19,59] Psychological effects are often associated with the cause for death, a very real concern for all eating disorders.[5,19,20,59] As little as 10% of those with AN or BN may be expected to die and only about ½ of those with AN or BN may be expected to recover.[5,20] Due to the seriousness of all the presented consequences, it is imperative that those most vulnerable (e.g. adolescents) and those highly influential to this group (e.g. coaches), are knowledgeable about how they emerge.[41,42,47,48]

2.2.4 Etiology of Disordered Eating

> Poor body image in childhood and adolescence is a major risk factor for chronic body image problems, weight cycling, and the development of eating disorders in adulthood (McCabe & Ricciardelli, 2003). Thus, it is important to understand the development of eating disorders during adolescence.[11]

The development of disordered eating and full-blown eating disorders is multi-faceted. A variety of triggers have been implicated in their emergence.[2,7,11,15,30,53,61,62,66,67] Only those pertinent to this dissertation are presented below: the changes (e.g. physiological) and influences

(e.g. coaches and media) during adolescence. The majority of the research reports that a dissatisfaction in one's body image (i.e. body dissatisfaction) is at the root of DE.[2,6,7,11,19,62,63] Beyond mere opinion, Akos and Levitt (2002) elaborate that, historically, body dissatisfaction is the "single strongest predictor of eating disorder symptomology."[7,15-17] Moreover, numerous researchers assert that adolescents are most at risk for this influence of body dissatisfaction.[7,14-17,69]

The widely recognized precursors to a negative body dissatisfaction derive from an interplay of related terms: Self-Concept, Self-Esteem, and Body Image.[2,11,54,60] The former refers to how one thinks about his- or herself in any dimension (e.g. physical or social). And self-esteem refers to the degree to which one feels positively about one's self-concept.[60] Each of these terms have been linked to body dissatisfaction, a cardinal precursor to DE.[11,70,71] For example, a study by Wiseman, Peltzman, Halmi, and Sunday (2004) revealed that low self-esteem in middle school girls was positively correlated with body dissatisfaction.[72] This is mainly due to their relationship to body image, one's perception of his/her physical appearance and any feelings (positive or negative) towards his/her body shape and size.[54,73] It is this latter term, body image, most intimately linked to one's body dissatisfaction, which can be defined as negative thoughts and esteem about one's body.[11,53]

It is well established that body dissatisfaction and the impending disordered eating behaviors that likely follow prevails among adolescents, especially females.[7,11,15-17,53,69-72] While researchers employ different operational definitions, and thus, different frequency statistics, the overall message is the same: an alarmingly high prevalence of DE exists in female *adolescents*.[1,3,20,57] While reported in young children, the typical age of eating disorder onset ranges from 14 – 18, which is in the prime of adolescence or just after for most individuals.[11,20] This provides the major impetus for adolescents as the population of interest for this research.

2.3 Adolescence and Disordered Eating

Thus, a worthwhile inquiry in the literature is why are adolescents at the greatest risk for body dissatisfaction and the advent of DE? The answers unearthed relate to the inherent physical changes of adolescence that can trigger DE. [2,7,11,15,30,53,61,62,66,67] Mattison (2010) summarizes this well:

> Change is the defining feature of adolescence, with rapid physical, cognitive, and psychological changes taking place. Physical changes often begin first, with puberty bringing a drastic change in an adolescent's appearance, with accelerated growth, weight gain, changes in body configurations, and the development of secondary sex characteristics (Steiner, 1996). These physical changes, especially an increase in weight, often become cause for concern among female adolescents.[11]

Germane to the study at hand is the influence of puberty and media messages on the development of body image, especially in adolescent athletes.

Hormone induced growth and addition of tissue during adolescence alters one's body appearance.[7,37,38,58,59,61-63] The most dramatic for females proves to be the "fat spurt," an increased accumulation and thickness of fat; body composition becomes a higher percentage of body fat than lean mass compared to that of prepubescence.[7,37,59] These inescapable changes have the potential to negatively alter self-concept and thus, one's body image.[7,11,37,65,66] Thus, the ensuing body dissatisfaction can compel one to over-focus on self-appearance and weight, ultimately spiraling into the afore-mentioned DE. [7,11,37,65,66]

It is well established that among adolescents, the desire to lose weight is *directly* related to weight loss behaviors, which increases the chance of DE.[1,10,11,33,38] Mardie Burckes-Miller and Lydia Burak (2002) reported that their results revealed that 57% of the adolescent female athletes reported that they looked fat, and 33% reported being afraid to eat.[1] They identified that this mirrors results (54% / 23%) of Childress et al. (1993) 10 years earlier[1] The resulting large number of adolescents engaging in DWCB is especially problematic because they are eager to please, and thus, highly influenced by peer group, which includes coaches and the media.[37-39,45,46] The influence of media is significant because, the media disseminates incorrect information

regarding body weight and adolescent nutritional needs.[19,24,38-40,45,46,57] And, unfortunately, adolescents ". . . often turn to their peers and the popular media for guidance."[37,38,45]

2.4 The Media and Adolescents

The media also portrays images of the "ideal" body type, which adds to the problems of misinformation and body dissatisfaction.[19,24,38,53]

> Women may view media and television images of what society thinks is the norm and their body should resemble and this media portrayal is usually of women who are extremely thin and frail. ...Many women become bombarded with these measurements and images and struggle between the natural physiological tendency of fat deposition in the hips and the desire to mimic American models …[19]

This quote illustrates the pervasive emphasis of a thin body type in the U.S. culture, which is commonly portrayed in the media.[11,19,24,38] A seminal study by Brown and Witherspoon (2002) identified that over 66% of women characters on television are thin.[38] Furthermore, Glover (2006) reports that in 2006, the average height and weight of American women was 5'4" and 164 pounds, respectively.[19] This is a marked contrast to the average female model portrayed in the media (e.g. 5'11" and 117 pounds) who was thinner than 98% of the female population.[19] The disparity between what was portrayed in media and the average woman has continued to increase since the 1950's.[19,38]

Being a target audience for the media poses several problems for adolescents.[19,38,74] First, food preferences and patterns are not usually established until adulthood; thus, adolescents are more likely to be influenced whether the information is correct or not.[10,24] Second, exposure to the thin, ideal models is highly associated with the formation or perpetuation of body dissatisfaction, among adolescent females.[1,2,7,19] Thus, the media alone can be a trigger to DE.[19,24,39] Third, adolescents live in a culture inundated with a variety of media forms, which is often at their fingertips in the form of a cell phone app or advertisement; the amount of exposure is increased.

Athletes are also vulnerable to the effects of media misinformation. "Female sports figures are prominent throughout the media on television. . . ."[18] Coverage of athletes has only

increased in the last decade and athlete spokespersons are popular additions to food commercials despite lacking knowledge of nutrition and physiology. Modern day tennis exemplifies the portrayal of what athletes may interpret as the ideal look. Virtually all professional female tennis players wear tight fitting shirts, short shorts, and / or skirts. And, during the telecast of major championships, the anchors have brought attention to the "sexy" appeal outfits. Melinda Manore (1999) poses an important question: "How do athletes separate fact from fiction portrayed in the media?"[24] Translation, how are athletes supposed to distinguish between what "looks" are possible through training or not realistic as they are specific to genetics and body type? Thus, adolescent athletes are highly predisposed to DE, when you also consider the influence of puberty and being in a stage of life where they depend on adults.[1,2,7,10] For example, a meta-analysis of 34 studies determined that athletes are more at risk for disordered eating compared to non-athletes.[1]

2.5 Adolescent Athletes and Sport Participation

> Since the passage of Title IX legislation in 1972, there has been a dramatic increase in the number of girls and women participating in organized sports. Because of this increase in participation, the prevalence of eating disorders in athletes has dramatically increased, as well (Murnen, Ruble, & Smolak, 2000). For these reasons, it is vitally important for anyone associated with adolescent athletes - coaches, . . . - to be knowledgeable and competent in understanding and dealing with issues related to eating disorders.[57]

This quote supports the primary purpose of this dissertation: the assessment of coaches' knowledge of DE. Distinct characteristics of athletes place them at greater risk of disordered eating and the like more so then non-athlete counterparts.[1,75-78] Relevant, well-documented characteristics of athletes are perfectionism and competiveness.[19,52,55,76-78] This is important as a large number of adolescents participate in sports.[28,52,79] However, there is scant research of adolescent athletes in general, let alone the relationship of their characteristics to DE etiology.[11] What does exist is research into the overall positive benefits conferred from sport participation.[11,18,19]

To appreciate the stance of the proposed research, one must be aware that two opposing views of sport participation exist. While beyond the scope of this literature review, each merits

mention. The two perspectives are those who contend sports confer positive benefits (e.g. positive body image), while the opposing group contends that sports deliver negative consequences (e.g. lower body image).[11,19] For the purposes of this study, this author has the perspective that sport participation alone, in general, offers positive benefits and is not the root of poor body dissatisfaction and resulting DE.[11,19,117] It is the characteristics that drive him/her to play in sport that can drive them to engage in DWCB. [11,19]

2.5.1 Perfectionism and Competitiveness

Rather, specific factors of the individual are the likely culprits to the behaviors and attitudes that lead to disordered eating, and potentially eating disorders.[55,61,75,80-83] Perfectionism and competiveness nature of athletes have been linked to etiology of DE.[52,55,61,75,80-83] It is important to note that relatively little research exists that specifically examines the relationships between perfectionism and competiveness of adolescent athletes and DE. However, an assumption is that the dearth of findings in older athletes is expected in adolescents.

The perfectionist tendencies and competiveness of adult athletes has been positively correlated with increased body dissatisfaction. Perfectionism can drive an athlete to attempt what most would recognize as impossible and/or unnecessary to achieve.[52,61,80-83] For example, perfectionist personalities has been positively correlated with those who possess body dissatisfaction and engage in dangerous, and unfounded weight loss behaviors.[19,55,75,81] Likewise, the expected competiveness nature of athletes has been implicated with their pursuit of such behaviors, which are originally aimed at gaining a competitive nature.[52,55,75,81] They may erroneously begin to believe that "if I weigh less, than I will perform better."[19,52,80]

2.5.2 Lean-Emphasized Sports

Ultimately, the mentality to compete at all costs can spiral out of control, especially in female athletes.[6,19] A continual focus of achieving a certain body weight often manifests into behaviors congruent with DE when an athlete views weight loss as an integral component of success.[6,19,80] Compounding the problem is a pervasive emphasis on an ideal body type and

thinness in the sports culture.[6,19,52,57,84] This is especially true in what is labeled Lean-Emphasized Sports (LES).[6,19,52,57,84]

Sports identified as LES vary in the literature as there is no universal definition of what is categorized as such. However, LES are generally recognized as sports where the body is viewed as ". . . the instrument for successful sport performance."[57] That is, attention is placed on an athlete's body shape, body composition, and/or physical appearance because it is believed, incorrectly or not, that these attributes are directly related to success or appropriate "look" (i.e. aesthetics).[1,42,52,84] Gymnastics, swimming, and tennis are classic examples of LES.

Moreover, it is well established that increased body weight is negatively correlated with performance variables like speed, endurance, and agility.[6,41,57,85] Thornton (2004), declares that "A high percentage of body fat is assumed to slow movement, hinder performance, and cause fatigue both in quickness and endurance activities."[57] Also, many concur that DE appear in sports which athletes wear tight and/or short uniforms.[52] Thus, tennis can be regarded as a LES since such attire is increasingly popular and quickness and endurance are directly related to the level of one's success in this increasingly fast-paced sport.[86-93]

2.5.3 Tennis and Nutrition Demands

In order to fully understand the consequences of DE in adolescent tennis players, one must be familiar with the physiology and nutrition demands of tennis. As early as the 14th century, accounts of tennis strokes appeared, preliminary evidence of interest of recording human movement.[87] Since then, a variety of tennis topics ranging from kinematics (e.g. velocity) to the etiology of tennis elbow have been served up. Yet, to date, no specific inquiry into the adolescent population and DE exists. Nonetheless, abundant data on the metabolic, caloric, and nutrient needs germane to the presented problem is available.

Tennis has transformed since the inception of graphite rackets.[92] Skin tight clothing has replaced the classic white shorts and speed and power prevail.[86-91] Competitive tennis necessitates speed, speed, agility and endurance coupled with a combination of all three energy systems.[92] It

also requires one to return a relatively fast moving ball in a short amount of time with any one of several technically complex strokes.[87,89,94] The technical side cannot be overlooked as a significant amount of training activities must occur to develop such skills, which elicit significant energy and macronutrient needs. These inherent demands influences one's training activities and caloric needs.[21,93,95,96]

Due to the quick pace and technical demands of tennis, points do not last long.[92,93,95,96] Also, since the rules allow for scheduled breaks, 25 seconds and 90 seconds between points and games, respectively, tennis is characterized by brief bouts of intense activity, coupled with rest periods of different durations.[92,93,95,96] The breaks aren't long enough for the cells to regenerate phosphocreatine.[92] So, the body begins to rely more on the next energy systems (i.e. anaerobic and aerobic) in line.[92,93,95]

Furthermore, the duration of a match can be so long that the metabolic state mirrors that of aerobic athletes. As an activity increases in intensity and duration, a body in an anaerobic state beings to rely more on the aerobic system.[21,59] Thus, the aerobic system, which typically dominates in marathon-like events, progressively becomes more active with tennis's long duration performing multiple short bursts of intense activities.[96] This only increases one's kcal and carbohydrate (i.e. macronutrient for intense activities) needs. The bottom line is that the energy systems are complex and the degree to which each one is used depends on many factors (e.g. ability and match duration).[92,93,96] Thus, there is also a commensurate variability in nutritional needs.[21,93,95,96] Unfortunately, literature suggests that coaches are not knowledgeable about this variability and often dole out generic, "one size fits all" nutrition (e.g. kcal) recommendations.[41,42,48,49]

2.5.4 Energy Needs

Tennis coaches must be familiar with the athletes they "serve." While a variety of nutrition issues exist (e.g. obesity epidemic), this review focuses on the distinct needs of adolescent athlete population, who are presumed to have access to healthy foods. First, meeting

energy needs is of utmost importance for athletes, especially for those who are growing.[21,26,69,97] An athlete's energy needs increase because of their increased energy expenditure during training activities and performance.[26,37,97,98] So, one must consume enough for basic life processes (e.g. heart beat and breathing) as well as all physical activities (e.g. practice and performance) in order to avoid energy deficiency and associated health consequences.[24,59]

> If a female athlete restricts energy intake to less than 7430 kJ (1800 kcal), getting adequate macronutrients and micronutrients to maintain good health and an intense training program is almost impossible. This level of energy intake is too low for most competitive athletes regardless of body size, but it can be especially devastating for young female athletes who are still growing.[24]

Consequently, females who consume a low fat or kcal diet and/or engage in high kcal, fat-burning physical activities may not achieve the required proportion and menarche starts later or never begins (e.g. primary amenorrhea).[11,21,24,25] Females require certain proportion of body fat (i.e. stored, easily mobilized energy source) to attain and maintain menarche.[24,25] Current data contends that *Functional Hypothalamic Amenorrhea* (FHA), and its associated consequences (e.g. osteoporosis), typically emerge when energy availability is less than a threshold of 30 kcal per kilogram (kg) of lean body mass.[21]

Repeated, prolonged energy restriction also compels the body to rely on breakdown (and loss) of *lean muscle mass* (LMM) for energy provision.[21,59] The loss of LLM is associated with the decrease in strength, endurance, and overall performance of athletes.[21,26,59] Following the Academy of Nutrition and Dietetics (AND) evidence based recommendations can prevent energy and carbohydrate deficiencies and associated problems.[6,21,26]

2.5.5 Carbohydrates

Carbohydrates should comprise the bulk of intake for not only the general population, but athletes (e.g. tennis players) as well.[21,26,59] Not only should carbohydrate intake comprise in the highest proportion of daily macronutrients intake for a variety of reasons (e.g. brain function, limited storage), needs increase with additional physical activity.[21,26,59] The more intense the activity, the greater the reliance on carbohydrates.[21,26,59] Relatively speaking, any athletic event is

regarded as more intense than normal physical activity because of the former's training activities and performance.[21,26,59] The carbohydrate needs for growth and development that accompanies adolescents are in addition to that of athletic demands. [21,26,59] The AND recommendations for carbohydrates take this into consideration; each recommendation is presented as a range since the number of carbohydrates depends on many factors like type of sport and its duration.[21,26,59] For a comprehensive summary of the AND carbohydrate and protein intake recommendations, refer to Table 2 – 1.

TABLE 2 – 1. *Recommended Macronutrient Intake for Athletes

Carbohydrates (i.e. carbs.)	
**Daily	6 – 10 grams of carbs. per kilogram of body weight (2.7 – 4.5 grams of carbs. per pound of body weight).[a]
**During Physical Activity (e.g. Exercise)	^^30 – 60 grams of carbs. per hour of activity
**After Physical Activity (e.g. Exercise)	^1.0 – 1.5 grams of carbs. per kilogram of body weight (0.5 – 0.7 grams of carbs. per pound of body weight) during first 30 minutes and again every 2 hours for 4 – 6 hours.
Protein	
Sedentary – Standard Recommended Dietary Intake (RDA)	0.8 grams of protein per kilogram of body weight
Strength Training, Maintenance	^^^1.0 – 1.2 grams of protein per kilogram of body weight
Strength Training, Gain Lean Tissue	^^^1.5 – 1.7 grams of protein per kilogram of body weight
Moderate – Intensity Endurance Training	^^^1.2 grams of protein per kilogram of body weight
High – Intensity Endurance Training	^^^1.6 grams of protein per kilogram of body weight

*As defined and presented in *Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. 2009*[26]
**Dietary intake needs vary from individual to individual. These evidence based recommendations are guidelines. Only a qualified professional (i.e. RD) should advise an athlete what to eat, how many kcalories to consume, and design menus.
[a]These values are not the same as the Recommended Dietary Intake for Carbohydrate (130 grams a day) as the RDA only considers basic carbohydrate needs such as brain function).
^^Minimum needed to maintain blood glucose levels necessary to maintain current level of performance.
^^^The assumption is that the athlete is working out at the work load (i.e. duration and intensity) necessary to produce changes.

It is possible to consume enough kcals, but fall short of carbohydrate requirements.[6,23,26] This is a common problem among athletes, especially females.[6,23,26] Glycogen, the storage form of carbohydrates, supplies muscles with energy, which increases in contribution during intense activities.[21,59] Thus, deficient carbohydrate intake makes movement, let alone the intense training activities (e.g. tennis practice), difficult, if not impossible.[26,36,37,99,100] Further, the replenishment of glycogen is compromised with deficient carbohydrate intake.[21,26,36,59] Optimal glycogen levels are

not achieved, which translates to reduced recovery and training.[21,26,36,59] Ultimately, optimal performance (i.e. speed or endurance) is impaired.[26,37]

2.5.6 Athletes' Nutrition Knowledge

Unfortunately, a prevailing theme in the literature is that college athletes lack knowledge in nutrition.[27,39-41,43,44,46,79] The most cited sources of athletes' nutrition knowledge are their respective coaches and afore-mentioned media, both of which disseminate incorrect nutrition information. [1,18,19,24,37-43] Ironically, "those individuals who depend on sound nutrition the most are consistently among those most uneducated about DE."[43]

The most consistent confusion surrounds total kcal intake; many believe kcals are to be avoided and a healthy practice is limiting kcals.[43,57,101] This is a foundational belief to DWCB, which may precipitate their emergence.[24,44,101] Few understand a fundamental sports nutrition maxim: "Food should be thought of as the fuel for sport, not as something to be afraid of or avoided."[24] Rosenbloom (2002) acknowledges that tennis players are among that group of athletes that would benefit from "targeted messages" about consuming enough kcals.[44] Authors have also identified that a large proportion of athletes (a) believe they need greater amount of protein than recommended, (b) do not know the correct recommendations for macronutrients, and (c) have multiple misconceptions of weight loss.[27,39,42,100,102,103]

Misguided mindsets such as this ultimately leads to a deficient macronutrient intake, especially carbohydrate, the primary energy source.[24,37,46,57] These fallible beliefs and behaviors have consequences, including the lack of energy for optimal performance previously described.[19,57] Thornton (2008) summarizes this well:

> These athletes think that by restricting their food to lose weight, they will exercise better, look better and enhance their overall performance. Ironically, restricting food in an attempt to improve performance can actually result in depleted fuel stores,muscle wasting, stress fractures, fainting, weakness, fatigue and eventually, impaired performance. Some athletes may manage to exercise well for a while without an obvious decline in performance. But . . . lack of energy will eventually catch up with them.[57]

With such misunderstanding and the impending dangerous consequences, it is important to identify the source of athletes' knowledge and misinformation.

2.6 Coaches' Knowledge

The most cited sources of athletes' nutrition knowledge are their respective coaches and afore-mentioned media, both of which disseminate incorrect nutrition information. [1,18,19,24,37-43] Nutrition misinformation can be traced back to the ancient Greeks who purported that eating the meat of animals regarded as strong and quick would pass on these same traits to anyone who consumed them.[37] These outlandish thoughts were passed on from generation to generation. Unfortunately, such transmission continues today between coaches and athletes, which can lead to very real health consequences previously described.[41]

2.6.1 College Coaches

It is important to note most research of coaches' nutrition knowledge has been done on college coaches, with considerably less on high school coaches, and none on middle school (i.e. adolescents) coaches. A major assumption is that, in general, college coaches of any given sport possess more sports nutrition knowledge than high school (and middle school) counterpart; so, if a college coach lacks knowledge on a given topic, than it is likely that a high school coach does as well. Unless otherwise stated, when citing data, it is that of college coaches, which is used as the reference norms.

Also, similar to that of athletes' nutrition knowledge research, no known research explores coaches' knowledge from a specific sport (e.g. tennis coaches' knowledge or soccer coaches' knowledge). Thus, for this dissertation, the data reported on college coaches provided the basis for what to assess of high school coaches of a specific sport, tennis. Since DE is a potential reality of tennis (a Lean-Emphasized Sport), players that high school coaches "inherit" fresh from or in the midst of adolescence's influence, it was imperative to investigate their knowledge of DE.

At the core of this research problem is the well documented reality that, overall, coaches of various sports and experience levels have limited basic and sports nutrition knowledge.[27,29,39,41,43,44,48] Most certainly don't have requisite knowledge or training to appropriately guide athletes in dietary intake and weight managment.[27,29,39,41,43,44,48] A majority of coaches are unaware of their appropriate scope of practice, often overstepping boundaries of their training and education.[7,42,47,48] Yet, the same research illustrates they are confident in the information they provide, which can perpetuate the transmission of incorrect nutrition counsel to respective athletes. This phenomenon of "blind leading the blind" persists, which creates the very real threat of dangerous health consequences from misinformation.[1,2,7,42,47]

This phenomenon has received considerable attention and criticism.[42,47,48] Perhaps, the most clear reaction to this problem manifests as the title Justine Reel's and Nick Gali's (2013) article: "Should Coaches Serve as the 'Weight Police' for Athletes?"[42] Their AND supported opposition compelled them to beseech ". . . when did coaches become expert dietitians?"[42] A primary purported reason for unfounded weight loss recommendations by coaches is related to their lack of knowledge; they, unfortunately, believe they are providing helpful, factual information.[41,47,48] For example, a majority of coaches don't have the training, education, and or credentials (e.g. Registered Dietitian) in all the factors of weight management and, so are not qualified, to determine individual nutritional needs (e.g. kcals).[41,42,47] A popular mistake is to recommend and/or support unfounded, "cookie-cutter," low kcal intakes coupled with exercise.[41,42,47] This is a dangerous irony as athletes are among the most calorically demanding populations.[26,37,97,98]

In 1999, Bickford reported a relatively new finding: "coaches are the single most blamed source of eating disorders in the athlete population."[19] Since then, no authors have refuted this, but only confirmed support for the blame.[19,41,42,45] For example, more than a "guilty by association" verdict, the coaches are in a very influential position, often more than that of a parent.[42,45] Those athlete characteristics (e.g. competitive and perfectionist) associated with

emergence of disordered eating have also been positively correlated with the "good" athletes (e.g. pursues excellence, doesn't give up, etc.) who unquestionably obey and listen to a coach.[5,104,105] This could elicit dire consequences since it is well established that a common coaching practice is the encouragement of dieting and weight loss.[19,41,42,48,104,105] Not only is this beyond any coach's scope of practice and professional training, weight loss recommendations are the most cited misguided information linked to body dissatisfaction, the previously presented catalyst to DE.[2,6,7,11,19,62,63] It has been purported that an ill-advised weight loss comment is all it takes for DE to take root as an athlete vows not to let the coach and/or team down.[5,42,104,105]

2.6.2 Educational Background

So, with the established lack of sports nutrition and weight management physiology knowledge, it is natural to seek the root of this problem. The search begins with the sources of coaches' knowledge or the lack of it. First, coaches' overwhelmingly cite that their sources of nutrition knowledge are other coaches, the media, and past experience of being an athlete all of which have previously being identified as not having accurate nutrition infor-mation.[11,32,41,48,105,106] Also note that very little cite a nutrition college course or equivalent formal nutrition education as a source.[11,32,41,43,48,105] How can this be the norm rather than the exception for individuals who are working with the adolescent population, so at risk for DE?

2.6.2.1 Education requirements – United States versus International.

American coaches simply aren't required to acquire education in basic nutrition let alone sports nutrition, weight management, or DE.[19,43,48,107] This is a stark difference compared to other countries. Countries such as the United Kingdom and Australia possess National Governing Bodies of Sport (NGBS).[19,43,48,107] These are beyond this review's scope as the United States does not have an NGBS. However, it is important to note that an NGBS's primary responsibility is the establishment of minimum coaching education requirements and regulation of satisfying them for respective country. Translation: you cannot become a coach without going through them. In contrast, the United States has no universal educational requirements for a coach at any level (i.e.

college, high school, or middle school).[19,43,48,107] Any requirements are left to the discretion of the individual hiring personnel and/or organization. This creates a system of requirements that are as variable as the number of coaching positions.

More specifically, most collegiate and high school positions have minimum requirements that are determined by the institution or the state (e.g. teaching license). Yet, they vary, and very seldom require nutrition education of any kind. The prevailing mindset is if you have played the sport and you have a college degree, than you are qualified to be a coach. For example, while U.S. colleges and universities usually require at least a bachelor's degree, most don't specifically mandate that the degree(s) must be in a certain discipline (e.g. nutrition or physiology).[19] Therefore, at best, coaches might have had one course in nutrition, which isn't sufficient considering the scope and breadth of adolescent nutritional needs and DE.[19,43] A study by Shifflet, Timm and Kahanov (2002) revealed that 37% of the 68 National College Athletic Association (NCAA) college coaches surveyed had never had a basic nutrition course at any time during college education.[27] Further, the average score on their basic nutrition assessment was 64%, below what is usually considered passing (70%+) in a college course.[98,108,109] This mirrors similar findings, which range from 33% to 70%.[98,108,109]

Unfortunately, the information presented above is not any better for high school coaches.[3] So, as discussed, one can expect that a coach who is not educated in basic nutrition, let alone sports nutrition or DE, will be a danger to a population at high risk for DE. Thus, when looking into prevention and intervention of DE, an obvious approach would be to change the system. However, an overhaul on who and what is qualified in the eyes of academic institutions is not practical.

2.7 Scope of Practice

It is just as important for coaches to know what they are not qualified to do either through training, credentialing and/or education, as it is for what they can do. Of significant interest entails weight loss (e.g. recommendations and body composition assessments) and dietary intake

recommendations (e.g. kcal restriction).[19,42,110] Reel and Galli (2013) assert that "Decisions on who is 'overweight' or who needs to gain weight should be made with (by) trained professionals such as registered dietitians."[42] Yet, the common practice of coach recommended weight loss ultimately demonstrates coaches are not knowledgeable about their roles and responsibilities (i.e. scope of practice).[19,41,42,110]

In light of the presented problem, it is imperative that coaches understand the prevention and treatment of DE, including their scope of practice as well as that of other personnel. This section explores the roles and responsibilities of coaches and dietitians in the most current DE treatment and prevention measures. However, before delving in, it would be irresponsible to not first acknowledge Lynn Thornton's (2004) words of caution:

> Parents, teachers, coaches, fitness instructors and health educators do not cause, cannot control, and cannot cure eating disorders. But they *can* contribute either negatively by allowing life threatening maladaptive behavior to continue or positively by detecting and referring eating disordered individuals to qualified health professionals.[57]

2.7.1 Coaches' Roles

The coach construct can be traced back to ancient days when a primary need was the transmission of survival skills from one generation to the next.[79] While passing on knowledge remains an enduring hallmark of the coaching profession, many needs and, thus, types of coaches have since emerged.[79] The most prevalent, and pertinent, type is that of youth sports.[79] The most recent data from the National Council of Youth Sports (NCYS) (2008), affirms the number of youth (6-18) athletes has increased by approximately 15 million from 1997 (45 million) to 2008 (60 million). As of 2008, 31% of the 60 million (1,860,000) was adolescent (10-15 years) females.[28] Furthermore, the reported number of coaches was 2.4 million and expected to increase.[28,79] As these statistics are only reported for coaches and athletes who are members of the NCYS, these figures underrepresent the true number. Nonetheless, the message is clear: there is a large number of coaches working with a population highly vulnerable to DE, adolescents.

Compounding the problem is the previously presented reality that a vast majority of older athletes lack knowledge of basic nutrition let alone DE.[27,39-41,43,44,46,79]

This relates to two frequently cited roles of coaches: (1) an educator and (2) a role model.[7,18,19,42,57] First, "A coach's role is to teach athletes how to perform best in their particular sport."[42] It is well established that optimal nutrition maximizes sports performance.[26] However, basic nutrition and related physiology principles are not standard middle or high school curriculum; this knowledge is typically only obtained through electives, assuming it is even offered. The knowledge of greatest need among adolescents include healthy eating, physical activity, and body acceptance.[57] So, the transmission, ironically, is dependent on individuals who are not knowledgeable of such topics.[3,42,43,48,57]

Second, "A coach can also serve as a positive role model for adolescent female athletes."[18] potential highly influential member of an athlete's peer group, a coach is a model of behaviors and attitudes, positive or negative.[7,18,42,45] Thus, if a coach has inappropriate, misguided views of weight management, then there is a great risk of the athlete mimicking them.[7,41,45] This mimicking is especially likely for individuals (e.g. female athletes) who feel modeling such actions and views are positively linked to their athletic success.[7,19,45,57]

Moreover, authors have contended that a coach's influence may be as powerful as that of an athlete's parent(s).[7,19,45,57] Further, it has been theorized that due to a coach's position of power and frequency of contact, athletes rely on counsel from coaches more than anyone else including coaches.[19,45] For example,

> Very often in college athletics the coaches play the role of "in loco parentis", that is they substitute the roles of parent and teacher for student athletes. In this role of authority a coach generally has a great deal of influence on the athletes and increasing their knowledge of eating disorders seems to be a logical step in prevention of eating disorders. Coaches are in a position to play a primary role in the prevention and management of clinical or non-clinical eating disorders.[19]

2.7.2 Coaches' Responsibilities

Thus, given that coaches lack knowledge and are highly influential, the literature agrees on two primary responsibilities of coaches. They must (1) acquire sports nutrition knowledge and (2) play a unique role in prevention.[19,40,41,43,48,50,52] First, most authors who identify coaches' lack of knowledge simultaneously implore that coaches receive requisite education in sports nutrition and DE.[19,26,40,41,43,48,50,52] The AND specifies that individuals age 13 – 18 require accurate sports nutrition, safe weight management practices, and eating disorders and "it is important to educate coaches. . . regarding these topics . . . (Steen, 1996)."[57]

Second, a general consensus is that DE prevention efforts must begin as young as possible, during if not before adolescence.[2,19,52,57] Coaches serve as major players in preventative efforts.[19,57] Since adolescent athletes are vulnerable to DE, coaches are in the front lines in the battle against DE development.[2,19,57] The frequency of coaching contact (i.e. multiple, daily practices) alone places them in an ideal position to identify symptoms of current or soon to be DWCB that can manifest as a diagnosed eating disorder.[2,19,57]

Also, the commonly touted "key to prevention", is education, which is a previously identified role of coaches.[19,52,57] The primary focus should be on dispelling sports nutrition and weight management myths and misconceptions such as those transmitted through the media as previously described.[40,57] Further, weeds must be removed before a garden can be planted; that is, one must be clear on basic nutrition before understanding more complex disciplines.

2.7.3 Scope of Practice: RDs vs. Coaches

It is also a responsibility of coaches to be educated on the roles and responsibilities of others. Registered Dietitians (RDs) are regarded as authorities on nutrition and weight management. They earn their credential only after completing a universal curriculum and comprehensive exam mandated by the AND. While RDs are not the focus (e.g. subjects) of this research, a brief overview of their scope of practice is necessary as coaches' knowledge of it will be assessed. First and foremost, under no circumstances, should a coach attempt to treat or

diagnose an eating disorder; any suspected cases should be referred to an RD or other qualified health professional.[19,41,42,48]

Unfortunately, it is not common practice as a coach is not familiar with his/her role, an RD is not accessible (e.g. not on staff) or a combination of both.[19,42] (Dissert 1). For example, Glover (2006) reported that more than ½ of the surveyed coaches (N=125) intervened in identified eating disorders and only 4% referred them to an RD.[19] Next, unless a coach is an RD, than an RD is the ideal nutrition educator for any population, no matter how much nutrition knowledge the coach has obtained.[19,41,42,44,57,111] Moreover, RDs should provide education to coaches whenever and however possible.[44,111]

2.8 Theoretical Framework

This final section addresses "A major stumbling block in the advancement of coach education literature," the limited use of theory."[33,112] Before continuing, it is important to acknowledge that no one theory can explain away the multifaceted phenomenon of DE. The use of a theory, however, is still useful for purposes of prediction and objectively comparing variables.[113] To these ends, this dissertation's framework was based on assertions of Albert Bandura's Social Cognitive Theory (SCT). Not only does its core constructs correlate with information previously presented (e.g. lack of knowledge and role models), the SCT has been associated with the "most promising long-term results" of DE prevention endeavors.[3] An overview of this theory and how the specific constructs of *Behavioral Capability*, *Observational Learning*, and *Situation* relate to the presented problem and purpose follows.

2.8.1 Social Cognitive Theory Defined

The SCT operates on the premise that reciprocal determinism shapes one's behavior. This is the term for Bandura's contention that human behavior is continually regulated by the interplay between personal factors (e.g. competitive), behavior (e.g. kcal restriction), and the environment (e.g. pressures from a coach to lose weight).[114] As the hallmark of SCT, the term reciprocal determinism implies that a change in one of these elements will modify the other two. Moreover,

the following constructs affect the changes in these elements: reinforcement, outcome expectations, outcome expectancies, self-efficacy, self-control (i.e. locus of control), emotional arousal, behavioral capability, observational learning (e.g. modeling), and situation.[114]

2.8.2 Core Constructs

The latter trio are directly related to this dissertation. First, Hayden (2009) provides an excellent description of behavioral capability.

> . . . if people are to perform a certain behavior (i.e. be a role model of appropriate eating behaviors and attitudes), they must have knowledge of the behavior and the skills to perform it. Simply put, before doing something, you have to know what it is you're going to do and know how to do it.[114]

In other words, coaches cannot be expected to deliver sports nutrition and the like if they do not have the appropriate education or training. Behavioral capability provides the rationale for the knowledge assessment (i.e. NET Survey) that was employed in this study. Treatment interventions for DE among LES (e.g. tennis) cannot be designed without identifying specifically what those most closely connected to adolescents, high school coaches (versus college coaches), know.

Second, observational learning refers to the process whereby people learn by watching another demonstrate behaviors or beliefs through actions and/or speech.[114] Modeling is a natural component of the human experience; basic tasks like walking and eating are traditionally learned by observing the actions and beliefs of parents, the typical first model. Moreover, it has been suggested that role models play a vital role in body image development.[7,18] So, considering a coach's role as a role model, it is imperative that they demonstrate positive behaviors such as consuming enough kcals and carbohydrates as well as avoiding weight monitoring and the comparison of athletes' bodies (types and weight).[6,18,42,115] Unfortunately, the modeling of appropriate body image and weight management is rare in this population.[7,42,115]

Moreover, the SCT contends that learning only occurs if the observer successfully progresses through four stages: attention, retention, reproduction, and motivation.[114] The attention

stage sets the tone for what is ultimately learned; if one doesn't pick up all the pertinent information (e.g. kcal restriction in *any* form has consequences) or pays attention to wrong information (e.g. while harmful, kcal restriction does lead to weight loss), then appropriate learning is diminished or thwarted.[114] Retention is synonymous with the storage of information; all details to be learned must be modeled in a way to maximize retention.[114] Likewise, for reproduction, the learner must be practiced in a way (e.g. appropriate amount of time) that allows learning to improve.[114]

The first three stages are futile if the learner has no incentive to begin or persist in learning from the model, which involves the fourth stage, motivation. For example, as established, an irrational fear of food is a hallmark of eating disorders; the motivation to avoid energy intake and weight gain at all costs is likely to be higher than a motivation to mimic a model. Similarly, if the motivation to "win at all costs" is greater than taking care of one's health, than any modeling of appropriate eating habits will be ignored by an athlete.

This relates to situation, which refers to the individual's perception (incorrect or correct) of the environment.[114] It can be applied to their interpretation of information presented to them. If the observer perceives that he or she already knows the information (i.e. "I already know nutrition" or "I know because I used to be an athlete" mentality), then learning will not be pursued. For example, coaches of a variety of college sports at a Division I University perceived they had the correct knowledge and skills to impart nutrition knowledge.[41] Yet the data revealed that while each coach felt adequately prepared to disseminate "basic sports nutrition," only 16 of the 177 (9%) demonstrated this through performance on written questionnaire.[41] Thus, situation was the primary rationale for a component of survey where coaches reported the level of confidence in their answers. Chapter 3 delineates this survey as well as the other pertinent details of the methods.

CHAPTER THREE: METHODOLOGY

3.1 Methodology

All components (e.g. Instruments, Data Analysis, etc.) of the methodology described in this chapter were approved by the Indiana University – Purdue University, Indianapolis (IUPUI) International Review Board (IRB). They are described in the following sections (1) Participants, (2) Instruments, (3) Data Collection, and (4) Data Analysis.

3.2 Participants

The population for this study was all varsity and junior varsity head and assistant high school tennis coaches in Indiana during the 2014 – 2016 year that the researcher had confirmed emails at the time of study through respective school website and/or athletic department personnel (e.g. athletic director). That number emerged as 338. The participants included all those coaches who respond to survey via emails obtained as previously described. Seventy-nine (79) completed every question, which corresponds to a 23% rate of return. According to Table 3 – 1 (Israel, G. D. 1992), 78 to 187 completed surveys were needed to achieve significant statistical power of 90% to 95%, respectively, for a population of 350. As previously presented, the population size was 338; thus, the 79 completed surveys met the criterion for 90% statistical power (i.e. 10% precision level).

TABLE 3 – 1. Sample Size Required for Precision Level

Size of Population	**Sample Size (n) Needed for Precision Level:**		
	5%	**7%**	**10%**
100	81	67	51
150	110	86	61
200	134	101	67
250	154	112	72
300	172	121	76
325	180	125	77
350	187	129	78

Israel, G. D. (1992). Determining sample size 'Program Evaluation and Organizational Development. IFAS, University of Florida, PEOD-5.{Israel, 1992 #64}

The 2014-2015 Indiana High School Athletic Association (IHSAA) School Directory served as the official reference for all Indiana High Schools that have tennis programs. This vital document also provided names and emails for athletic department personnel (e.g. Athletic Directors) when needed. Respective coaches' emails were acquired from the respective school's website and/or school's athletic department (e.g. Athletic Director) at least a month before sending out the survey. In instances where a coach and/or coach's email could not be identified, the survey link was sent to respective athletic department personnel (e.g. athletic director) in hopes he/she would forward to appropriate coach.

Participation was voluntary. If a participant did not complete and submit the survey after two attempts, the researcher presumed he/she declined to participate. To encourage participation, the following incentive was offered to any coach who completed the survey: one entry into a drawing for one of 20 Amazon.com gift cards. At the conclusion of the survey, the respondent was instructed to submit an email address where an electronic gift card could be emailed if randomly selected as a winner.

To participate, each coach provided informed consent prior to taking the survey by clicking on the button that he/she agreed to participate in this research. Clicking "Yes, I agree" served as an electronic signature that he/she understood that his/her participation is 100% voluntary and may stop at any time.

3.3 Instruments

At time of survey distribution, no known validated questionnaire designed specifically to assess *high school tennis* coaches' knowledge of DE existed. However, one has been designed by Zemke (2008) for high school wrestling coaches entitled *Wrestlers, Coaches and Parents Eating Disorders and Sport Nutrition Knowledge Questionnaire*.[3] While there was not enough strength for any other type of validity other than face, it is still a reasonable model since, like wrestlers, tennis players face potential consequences of LES (e.g. inappropriate weight loss in order to improve performance). Therefore, the participants were given one instrument entitled the

Nutrition & Eating Disorders in Tennis (NET) Survey. The NET Survey is an amalgamation of 12 questions from the Zemke survey and 15 original questions for a total of 27. It must be noted that the original questions were created to represent the pertinent key topics of interest from the literature review. Where appropriate, minor changes were made to the 12 questions previously employed by Zemke. It is also important to note that the 12 questions "borrowed" from Zemke's questionnaire originally appeared in Turk et al.'s (1999) instrument entitled *Five Domains of Eating Disorders: A Survey for Collegiate Coaches*.[3,116] Permission was also granted to use, in whole or part, the instrument employed by Turk et al. (1999).

The NET Survey was ultimately designed to assess high school tennis coaches' knowledge of DE and related nutrition principles (Appendix B). It consists of three parts: (I) Tennis Coach Demographic Background, (II) Tennis Coaches' Knowledge, (III) Tennis Coach Behavior. The former part consists of 14 questions regarding a coach's demographics (e.g. gender, experience). Part II consists of the 25 afore-mentioned questions. The questions in Part II are equally divided into 5 sections based on distinct domains of knowledge that they are designed to assess. (Again, domains mirror key topics from the literature review). Thus, there are five questions for each of the following DE related domains: (1) Macronutrients and Energy, (2), Etiology, (3) Identifying Signs and Symptoms, (4) Tennis Coaches' Scope of Practice, and (5) Treatment and Prevention. Finally, Part III consists of two open ended questions designed to get insight into a coach's behavior regarding disordered eating and nutrition.

For Part II, the questions are a mix of "True / False" questions and Multiple Choice questions. Statistics will be calculated regarding how many select the correct answer and the variance of those who do not. To limit the appearance of taking a test, the traditional True and False terms are replaced with "Yes, Agree" and "No, Disagree," respectively. Next, coaches indicated their confidence in the correctness of their response to each statement using the same 4-

point Likert scale (1 = Not At All Sure, 2 = Not Very Sure, 3= Somewhat Sure, 4 = Very Sure) originally employed by Turk et al. (1999) and later by Zemke (2008).[3,116]

3.3.1 Expert Panel

A panel of 7 experts in the relevant disciplines (e.g. macronutrients, DE) evaluated the content and face validity for all "borrowed" and original questions of Part II. The former refers to the extent to which a measure represents all facets of a given construct (i.e. topic). So, the review process required each panelist to identify the fundamental facets of the topics represented by each domain (e.g. Macronutrients). Next, the panelists evaluated the degree to which the five questions from respective domain represent the identified facets in terms of percentage. In order to be deemed to have content validity, each domain must have achieved, at minimum, a 75% alignment of questions to identified facets. All domains achieved this criteria. For example, all five questions (100%) in Domain #1 aligned to what panelist identified as key facets.

Last, the panelists provided feedback on face validity, the match between test questions and the domain ("content") they are intended to assess. Each member was asked to select "No Modification Needed," "Keep with Modifications" OR "Delete" for all questions. If at least half of the panel members select "No Modifications Needed" or "Keep with Modifications," for a question, then it officially became part of the survey. All questions presented to them were included as part of the survey. Grammar and readability edits were made on some multiple choice (Part II) and both of the Open-Ended (Part III) questions.

Members of the panel (9) included professionals who represent the domains of the NET Survey. RDs, experts in eating disorders, a tennis teaching professional, members of USTA's Sports Science Committee, and tenure track professors in pertinent discipline (e.g. nutrition, child development, and physiology) comprised the panel . A letter (Appendix A) along with the NET Survey was emailed to individuals who were deemed experts in at least 2 of the 5 domains of the NET Survey. Ultimately, the panel assessed the content and face validity for each question in PART II and III. The target readability level was between 7th and 9th grade, which mirrors past

research and recommendations.[3] The widely accepted Flesch-Kincaid Grade Level test was used as the official determinant of reading level. The NET Survey that was emailed to the panel and participants received scores of 7.6 and 7.7, respectively, which represents a 7th grade reading level.

3.3.2 Pilot Study

A pilot study followed the creation of the official panel approved NET Survey. A variable, convenience sample of 7 coaches were asked to complete the survey to detect any type of errors. Like the panel recruiting process, the participation in the pilot study was voluntary; each agreed to the Informed Consent form and took the NET survey electronically. Ultimately, the goals of the pilot study were to unearth any questions or issues with the directions, survey, and general administration of the survey through Qualtrics, a private research software company based in Provo, Utah.

The pilot study did not unearth any needed changes. Thus, the survey was scheduled to be sent via Qualtrics. The initial distribution of the survey was sent with an explanation of overall purpose, details of how to complete, and an electronically presented informed consent form. The initial distribution of the survey was sent during the regular season as this was deemed the time where a coach would be most likely to be actively checking emails and willing to complete survey. Two follow-up reminder emails were sent one and two weeks after the initial distribution of survey. All emails were sent before tennis tournament season (e.g. Sectionals) or summer break. This time frame was deemed the least busy for any coaches who were currently in season, and, thus most likely to participate.

After a coach submitted a completed survey, he/she received a thank-you message and invitation to participate in random drawing for the Amazon.com gift cards previously described. Sixty-eight (68) of the 79 survey completers submitted an email, which were placed in alphabetical order. A website was used to randomly generate a number between 1 – 68, with the

number representing the position in the alphabetized list (i.e. the first and last email in list were #1 and #68, respectively).

3.4 Data Collection and Scoring

The most current version of Qualtrics was employed to administer the NET Survey as well as collect data from each individual submission. Data from Qualtrics was originally obtained as a Comma Separated Variable (CSV) file. It was converted to a Microsoft Excel spreadsheet for statistical analysis and export to Statistical Package for the Social Sciences (SPSS) for the same purpose. For security, the data was only accessed by the author. The data was coded and/or scored as necessary for data analyses.

3.4.1 NET Survey Part I Scoring

For Part I (e.g. Demographics), there were no scores, per say. Various descriptive statistics were performed on all data from Part I and are reported in Chapter 4. Some responses required special coding before statistical analyses were possible. Yes (e.g. Yes, a head coach) responses were coded as 1, with the counterpart as 2. The following data was of this nature: *Head Coach, Assistant Coach, Licensed Teacher*, *Coach's Gender* and *Team Gender*.

Moreover, other variables were categorized in manageable, related groups. Similar to Torres-McGehee, Pritchett, Zippel, Minton, Cellamare, and Sibilia, (2012), age, team gender, education, and number of years coaching were placed in three groups. These variables were coded as follows: *Age* (1 for 24 – 39 years, 2 for 40 – 49 years, and 3 for 50 years and over), *Team Gender* (1 for only boys team, 2 for only girls team, and 3 for both boys and girls team) *Years Coaching High School Tennis* (1 for 1-5, 2 for 6-10, and 3 for 11 or more) and *Education* (1 for High School Diploma, 2 for Bachelor's Degree, 3 for Graduate Degree.) The few who selected "Some College" were logically placed in the group High School Diploma as the highest level of education received.

Descriptive statistics of *Geographic Location*, *Competitive Experience*, *Source of Nutrition Knowledge*, and *School Size* were calculated to create a more complete profile of the

coaches' background. For the former, the counties represented were organized and coded into 6 distinct Indiana regions: Northwest, Northeast, West Central, East Central, Southeast, and Southwest Indiana. The latter was coded into just two categories: 1 for 1-3A (*Small Schools*) and 2 for 4-5A (*Big Schools*).

3.4.2 NET Survey Part II Scoring

Part II is comprised of two distinct types of questions: Multiple Choice (#1-5) and Yes/No (#6-25) that had previously described accompanying *confidence in response* questions, which yielded six types of scores labeled (a), (b), (c), (d), (e), and (f) as detailed below. Before scores could be calculated, all responses had to be coded as follows: 1 for correct answers and 0 for incorrect answers. It must be noted that one question was inadvertently repeated, which led to one question not being asked despite the efforts of pilot study to detect any errors.

First, Score (a), is an *individual's* overall total of correct and incorrect answers (e.g. total percent correct of 24 questions). Likewise, Score (b) is an *individual's* total of correct and incorrect responses (e.g. percent correct) for *each domain*. Thus, with five domains, each participant has five scores of this nature. The unintentionally omitted question was to be part of Domain 5.

So, for the first four domains (Macronutrients and Energy, Etiology, Identifying Signs and Symptoms, and Tennis Coaches' Scope of Practice), the possible scores were 0%, 20%, 40%, 60%, 80% or 100% (# correct divided by 5 questions). For the last domain (Treatment and Prevention), the possible score of percent correct was 0%, 25%, 50%, 75%, or 100% (# correct divided by 4 questions). A score of 80% and 75% served as the criterion scores to represent adequate knowledge of domains 1-4 and 5, respectively, which is similar to criteria used by previous authors such as Torres-McGehee, et al. (2012). (For overall knowledge, 80% was the minimum threshold necessary to qualify as adequate knowledge.)

The final calculated *individual* total score was Score (c), which is a participant's Confidence score (e.g. Not At All Sure to Very Sure) on each question. As previously presented,

the coaches were requested to identify their confidence in the correctness of their answers using the following 4-point Likert Scale: (1 = Not At All Sure, 2 = Not Very Sure, 3= Somewhat Sure, 4 = Very Sure). Considering the inadvertently omitted question, each coach received a confidence score of 1, 2, 3, or 4 on 24 questions.

Scores (a), (b), and (c) were needed to calculate scores (d) – (f). This final trio of scores were vital for addressing the research questions (i.e. research and null hypotheses). Score (d) is the *average* of all coaches' total score on NET Survey (i.e. total percent correct of 24 questions), Score (e) represents the *average* correct responses *per domain*. And Score (f) is the average confidence responses *per domain*. The former was needed to address research questions 1 (overall knowledge) and 5 (behavior and knowledge). Score (e) was used for research question 2 (disordered eating knowledge), 3 (macronutrient knowledge) and 5. Score (f) was necessary for answering research question 4 (confidence of knowledge). A mean confidence score (i.e. Score f) of three or higher was labeled as *Confident*, while less than three equates to *Not Confident*. Confidence scores were calculated for a variety of demographic variables and differentiated between those who answered questions correctly and incorrectly. The term *Overall Confidence* was given to the combined average of confident scores on correctly and incorrectly answered questions. Scores (d), (e), and (f) are presented in tables with further description in Chapter 4.

3.4.3 NET Survey Part III Scoring

Responses to Part III questions (i.e. 2 open ended questions) were scored in two ways. There were four possible concepts to address for each of the two Scenario style, open ended questions. Both Scenario 1 and 2 assess knowledge of the following 3 concepts: Caloric intake, carbohydrate intake, and appropriate scope of practice. Scenario 1 and 2 also address a unique concept, protein intake and body image, respectively. A score of 1 (Yes) or 0 (No) was assigned to each concept choice upon evaluation of overall response. In order to earn a 1, the coach must have specifically addressed the respective concept correctly. A 2 signifies that the response was

incorrect in regards to the specific concept or not addressed at all. Thus, each coach received a score out of eight (i.e. 2 scenario questions times four).

Second, the responses were qualitatively analyzed for any themes. All responses were "scored" in terms of frequency of response, which were transformed to themes. If at least 10% of the participants conveyed the same sentiment, it was recorded as a *Common Theme*. The monikers *Major* and *Prevailing* theme were applied to any theme that appeared in at least 25% and 50%, respectively, of the participants' responses.

3.5 Data Analysis

Microsoft Excel and SPSS for Windows (23.0 Edition; SPSS Inc., Chicago, Il., USA) were the statistical analysis tools. A variety of statistical procedures were employed to address the five research questions. Frequencies, modes and means were calculated for the demographic variables, which was needed for Research Question 1. Likewise, these same descriptive statistics were performed on Part II knowledge scores, which was necessary to address all five research questions. Moreover, a three – way analysis of variance (ANOVA) and Spearman's correlation were done for Research Question 1 and 5, respectively. The α level was set at .05 for all analyses. Data from all parts of NET Survey were needed to accept or reject the null hypotheses.

3.5.1 Research Questions

1. What are the differences, if any, between Indiana high school tennis coaches' demographic variables and assessed knowledge?
2. What is the extent of Indiana high school tennis coaches' knowledge of disordered eating?
3. What is the extent of Indiana high school tennis coaches' knowledge of macronutrients?
4. What is level of confidence in Indiana high school tennis coaches' knowledge of disordered eating and macronutrients?
5. What is the relationship between Indiana high school tennis coaches' behavior and knowledge?

3.5.2 Part I of NET Survey Analysis

Various descriptive statistics were calculated for all demographic data from Part I of NET Survey. All research questions involved evaluating results across a variety of demographic variables. So, frequencies and means were calculated for participants' *Geographic Location*, *Competitive Background*, *Source of Nutrition Knowledge*, *School Size*, *Coach Type* (e.g. head, assistant or both), *Teaching License Status*, *Age*, *Coach's Gender*, *Education*, *Years Coaching High School Tennis* (i.e. Experience), and. *Team Gender Coached.*

3.5.2.1 Hypotheses Set #One.

Remember that these last three were the independent variables for Research Question 1. And, the first set of hypotheses involved identifying any significant differences between this variable trio and assessed knowledge. Assessed knowledge was operationally defined as the overall score mean, which served as the dependent variable. Thus, a three-way analysis of variance (ANOVA) was utilized to identify any significant differences between means of total knowledge scores (i.e. the DV) and a coach's education, coaching experience, and gender of team coached. A three-way ANOVA was used instead of multiple t-tests to minimize Type I error, a "false positive." SPSS was used to determine if the assumptions for ANOVA were met.

3.5.3 Part II of NET Survey Analysis

Knowledge scores from Part II analysis were also needed to answer the remaining four research questions. Frequencies, modes, and means were calculated for all Multiple Choice (#1-5) and Yes/No (#6-25) responses. The latter two were used to calculate score (a), each individual's overall total percent correct, (b), an individual's total percent correct *per domain*, and (c), an individual's Confidence score on each question, all previously described. Likewise, sums and averages were also used to calculate score (d), the *average* of all coaches' total score (i.e. percent correct), (e), *average* correct responses *per domain*, and (f), the average confidence responses *per*

domain. After calculation of scores (a) through (f) occurred, data analysis of Hypotheses Set 2 – 5 could occur.

3.5.3.1 Hypotheses Set #Two and Three.

As a review, these hypotheses sets involves identifying extent of Indiana high school tennis coaches' knowledge in respective domains. Thus, for Set Two (i.e. knowledge of DE), the coaches' average total number of correct responses were calculated for Domain 2 (Etiology), Domain 3 (Signs and Symptoms), and Domain 5 (Treatment and Prevention). Set Three analysis only required mean score of Domain 1 (Macronutrients). These calculations were compared to the criterion for adequate knowledge (e.g. 80%) to identify coaches' level of knowledge, labeled as performance scores. These domain specific performance scores were also totaled. SPSS's *Select Cases* option was used to average performance scores across a variety of coaching demographics. The same process was utilized for Hypotheses Set Three, which involved Domain 5 (Macronutrient and Energy).

3.5.3.2 Hypotheses Set #Four.

Recall that the fourth set involved identifying coaches' level of confidence in knowledge of DE (Domains 2, 3, and 5) and macronutrients and energy (Domain 1). Thus, the average confidence (versus performance) scores (i.e. 1, 2, 3, or 4), were calculated for the respective Domains. Likewise, *Select Cases* procedure was again used to attain averages for a variety of coaching demographics by domain and in total.

3.5.3.3. Hypotheses Set #Five.

Finally, the same calculations of average overall knowledge and average by domain was needed to address the fifth set. However, this research question also involved comparing such

knowledge to coaches' behavior. Behavior was operationally defined as the scores from Part III's open ended questions. A Spearman's correlation was performed on these variables.

3.5.4 Part III of NET Survey Statistics

The two open – ended questions were designed to garner responses related to the research questions. Recall, that there were two types of scores: (1) overall number of addressed concepts and (2) overall themes ranked by strength (i.e. frequency of response). So, first, frequencies and means of those who addressed the (a) Caloric intake, (b) carbohydrate intake, (c) scope of practice, (d) protein intake, and (e) body image concerns portrayed in the hypothetical scenarios were calculated. Since both open ended questions portrayed the first three, while protein intake and body image appeared in the first and second one, respectively, there were eight possible answers between the two questions. Thus, the percentage of eight answers (i.e. addressed concepts) for each coach as well as mean percentage for all coaches were calculated. In addition, the overall number of those who attempted to address these concepts was further divided into *addressed correctly* and *addressed incorrectly*. If the coach did not address a concept, it was presumed because he/she did not recognize it, a form of not knowing. Thus, not addressing a concept was included in the *addressed incorrectly* calculations.

Second, all responses were analyzed for common themes. This began with a review of individual responses for Scenario 1 and Scenario 2. Each statement was individually coded for overall concept conveyed. Repeated concepts were grouped together, which became a separate theme. Some statements had multiple codes, and thus, assigned to multiple themes. It is important to note that this process was done conservatively; only statements that clearly conveyed a theme were recorded. That is, there was no "reading into" responses. Next, each different type of category (i.e. theme) was assigned a rank based on the number of associated responses. So, percentages of total respondents per category were calculated. Any category comprised of at least

10% of respondents was further labeled a *Common Theme*. Finally, *Major Theme* and *Prevailing Theme* was applied to any theme expressed by, 25% and 50%, respectively, of the participants.

CHAPTER FOUR: RESULTS

4.1 Part I of the NET Survey Results

4.1.1 Gender, Age, and Coaching Experience

Descriptive statistics were calculated for each of the Indiana High School Tennis coaches. A majority of the 79 who completed the NET Survey were predominately male (77.2%, n=61) and serve as head coaches (86.1%, n=68). Moreover, 20.3% (n=16) were assistant coaches; it is important to note that some participants were both head and assistant coaches, which is reflected in percentage of assistant coaches (20.3%, n=16) that, when added to the percentage of head coaches, exceeds 100%. The median age was 48 years (n=7) with a mean age of 43.97 years (+/- 11.97). The oldest and youngest coaches were 71 years (n=2) and 24 years (n=2), respectively. For all participants, there are three relatively equal size age groups: 24-39 years (n=27), 40-49 years (n=28), and 50 years and over (n=24). Similarly, the number of years coaching tennis (i.e. experience) consists of three relatively equal size groups: 1-5 years (n=27), 6-10 years (n=26), and 11 or more years (n=26), with a mean of 3.19 years (+/- 1.50). Over half (n=42) had been coaching for 1-8 years. The highest reported number of years coaching was 40 years (n=1). Table 4 – 1 summarizes descriptive data for the coaches' age and total number of years coaching.

TABLE 4 – 1. Summary of NET Survey Part I Descriptive Statistics: Age and Years Coached

	N	Mean	Median	Mode(s)	S.D.	S.E.M.
Age (Years)	79	43.97	46.00	48	11.97	1.35
Years Coaching Tennis	79	10.30	8.00	2, 5, 8, 10	8.02	0.90

S.D. = Standard Deviation S.E.M. = Standard Error of the Mean

4.1.2 School Geographic Location and Size

Overall, the results reflect a balanced diversity among the participants. A total of 41 of the 92 Indiana counties were represented in this survey. Marion (n=10, 12.7%), Hendricks (n=4, 5.1%) and Allen (n=4, 5.1%) counties had the greatest number of participants from respective county. Of the 6 regions, East Central Indiana had the greatest number (n=23, 29.1%) of participants. As an important note, Indianapolis, which had the greatest number of tennis programs in the population, was part of this group. In contrast, those counties categorized as Southwest Indiana had the least number of participants (n=7, 8.9%). Table 4 – 2 presents a complete summary of the county descriptive data.

TABLE 4 – 2. Summary of Participating Counties Organized by 6 Indiana Regions

	Frequency in Total Sample (n=79)	Percent of Sample	Percent of County Participants
Northwest Indiana Counties			
Carroll	1	1.27	7.69
Jasper	1	1.27	7.69
Lake	3	3.80	23.08
Marshall	2	2.53	15.38
Newton	1	1.27	7.69
Porter	1	1.27	7.69
St. Joseph	3	3.80	23.08
White	1	1.27	7.69
County Totals	**13**	**16.5**	
Northeast Indiana Counties			
Adams	1	1.27	7.14
Allen	4	5.06	28.6
Dekalb	1	1.27	7.14
Elkhart	3	3.80	21.4
Grant	2	2.53	14.3
Noble	1	1.27	7.14
Steuben	1	1.27	7.14
Wells	1	1.27	7.14
County Totals	**14**	**17.7**	
West Central Indiana Counties			
Boone	2	2.53	15.4
Hendricks	4	5.06	30.8
Montgomery	2	2.53	15.4
Morgan	2	2.53	15.4
Tippecanoe	3	3.80	23.1
County Totals	**13**	**16.5**	
East Central Indiana Counties			
Delaware	2	2.53	8.70
Hamilton	1	1.27	4.35
Hancock	3	3.80	13.0
Henry	2	2.53	8.70
Johnson	1	1.27	4.35
Madison	2	2.53	8.70
Marion	10	12.66	43.5
Randolph	2	2.53	8.70
County Totals	**23**	**29.1**	
Southwest Indiana Counties			
Crawford	1	1.27	14.3
Greene	1	1.27	14.3
Monroe	1	1.27	14.3
Perry	1	1.27	14.3
Vanderburgh	3	3.80	42.9
County Totals	**7**	**8.9**	
Southeast Indiana Counties			
Clark	2	2.53	22.2
Dearborn	1	1.27	11.1
Decatur	1	1.27	11.1
Harrison	1	1.27	11.1
Jackson	1	1.27	11.1
Scott	1	1.27	11.1
Washington	2	2.53	22.2
County Totals	**9**	**11.4**	

Furthermore, all coaches reported the school size of their team. School size was operationally defined in terms of IHSAA criteria for Indiana Basketball Class 1A-5A designation. Class 1A refers to the smallest school while 5A is reserved for the largest counterpart at the other extreme. All school sizes were represented in this study. Class 4A (n=26, 32.9%) and 3A (n=22, 27.8%) had the greatest number of participating coaches. In contrast, the smallest (1A) and largest (5A) schools had the least quantity of representation at 3 (3.8%) and 9 (11.4%). Table 4 – 3 presents a complete summary of the participating coaches' school size.

TABLE 4 – 3. Summary of Participating Schools' Size

	N (%)	Mean	Median	Mode(s)	S.D.	S.E.M.
School Size						
Total Response	79	3.24	3.00	4 (4A)	1.065	0.120
1A (1)	3 (3.8)					
2A (2)	19 (24.1)					
3A (3)	22 (27.8)					
4A (4)	26 (32.9)					
5A (5)	9 (11.4)					

S.D. = Standard Deviation S.E.M. = Standard Error of the Mean

4.1.3 Background: Competitive Experience, Source of Nutrition Knowledge, Education and Licensure

Moreover, the coaches reported on a variety of variables pertaining to their knowledge base. A considerable majority (n=63, 79.7%) indicated a competitive background that, in theory, could be drawn upon (correctly or incorrectly) for knowledge of nutrition and/or DE. This notion is further supported by the finding that the majority of coaches (n=38, 48.1%) cited their *Experience as an Athlete* as the number one source of nutrition knowledge. In stark contrast, only one coach (1.3%) cited an RD, the authority on nutrition, as chief source of such knowledge. This is not a surprise in light of the literature review and the present study where only 6 coaches indicated that their respective school system had access to an RD.

A substantial majority (n=65, 82.3%) of participants possess a college degree. Of the 65, 35 (44.3%) hold at least a Bachelor's while 30 (38%) have also earned a graduate degree. None cited nutrition, let alone dietetics, as the degree discipline (i.e. "Major"). Only 2 majors (3.3%)

were related to nutrition. Note that this reported percent is of 60 as 5 did not provide their degree content. Education (n=15, 25.0%), Business (n=9, 15.0%) and Math (n=6, 10.0%) were the most frequently reported type of major. Thirty – three (41.8%) of the coaches have a teaching license and zero are an RD. These results of knowledge base provided interesting insight for Chapter 5 discussion of Part II knowledge scores. Table 4 – 4 summarizes the coaches' knowledge background.

TABLE 4 – 4. Summary of Coaches' Knowledge Background

	N	Percent of Sample
Competitive Experience		
Total Response	79	100
Professional (1)	0	0.0
College (2)	36	45.6
High School (3)	27	34.2
None of Above (4)	16	20.2
Source of Nutrition Knowledge		
Total Response	79	100
Fellow coach(es) (1)	5	6.3
College courses (2)	14	17.7
Experience as an athlete (3)	38	48.1
Strength/ Conditioning coach (4)	4	5.1
Registered Dietitian (5)	1	1.3
Media (6)	17	21.5
Highest Education Earned		
Total Response	79	100
High School Diploma (1)	14	17.7
Bachelor's Degree (2)	35	44.3
Graduate Degree (3)	30	38.0
Licensure		
Total Responses	79	79
Licensed Teacher	33	41.8
Registered Dietitian	0	0.0

4.2 Part II of the NET Survey Results: Overall Knowledge Scores

Coupled with results of Part I, those of Part II were used to address each of the five research questions and associated research and null hypotheses. This part of the survey consisted of 5 multiple choice questions and 19 Yes/No (i.e. True / False) statements designed to assess high school tennis coaches' knowledge of disordered eating and related nutrition concepts. The panel of experts confirmed that the NET Survey had both face and content validity. The mean score for all completed surveys (n = 79) was 17.01 out of 24. This average score equates to 70.9% ± 10.9% (Range = 46% – 92%). So, per the established criteria (i.e. 80%) for "adequate

knowledge," this data delineates that the surveyed Indiana high school tennis coaches lack the assessed knowledge. Moreover, the overall mean knowledge scores were analyzed across demographic variables. Table 4 – 5 summarizes this descriptive data.

TABLE 4 – 5. Mean Part II Overall Knowledge Scores (i.e. % Correct) Descriptive Statistics by Demographics

	[a]Overall Mean (%)	S.D. (%)	Median (%)	Mode (%)	Minimum/ Max. (%)	Variance (%)
Gender						
Male (n=61)	69.47	10.67	70.83	63	46 / 88	1.1
Female (n=18)	75.69	10.62	77.08	83	54 / 92	1.1
Coach Type						
Only Head Coach (n=63)	70.24	11.12	70.83	[b]63	46 / 92	1.2
Only Assistant (n=11)	75.76	8.90	75.00	[b]67	63 / 88	.8
Both types (n=5)	68.33	11.26	66.67	[b]54	54 / 83	1.3
Gender of Team						
Only Boys Team (n=12)	71.53	9.87	72.92	[b]63	54 / 83	1.0
Only Girls Team (n=33)	71.72	11.54	75.00	54	46 / 92	1.3
Coach both types (n=34)	69.85	10.86	68.75	[b]63	46 / 88	1.2
Teaching License						
Yes (n=33)	69.32	11.45	70.83	[b]67	46 / 92	1.3
No (n=46)	72.01	10.49	72.92	63	46 / 88	1.1
Highest Education Earned						
High School Diploma (n=14)	69.35	12.30	70.83	83	46 / 83	1.5
Bachelor's Degree (n=35)	72.98	9.71	75.00	75	46 / 88	.9
Graduate Degree (n=30)	69.17	11.51	66.67	67	46 / 92	1.3
Number of Years Coached						
1-5 (n=27)	75.93	9.27	75.00	[b]67	58 / 92	.9
6-10 (n=26)	68.11	10.40	66.67	63	46 / 83	1.1
11 or more (n=26)	68.43	11.50	70.83	75	46 / 88	1.3
School Size						
1A (n=3)	75.00	11.02	70.83	[b]67	67 / 88	1.2
2A (n=19)	69.96	13.00	70.83	63	46 / 88	1.7
3A (n=22)	70.45	9.35	68.75	67	58 / 92	.9
4A (n=26)	70.19	10.45	72.92	79	46 / 83	1.1
5A (n=9)	74.54	12.40	75.00	75	46 / 88	1.5

[a]Overall percent score was calculated by dividing total number correct by 24 questions.
[b]The smallest among multiple modes for this variable.
S.D. = Standard Deviation

Multiple trends can be gleaned from Table 4 – 5 data. First, none of the coaching categories (e.g. male, assistants, coach only a girls team, etc.) demonstrated adequate knowledge. The lowest mean score was for those who have 6-10 years of tennis coaching experience (68.1% ± 10.4%), closely followed by coaches of both genders (68.3% ± 11.3%) and the most experienced coaches (68.4% ± 11.5%). In contrast, the highest overall means emerged for coaches who have 1-5 years of tennis coaching experience (75.9% ± 9.3%), assistant coaches

(75.8% ± 8.9%), and female coaches (75.7% ± 10.62%). Other trends include college education not making a difference on score; in fact, coaches with a graduate degree had a lower average score (69.2% ± 11.5%) than those with high school diploma, (69.4% ±, 12.3%). Also, non-teaching licensed coaches scoring higher than licensed and relatively new coaches (i.e. 1-5 years of experience) scoring higher than more experienced coaches comprise other notable trends. These findings link to addressing the first research question.

4.2.1 Research Question 1 Hypotheses

To test research hypotheses 1, a three – way ANOVA was used to detect any significant difference between the mean Part II overall knowledge scores (DV) and the tennis coaches' education, experience, and the gender whom they coach (IVs). As required, the DV was continuous, the IVs were categorical with at least two groups, and the participants were independent from each other. SPSS was used to test for the remaining assumptions of an ANOVA: outliers, DV normality, and homogeneity of variance. First, there was only one significant outlier in boxplot, as defined by a value greater than 3 box-lengths from the edge of the box. Second, all test scores were normally distributed as assessed by Shapiro-Wilk's test of normality. Last, there was homogeneity of variances, as assessed by Levene's test for equality of variances, $p = .361$.

While there was no statistically significant three-way interaction between education, experience, and gender coached [$F(4, 56) = 1.176$, $p = .331$], statistical significance emerged in the pairwise comparisons. Simple pairwise comparisons were run each of the IVs with a Bonferroni adjustment applied. There was a statistically significant mean difference in test scores between the first (1-5 years) and second (6-10 years) group of coaching experience (95% CI, 0.010 to 0.150), $p = .027$, as well as first group and third (11 years or more) group (95% CI, 0.001 to 0.160), $p = .047$. However, there were no statistically significant differences among the groups

of coaches' education or the gender of team coached. Table 4 – 6 through 4 – 8 summarizes the pairwise comparison results.

TABLE 4 – 6. Summary of Level of Education Pairwise Comparison Results

(A)	(B)	[a]Mean Difference (A-B)	Standard Error	[b]Significance	[c]C.I. Lower Bound	[c]C.I. Upper Bound
HS Diploma	Bachelor Degree	-.028	.040	.487	-.108	.052
	Graduate Degree	.021	.041	.606	-.060	.102
Bachelor Degree	HS Diploma	.028	.040	.487	-.052	.108
	Graduate Degree	.049	.034	.159	-.020	.118
Graduate Degree	HS Diploma	-.021	.041	.606	-.102	.060
	Bachelor Degree	-.049	.034	.159	-.118	.020

[a]Based on estimated marginal means of modified population
[b]After Bonferroni adjustment applied
[c]C.I. = Confidence Interval of 95% for Difference

TABLE 4 – 7. Summary of Experience (i.e. number of years coaching tennis) Pairwise Comparison Results

(A)	(B)	[a]Mean Difference (A-B)	Standard Error	[b]Significance	[c]C.I. Lower Bound	[c]C.I. Upper Bound
1 – 5 Years	6 – 10 Years	.080	.035	.027	.010	.150
	11+ Years	.081	.040	.047	.001	.160
6 – 10 Years	1 – 5 Years	-.080	.035	.027	-.150	-.010
	11+ Years	.001	.036	.982	-.071	.072
11+ Years	1 – 5 Years	-.081	.040	.047	-.160	-.001
	6 – 10 Years	-.001	.036	.982	-.072	.071

[a]Based on estimated marginal means of modified population
[b]After Bonferroni adjustment applied
[c]C.I. = Confidence Interval of 95% for Difference

TABLE 4 – 8. Summary of Gender of Team Coached Pairwise Comparison Results

(A)	(B)	[a]Mean Difference (A-B)	Standard Error	[b]Significance	[c]C.I. Lower Bound	[c]C.I. Upper Bound
Boys Only	Girls Only	.012	.041	.778	-.070	.093
	Both Genders	.040	.041	.328	-.042	.123
Girls Only	Boys Only	-.012	.041	.778	-.093	.070
	Both Genders	.029	.032	.377	-.036	.094
Both Genders	Boys Only	-.040	.041	.328	-.123	.042
	Girls Only	-.029	.032	.377	-.094	.036

[a]Based on estimated marginal means of modified population
[b]After Bonferroni adjustment applied
[c]C.I. = Confidence Interval of 95% for Difference

Thus, results of the three-way ANOVA confirmed two null hypotheses and one research hypothesis for Research Question 1. Since there was no significant difference between Indiana high school tennis coaches' levels of education and assessed knowledge, Null Hypothesis 1a was

accepted as true and Research Hypothesis 1a was not upheld. Likewise, there was no significant difference between the gender of team coached and assessed knowledge; Null Hypothesis 1c was accepted as true while Research Hypothesis 1c was not upheld. In contrast, since there was a significant difference between tennis coaches' coaching experience and assessed knowledge, Research Hypothesis 1b was upheld and the associated null was rejected.

4.2.2 Part II of the NET Survey Results: Knowledge Scores by Domain

NET Survey Part II questions were divided among five domains: Macronutrients and Energy, Etiology, Identifying Signs and Symptoms, Scope of Practice, and Treatment and Prevention. The domain with the highest mean total score was Scope of Practice (89.6% ± 15.0%) followed by, in descending order, Etiology (82.8% ± 18.6%), Treatment and Prevention (63.6% ± 22.9%), Signs and Symptoms (60.0% ± 21.7%), and Macronutrients and Energy (57.0% ± 22.4%). These results contributed to addressing Research Question 2 and 3 and are presented in Table 4 – 9.

TABLE 4 – 9. [a]Mean Part II Overall Knowledge Scores (i.e. % Correct) Descriptive Statistics by Domain

	[a]Overall Mean (%)	S.D. (%)	Median (%)	Mode (%)	Minimum / Max. (%)	Variance (%)
[b]Domain 1 (Qu. 1 – 5) Macronutrients/Energy	57.0	22.4	60.0	60.0	0. / 100.0	5.00
[b]Domain 2 (Qu. 6 – 10) Etiology	82.8	18.6	80.0	80.0	20. / 100.0	3.50
[b]Domain 3 (Qu. 11 – 15) Signs / Symptoms	60.0	21.7	60.0	60.0	0. / 100.0	4.70
[b]Domain 4 (Qu. 16 – 20) Scope of Practice	89.6	15.0	100.0	100.0	40. / 100.0	2.20
[c]Doman 5 (Qu. 21-23, 25) Treatment / Prevention	63.6	22.9	75.0	50.0	25. / 100.0	5.30

S. D. = Standard Deviation
[a]Mean based on average correct responses to questions of respective domain.
[b]The percent scores for Domains 1-4 were calculated by dividing total number correct by 5 questions of respective domain.
[c]The percent score for Domain 5 was calculated by dividing total number correct by 4 questions.

4.2.3 Research Question 2 and 3 Hypotheses

Domain means were needed to address the research and null hypotheses of both Research Question 2 and 3. The average of Domain 2, (Etiology), 3 (Signs and Symptoms), and 5

(Treatment and Prevention) mean total scores (i.e. % correct) was 68.8% (± 14.2%); this value represents the participants' *overall knowledge of disordered eating*, which fell below the 80% adequate knowledge criterion. Furthermore, since the mean knowledge scores for Domain 1 (57.0%), 3 (60.0%), and 5 (63.6%) also fell below the predetermined criterion for adequate knowledge, the associated research hypotheses were confirmed. Specifically, Research Hypothesis 3 (lack of Macronutrient / Calorie knowledge), 2b (lack of Signs / Symptoms knowledge), and 2c (lack of Treatment knowledge) were upheld and their respective counter nulls were rejected. In contrast, the mean knowledge score for Domain 2 (82.8%) met the minimum knowledge criterion; thus, the null for 2a (have Etiology knowledge) was upheld. Finally, for a complete profile of coaches' domain specific knowledge, mean knowledge scores were calculated for various demographic variables as presented in Table 4 – 10.

TABLE 4 – 10. Mean Domain Scores (i.e. % Correct) Organized by Participants' Demographic Variables

	[b]Domain 1	[b]Domain 2	[b]Domain 3	[b]Domain 4	[c]Domain 5
Gender					
Male (n=61)	56.39	80.98	58.36	88.85	61.07
Female (n=18)	58.89	88.89	65.56	92.22	72.22
Coach Type					
Head Coaches (n=68)	55.88	82.94	58.53	88.53	63.24
Assistant Coaches (n=11)	63.64	81.82	69.09	96.36	65.91
Gender of Team					
Only Boys Team (n=12)	70.00	80.00	60.00	86.67	58.33
Only Girls Team (n=33)	52.73	86.06	61.21	90.30	67.42
Coach both types (n=34)	56.47	80.59	58.82	90.00	61.76
Teaching License					
Yes (n=33)	53.33	78.18	60.00	89.09	65.15
No (n=46)	59.57	86.09	60.00	90.00	62.50
Highest Education Earned					
High School Diploma (n=14)	57.14	77.14	57.14	88.57	66.07
Bachelor's Degree (n=35)	58.86	88.00	62.29	89.71	64.29
Graduate Degree (n=30)	54.67	79.33	58.67	90.00	61.67
Number of Years Coached					
1-5 (n=27)	59.26	90.37	64.44	93.33	71.30
6-10 (n=26)	54.62	80.77	57.69	84.62	61.54
11 or more (n=26)	56.92	76.92	57.69	90.77	57.69
School Size					
1A (n=3)	46.67	93.33	46.67	100.00	91.67
2A (n=19)	55.79	85.26	66.32	77.89	63.16
3A (n=21)	55.24	84.76	55.24	94.29	63.10
4A (n=26)	56.92	80.00	61.54	92.31	57.69
5A (n=9)	68.89	77.78	57.78	93.33	75.00

[a]Overall percent score was calculated by dividing total number correct by 24 questions.
[b]The percent scores for Domains 1-4 were calculated by dividing total number correct by 5 questions of respective domain.
[c]The percent score for Domain 5 was calculated by dividing total number correct by 4 questions.

4.3 Part II of the NET Survey Results: Confidence Scores

Also, Part II of the NET Survey assessed the Indiana Tennis Coaches' confidence in their responses to the multiple choice and true/false questions with the Likert scale (1 = Not At All Sure, 2 = Not Very Sure, 3= Somewhat Sure, 4 = Very Sure) also employed by Turk et al. (1999) and Zemke (2008).[3,116] The means of confidence scores for correctly answered questions were calculated for each domain as well as that for incorrectly answered questions. Collectively, these averaged scores equated to *Overall Confidence*. The highest domain specific mean Overall Confidence score emerged in Domain 5 (3.06) with the lowest in both Domain 2 and 3 (2.80).

Moreover, similar to results of Torres-McGehee, et al., (2012), there was a trend of coaches' expressing confidence in content where they lacked the most knowledge. For example, Domain 1 responses demonstrated the lowest average mean knowledge score (57.0%), but had an average Overall Confident score (2.85) that was greater than that (2.80) of Domain 2. This is a noteworthy result since Domain 2 had a considerably larger average knowledge mean score (82.8). Perhaps the most poignant example of this, however, appeared in Domain 5, which had a significantly low average knowledge score (63.6%) coupled with the highest average Overall Confident score (3.06) previously presented. Table 4 – 11 provides the Overall Confidence scores by domain.

TABLE 4 – 11. [a]Overall Confidence Scores by Domain

	Overall	Domain 1	Domain 2	Domain 3	Domain 4	Domain 5
Overall						
N=79	2.88	2.85	2.80	2.80	2.90	3.06

[a]Overall confidence by averaging confidence score for mean of correctly answered questions and mean of incorrectly answered questions. The highest possible score was 4.

4.3.1 Research Question 4 Hypotheses

Table 4 – 11 data was requisite information for Research Question 4. Specifically, the mean Overall Scores for Domain 1, 2, 3, and 5 were needed to address Hypotheses 4d, 4a, 4b, and 4c, respectively. In order to accept the Research Hypothesis 4a (confidence in Etiology), 4b (confidence in Signs/Symptoms), 4c (confidence in Treatment), and 4d (confidence in Macronutrient/Energy) a minimum mean Overall Confidence score of 3 was needed to establish confidence. Domain 5 was the only domain to achieve this benchmark. So, Research Hypothesis 4c (Indiana high school tennis coaches are confident in their knowledge of disordered eating treatment) was the only research hypothesis from set 4 that was upheld. The null hypothesis was rejected for 4c and accepted for 4a, 4b, and 4d.

Ultimately, the mean confidence scores for correctly and incorrectly answered questions and frequency (%) of response choice (e.g. Not At All Sure to Very Sure) frequencies were also calculated (Table 4 – 12). The highest mean confidence scores for correctly and incorrectly answered questions were in Domain 4 (3.30) and Domain 5 (2.87), respectively. The question pertaining to credentials needed to plan menus (Domain 4) received the highest mean confidence score (3.66) for those who correctly answered it, while the "Mental Health" related question (Domain 3), demonstrated the highest mean confidence score (3.13) for incorrectly answered (68.4%). It should be noted that there were similar high mean confident scores associated with relatively highly missed questions. For example, the mean confident scores were 3.04 and 2.96, for those incorrectly answering the "Timing of Declines" (34.2%) and "Total Calorie Intake" (31.6%) questions, respectively. Torres-McGehee, et al., (2012), identified similar trends in their research; they theorized that high confidence on incorrectly answered questions can be a sign of overconfidence. Additionally, the greatest frequency of *Very Sure* responses occurred for the menu planning credential (67.1% of responses), diagnostic team question (58.2% of total responses), weight loss recommendations (43.04% of responses), and total Caloric restriction

(40.5% of total responses) questions. These final points are among the talking points that inspired the discussion (e.g. overconfidence and behavior) presented in Chapter 5.

TABLE 4 – 12. Mean and Frequency of Confidence Scores for Incorrect and Correct Answers by Domain

Domain Knowledge assessed	**Average Confidence Score (%Correct Answer)**	**Average Confidence Score (%Incorrect Answer)**	**Not At All Sure Frequency (%)**	**Not Very Sure Frequency (%)**	**Somewhat Sure Frequency (%)**	**Very Sure Frequency (%)**
All Questions (n = 24)	**3.13 (70.6)**	**2.62 (29.4)**	**5.61**	**16.04**	**48.62**	**29.73**
Domain 1: Macronutrient	3.34 (84.8)	2.75 (15.2)	1.27	11.39	48.10	39.24
Intake and weight loss	3.16 (70.9)	2.91 (29.1)	2.53	10.13	63.29	24.05
Carb. metabolism	3.16 (64.6)	2.68 (35.4)	6.33	13.92	54.43	25.32
ID Calorie needs	2.80 (55.7)	2.51 (44.3)	3.80	34.18	53.16	8.86
Protein intake	3.00 (8.9)	2.15 (91.1)	16.46	48.10	31.65	3.80
Carbohydrate AMDR	**3.09 (57.0)**	**2.60 (43.0)**	**6.08**	**23.54**	**50.13**	**20.25**
Domain 1 Average						
Domain 2: *Etiology						
Puberty's influence	3.19 (94.9)	2.00 (5.10)	5.06	6.33	59.49	29.11
Body dissatisfaction	2.98 (78.5)	2.88 (21.5)	5.06	15.19	58.23	21.52
Coach's influence	3.22 (84.8)	2.67 (15.2)	1.27	12.66	56.96	29.11
Weight monitoring	3.00 (74.7)	2.40 (25.3)	6.33	20.25	55.70	17.72
Unqualified personnel	3.13 (81.0)	2.47 (19.0)	1.27	24.05	48.10	26.58
Domain 2 Average	**3.10 (82.8)**	**2.49 (17.2)**	**3.80**	**15.70**	**55.70**	**24.81**
Domain 3: Symptoms						
Timing of declines	3.08 (65.8)	3.04 (34.2)	2.53	13.92	58.23	25.32
Mental health	2.72 (31.6)	3.13 (68.4)	5.06	13.92	56.96	24.05
ED appearance	3.38 (97.5)	2.50 (2.50)	1.27	12.66	35.44	50.63
Extreme P.A.	3.03 (44.3)	2.55 (55.7)	11.39	20.25	49.37	18.99
APA diagnosis	2.42 (60.8)	2.10 (39.2)	29.11	22.78	37.97	10.13
Domain 3 Average	**2.93 (60.0)**	**2.66 (40.0)**	**9.87**	**16.71**	**47.59**	**25.82**
Domain 4: Scope-Practice	3.66 (96.2)	2.00 (3.80)	1.27	5.06	26.58	67.09
Menu Planning	3.31 (68.4)	2.96 (31.6)	3.80	11.39	45.57	39.24
Total Calorie intake	3.08 (94.9)	2.50 (5.10)	8.86	10.13	48.10	32.91
Carb. intake counsel	3.37 (92.4)	2.33 (7.60)	2.53	8.86	45.57	43.04
Weight loss counsel	3.09 (96.2)	2.67 (3.80)	7.59	17.72	34.18	40.51
Calorie restriction	**3.30 (89.6)**	**2.49 (10.4)**	**4.81**	**10.63**	**40.00**	**44.56**
Domain 4 Average						
Domain 5: Treatment						
The diagnostic team	3.56 (91.1)	3.00 (8.90)	1.27	5.06	35.44	58.23
Proper weight monitor	3.18 (43.0)	2.87 (57.0)	5.06	12.66	59.49	22.78
Proper weight goals	3.00 (63.3)	2.86 (36.7)	3.80	20.25	53.16	22.78
Getting educated	3.27 (57.0)	2.76 (43.0)	3.80	16.46	50.63	29.11
Domain 5 Average	**3.25 (63.6)**	**2.87 (36.4)**	**3.48**	**13.61**	**49.68**	**33.23**

*Etiology of Disordered Eating and Eating Disorders

4.4 Part III of the NET Survey: Open Ended Question Quantitative Results

The participants' completion of Part III yielded a variety of quantitative and qualitative data. Quantitative data derived from the score (i.e. percent correctly addressed) of the eight possible responses across the two scenarios. Definite trends emerged in the overall scores depicted in Table 4 – 13. A participant's possible score was 0, 12.5, 25.0, 37.5, 50.0, 62.5, 75.0, 87.5, or 100%. The mean combined score of Scenario 1 and 2 (hereafter referred to as behavior score) was 24.8% (± 11.8%), which was very close to the mode, 25.0%. The highest score was 50.0 % (i.e. 4 of 8 correctly addressed), which was only achieved by 4 of the participants. So, of special note is that no one was able to address at least 75% of the concepts correctly. This links to a trend that most of the responses were not in depth; no more than 19 responders were able to provide responses that correctly addressed at least 37.5% (3 of 8) of the possibilities.

TABLE 4 – 13. Frequency of Part III Knowledge *Scores

	Mean Total Score (%)	**Score of 0% n (%)**	**Score of 12.5% n (%)**	**Score of 25% n (%)**	**Score of 37.5% n (%)**	**Score of 50% n (%)**
Overall						
N=70	24.8	3 (4.3)	18 (25.7)	30 (42.9)	15 (21.4)	4 (5.7)

*(0 – 100 % correctly addressed concepts)

4.5 Part III of the NET Survey: Open Ended Question Qualitative Results

Similar, but more detailed information was gleaned from the qualitative analysis of each individual response for Scenario 1 (n = 70) and 2 (n = 70) for themes. Prevailing, Major, and Common themes emerged from analysis of both Scenario 1 and Scenario 2 responses. Several of the same themes were seen in each, but in different frequencies. The most common themes across both scenario responses were (1) advocating that a coach and/or athlete defer to an RD for nutrition knowledge and counsel and (2) that the respective tennis player needed to consume more Calories. Before looking at the Scenario specific themes, it is imperative to note responses pertinent to this study that did not meet minimum criterion (i.e. 10%) of a theme: between the two

scenarios, only 6 of 140 (4.3%) and 12 of 140 (8.6%) responses properly addressed the inappropriate protein and carbohydrate intake, respectively, portrayed in scenarios.

4.5.1 Scenario 1 Themes

The qualitative analysis of Scenario 1 revealed twelve different categories of responses, which yielded nine themes. There were four *Common Themes*, four *Major Themes*, and one *Prevailing Theme*. The most prevalent (in 55.7% of responses) theme (i.e. Prevailing) was the coaches' lack or incorrect response regarding appropriate macronutrient intake. Ironically, the next most popular (42.9%) response type involved recommending that the featured player consume more Calories. In light of the prevalence of misinformation reported in the literature, the third most frequent (28.6%) theme (i.e. Nutrition Misinformation) was not a surprise. However, the number of responses (27.1%) that candidly declared that he/she had no idea was not expected. Table 4 – 14 details the themes procured from Scenario 1 analysis in descending order of frequency.

TABLE 4 – 14. Scenario 1 Theme Summary: Ranked Frequencies and Types

THEME	*Response Frequency	**Theme Percentage	***Theme Type
1.) Response revealed incorrect or no knowledge of energy and macronutrients.	39	55.7%	Prevailing
2.) The player needs to consume more Calories.	30	42.9%	Major
3.) Coach's recommendations based on misinformation.	20	28.6%	Major
4.) I lack knowledge.	19	27.1%	Major
5.) Response reflects understands appropriate scope of practice.	18	25.7%	Major
6.) Response reflects understands inappropriate scope of practice.	11	15.7%	Common
7a.) Response of incorrect recommendation(s) of macronutrient intake.	10	14.3%	Common
7b.) Recognizes registered dietitian as appropriate nutrition expert.	10	14.3%	Common
9.) Recognizes professional(s) other than registered dietitian as nutrition expert.	8	11.4%	Common

*****Response frequency refers to the number of responses that linked to the respective theme.
******Theme Percentage refers to the number of responses that linked to the respective theme divided by the total n (70) of responses.
*******Achieved theme percentage of 10% – 24.99% (Common), 25% – 49.99% (Major) or 50% or greater (Prevailing).

4.5.2 Scenario 2 Themes

The qualitative analysis of Scenario 2 also produced twelve different categories of responses, but unearthed eight themes compared to the first's nine. There were five *Common Themes*, one *Major Theme*, and two *Prevailing Themes*. The most prevalent (in 60% of responses) theme (i.e. Prevailing) was similar to that of number one; it involved, more specifically, not appropriately addressing the severe Calorie deficiency. Moreover, the coaches' advocated athlete referrals to RDs for nutrition counsel, at the second highest incidence (54.3%). Also, as seen in scenario one, nutrition misinformation was again the third most frequent theme at a similar incidence (25.7%). Also, like in Scenario 1, there was almost as many responses (17.1%) who recognized other individuals as the authority on nutrition as there were for RDs (18.6%) being identified as nutrition experts. Table 4 – 15 details the Scenario 2 themes, also in descending order of frequency.

TABLE 4 – 15. Scenario 2 Theme Summary: Ranked Frequencies and Types

THEME	*Response Frequency	**Theme Percentage	***Theme Type
1.) Response revealed incorrect or no knowledge of macronutrient and energy deficiency.	42	60.0%	Prevailing
2.) Response supports referral to a dietitian for nutrition counsel.	38	54.3%	Prevailing
3.) Coach's recommendations based on misinformation	18	25.7%	Major
4.) Recognizes registered dietitian as appropriate nutrition expert.	13	18.6%	Common
5a.) Recognizes professional(s) other than registered dietitian as nutrition expert.	12	17.1%	Common
5b.) The player needs to consume more Calories.	12	17.1%	Common
7.) Disordered eating behaviors or attitudes are a potential issue.	10	14.3%	Common
8.) Response reflects understands inappropriate scope of practice.	9	12.9%	Common

*Response frequency refers to the number of responses that linked to the respective theme.
**Theme Percentage refers to the number of responses that linked to the respective theme divided by the total n (70) of responses.
***Achieved theme percentage of 10% – 24.99% (Common), 25% – 49.99% (Major) or 50% or greater (Prevailing).

4.5.3. Research Question 5 Hypotheses

The results section concludes with addressing Research Question 5. Recall that the (1) mean overall knowledge scores, (2) mean domain knowledge scores, and behavior scores from Part III (i.e. inferred, predicted behavior). Research Hypothesis 5 was based on the assumption that any lack of knowledge from Part II would also be reflected in the coaches' responses to Part III Scenario Questions. Thus, a Spearman's correlation was used to detect any relationships between overall knowledge scores (Part II) and behavior scores (Part III) as well as individual domain scores (Part II) and behavior scores (Part III).The requirements to perform such analyses were met.

First, the Spearman's correlation was run to assess the relationship between coaches' knowledge scores and scenario scores followed by the same for domain knowledge scores. For the former, there was only a non-significant ($p = 0.201$), weak, positive correlation between performance on Part II questions (i.e. multiple choice and true/false) and Part III scenario questions, $r_s = .155$. Furthermore, there were no significant relationships between the scenario scores (i.e. predicted behavior) and any of the *domain specific* knowledge scores (p=0.593, 0.093,

0.680, 0.756, and 0.337 for domain 1-5, respectively). Thus, Research Hypothesis 5 was rejected and its alternative null was accepted: There is no significant relationship between Indiana high school tennis coaches' assessed knowledge and behavior. Table 4 – 16 presents an acceptance summary of all the research hypotheses described in this Chapter 4.

TABLE 4 – 16. Research Hypotheses Acceptance Summary

Research Hypothesis	**Upheld**	**Not Upheld**
1a There is a significant difference between Indiana high school tennis coaches' education and assessed knowledge.		X
1b There is a significant difference between Indiana high school tennis coaches' experience and assessed knowledge.	X	
1c There is a significant difference between the gender of team coached and assessed knowledge.		X
2a Indiana high school tennis coaches lack sufficient knowledge of disordered eating etiology (Domain 2) of the NET Survey.		X
2b Indiana high school tennis coaches lack sufficient knowledge of disordered eating signs and symptoms (Domain 3) of the NET Survey.	X	
2c Indiana high school tennis coaches lack sufficient knowledge of disordered eating treatment (Domain 5) of the NET Survey.	X	
3 Indiana high school tennis coaches lack sufficient knowledge of macronutrient and Calorie needs (Domain 1) of the NET Survey.	X	
4a Indiana high school tennis coaches are confident in their knowledge of disordered eating etiology (i.e. Domain 2).		X
4b Indiana high school tennis coaches are confident in their knowledge of disordered eating signs and symptoms (i.e. Domain 3).		X
4c Indiana high school tennis coaches are confident in their knowledge of disordered eating treatment (i.e. Domain 5).	X	
4d Indiana high school tennis coaches are confident in their knowledge of macronutrient and Calorie needs and recommendations (i.e. Domain 1).		X
5 There is a significant relationship between Indiana high school tennis coaches' assessed knowledge and behavior.		X

CHAPTER FIVE: DISCUSSION

5.1 Significance

The primary purpose of this study was to assess high school tennis coaches' knowledge of (1) Macronutrients and Energy, (2), Etiology of DE, (3) Identifying Signs and Symptoms of DE, (4) Tennis Coaches' Scope of Practice, and (5) Treatment and Prevention of DE with the NET Survey. Secondary purposes consisted of identifying (a) any differences between high school tennis coaches' knowledge and demographic variables and (b) any relationship between coaches' behavior and knowledge. So, this dissertation added to the scant body of literature examining coaches' knowledge of disordered eating and related nutrition. Specifically, its results contributed to the limited research on high school coaches' knowledge as well as tennis coaches, in general. This chapter will discuss the (a) Knowledge Score Results, (b) Confidence Results, and (c) Themes (e.g. inferred behaviors) in lieu of the literature review as well as implications and areas for future research.

5.2 Coaches' Knowledge

5.2.1 Disordered Eating

Prevention of disordered eating and its serious consequences was the central concern of this research. It is acknowledged that the development of disordered eating and officially diagnosed eating disorders is linked to a multitude of potential triggers.[2,7,11,15,30,53,61,62,66,67] Thornton's (2004) cautionary sentiment merits repeating: no one person, including coaches, do not cause DE. Nonetheless, coaches were at the core of this investigation because of their well-documented lack of related knowledge. And, this study added to that body of literature; the low mean, 68.8% (±14.2%), of the DE Domains (1, 3, and 5) support a multitude of authors' pleas that coaches acquire education in this areas.[40,41,43, 48] Lack of such knowledge, perpetuates the incidence of giving out inaccurate dietary intake and weight loss recommendations to athletes. [1-3,6,7,11, 19,27,29,39-44,46,48,62,63]

Misinformation of this type has been implicated as prime precursors to DWCB and DE.[1,10,11,27,29,33,38,39,41,43,44,48] This coupled with coaches' frequent contact with athletes made this a worthwhile research endeavor.

Glover (2006) succinctly summarized this sentiment.

> Coaches are in a unique position to recognize and facilitate in the prevention of eating disorder in their athletes considering the amount of time they spend with the athletes. Yet, experts have shown concern that coaches are not knowledgeable of eating disorders and that they give inaccurate info to the athletes, which may lead to unhealthy eating and dieting behaviors (Griffing & Harris, 1996).[19]

Specifically, the present results revealed high school tennis coaches' limited knowledge of DE prevention, treatment, signs, and symptoms, which increases the risk of DE among their respective athletes. [2,6,7,11,19,62,63]

5.2.2 Research Question 2 Findings

Based on the literature, the logical place to begin is the treatment of disorders: it has be touted, that do to the seriousness of DE consequences and difficulty in treating them, the ultimate treatment is prevention.[19,52] And education has been repeatedly been recognized as the "key" to prevention.[1,3,6,7,11, 19,51,52,57,105] Out of the 24 knowledge assessment scores, the third most missed question (57.0% of responders), involved appropriate weight monitoring. This mimics the other few known studies on high school coaches.[3,85] For example, Zemke (2008) found that wrestling (another LES) coaches (n = 37) also lacked knowledge related to weight monitoring; only 38.1% responded correctly. Like Glover (2006), This is, perhaps, the most alarming finding since inappropriate (e.g. not qualified/trained) weight monitoring by anyone other than a qualified medical professional is often theorized to be the first trigger to body disastisfaction. And worth repeating, body dissatisfaction is the "single strongest predictor of eating disorder symptomology."[7,15-17] No participants conveyed qualifications that would suggest a medical professional.

Furthermore, the low mean score (63.6%) of Domain 5 (Treatment) suggests this population of coaches lack adequate knowledge of overall DE treatment. This creates a 2-fold concern. First, since education is the proverbial key to treatment, it is theorized that a coach might be less likely to seek out this information if he/she believes "I already know the answer." Thus, the real preventative goal is not to just create seminars, workshops, and the like, but to find a way to, tactfully, get coaches to attend. The second concern of this relatively high confidence score on a frequently missed domain is an overconfidence phenomenon that, ultimately, can exacerbate dissemination of misinformation.[19,41] That is, the more confident one is in knowledge, the more likely he/she will share it with others.[19,41] And, among the most cited sources of athletes' nutrition knowledge is their respective coaches.[1,18,19,24,37-43]

5.2.3 Macronutrients

Thus, of prime interest was coaches' knowledge of tennis players' nutrition demands and appropriate macronutrient intake. Overall, Part II results confirmed previous authors' contention that, in general, coaches' lack knowledge of DE, weight loss, and dietary intake. [7,29,39,41,43,44,48] Likewise, Part III results suggest that these high school coaches do not know that there is a variability in nutrition needs commensurate with in an athelte's indivdiual characteristics (e.g. training intensity, load). Any attempt at specific recommendations were in the form of what previous authors label "cookie-cutter," one-size all, counsel, which has been highly linked to DWCB.

5.2.4 Research Question 3 Findings

Specific red flags in the results involve carbohydrates. This is the major macronutrient needed on a daily basis for both biological (e.g. brain function) and training purposes (e.g. energy demands) as previously presented.[6,21,24,26-29] The present study corroborates previous findings that coaches' lack knowledge of carbohydrate function, metabolism, and appropriate intake (e.g. AMDR of 55-65% daily).[4,41] This was most evident in the high school tennis coaches' performance on Domain 1 (Macronutrients), which had the lowest mean score (57.0% correctly

responded). This is similar to Torres-McGehee, et al., (2012), where college coaches' also had the lowest mean score on macronutrient domain (62.6% ± 22.3%).

Just as alarming is Domain 1's mean confident score of 2.85, which signifies that the participants were more confident than that of Domain 2 (2.80). A considerably higher overall mean knowledge score (82.8%) emerged in the latter compared to the former (57.0%). Thus, they tended to not know what they do not know. This can precipitate the afore-mentioned "blind leading the blind" phenomenon, which poses threat of dangerous health consequences previously reviewed.[1,2,7,42,47]

The trend of not understanding macronutrient needs was further substantiated by the results of Part III. Overall, all responses revealed a lack of depth and breadth of knowledge; any correct information was only on a few topics as evinced by no one (and only 3) scoring higher than 50.0% on the 8 topics to correctly address. This was never more evident than in regards to the concept of carbohydrate deficiency. Only 8.6% properly indicated that the hypothetical tennis players needed to consume considerably more Calories, let alone identifying the correct recommendations. The procured themes also matched results of Part II. Recall that the number one, *Prevailing*, theme among both response sets (55.7%, 60.0%) ranged from no to limited to incorrect knowledge of macronutrients and energy deficiency.

So, it is ultimately concluded that tennis players served by this sample would be misinformed or not properly informed about the importance of carbohydrates comprising the bulk of daily intake. Both performance and health is at risk of being compromised if exposed to the misinformation or if information is not available at all. Only 6 (8%) reported that their tennis players would have access to an RD through school system. Since carbohydrates should be the major energy provider, this could lead to potential Caloric restriction and accompanying energy deficiency. Yet, ironically, an established theme in both sets of scenario responses was "The player needs to consume more Calories." That is, considerably more recognized he/she needed to consume much more Calories compared to those who also noticed the severe carbohydrate

deficiency. The essential question at this point is why didn't they recognize them together as carbohydrates should be the major energy contributor?

5.2.5 Team Gender, Educational Background, and Experience Differences

Worth mentioning is the fact that the "need to consume more Calories" theme was considerably less prominent in the second (17.1% frequency) relative to first (42.9%). While each scenario was written from a different perspective, the intended conclusion was that more Calories needed to be consumed. Mere conjecture as to why relates to the gender of depicted tennis player. Did the coaches' see the female (second scenario) as needing less Calories? This could provide the basis for future studies. Nonetheless, in the present study, since there was no significant difference in the knowledge of coaches' with regard to gender coached (i.e. a Research Question 1 Independent Variable), it is likely the same information would be given out to all genders. And unfortunately, despite, being a theme, there was still plenty of coaches, no matter what demographic variable was compared, who didn't recognize the Caloric restriction or the other themes.

5.2.6 Research Question 1 Findings

Also, coaches' knowledge did not significantly differ among another Research Question 1 independent variable, education. So, in light this, a discussion of the participants' education merits attention. There is "significance" in the non-significant results. Note that having a college degree did not lead to more knowledge on any domains or any specific question. In fact, the trend was that those with more college education had lower knowledge scores; coaches with a high school diploma fared better overall than those with a graduate degree.

This should not necessarily be surprising for two reasons. First, as one pursues a higher degree, it is more specialized; there is less likelihood that nutrition would be part of the curriculum and/or taken as an elective. Second, there is not many individuals in the general population with a nutrition or dietetics degree. There were none in this present study; even if there were, it is theorized that there wouldn't be enough to make a significant difference in

present results. Bottom line, if one doesn't specialize in dietetics or at least nutrition, how can one expect to know the assessed topics? The mindset that someone can gain (and retain) knowledge of DE in a single nutrition elective must change. Jacobson (2001) agrees: "Likewise, sport coaches should be required to have a nutrition background (not just a class) if they insist on distributing nutrition information…"[19, 42,43]

5.2.7 Education Requirements

A major discussion point involves advocating for universal education system and / or licensure for coaches of adolescents, the population most vulnerable to advent of DE and misinformation.[11,15-17,53,69-72] Curruiculum should include the sport specific demands and associated nutrition needs as well as that knowledge assessed in the five domains. The United States should follow the model of other countries NGBS. The popular, minimum, expectation that as long as you have played the sport, then you are qualified to coach it must be challenged for the well-being of athletes.[19] This should take priority over winning or any measure of success. Furthermore, an NGBS can contribute to licensure and associated continuing education requirements. Why is a coach who is regularly in a position to dole out knowledge about food not treated as a pharmacist who dispenses drug information? Imagine if the negative impact of improper dietary intake (i.e. Calorie deficiency) was treated with the same reverence as not following the prescription label. Both can lead to serious health consequences no matter how slow or quick they might manifest.

In contrast, the coaches' knowledge scores did significantly differ across the levels of coaching experience. Based on the results, newer coaches (i.e. 1 – 5 years) are expected to have more knowledge in all domains compared to any more experienced coach. Glover reported one of the earliest studies similar to the one at hand, where newer coaches performed better than more seasoned counterpart: Crawford (2004) found that the latter knew significantly less about ED.[19] Is this simply because, they are older, more far removed, from their education? Or another potential explanation might be related to the confidence scores. Logically, the more confident one

is, the less likely he/she would pursue further education in given topic. And more experienced coaches have had more time to develop and strengthen confidence in knowledge, no matter how incorrect or incorrect they may be. However, this is speculation; recommendations for further research includes investigating possible factors responsible for more experienced coaches demonstrating less knowledge in the assessed domains.

5.3 Confidence

According to Bandura's Social Cognitive Theory, coaches cannot be expected to provide appropriate macronutrient (e.g. carbohydrate) recommendations, recognize symptoms of DE, or know role in DE genesis, if he or she doesn't obtain the requisite education or training. The confidence scores of NET Survey were used as a gauge of the coaches' view if they have such education and training. This sample of high school coaches were generally more confident in the domains (4 and 2) with the highest mean scores (89.6% and 82.8%). Further, the most correctly answered domain (4-Scope of Practice) also had the highest mean confident score, 3.30 out of 4.

5.3.1 Research Question 4 Results

However, there were comparatively high confidence scores for the poorly scored domains. Domain 1 (Macronutrients) had the lowest mean of correct answers (57.0%) and, yet, had a mean confidence score of 3.09, which qualifies as "Confident." This is a surprising trend as this is only 0.01 less than the same for Domain 2, which had the second highest percent correct presented above. In fact, 4 of the 5 domain produced an average confidence score that qualifies as "Confident."

The conclusion is that this sample was over confident, especially in knowledge of macronutrients, energy, and treatment/prevention, of DE, each of which were central topics previously presented as paramount to the research problem. A fundamental, take home message is that this sample has faith in their incorrect answers and is more likely to be disseminating misinformation to their athletes. Other researches from past, Turk et al.(1999), to present, Torres-McGehee, et al., (2012), have reported the same trend and raised the same concern about

overconfidence.[19, 41] The former was primarily concerned about weight loss misinformation, while the latter warned against overconfidence in macro- and micronutrients, overall.

5.3.2 Research Question 5 Results

While there was no significant relationship between the overall test scores and behavior scores gleaned from the scenario questions, meaningful data was procured from the final part of the NET Survey. In addition to the themes already discussed (e.g. lack knowledge of Macronutrients), other themes provided insight into likely behavior of these surveyed coaches. In regards to both scenarios, almost as many people conveyed that RDs are experts in nutrition as those who saw others as more qualified than an RD. Among this latter group were physicians, athletic trainers, parents, and the coaches, themselves.

It was alarming that an RD's expertise was not seen as an authority on all nutrition matters, especially weight loss physiology. And, in each case where the coach conveyed he/she possessed the same qualifications as an RD, the response contained wrong information. Specifically, carbohydrate and energy intake were the most frequently misunderstood topics, which has big health implications previously explained. Thus, another, unexpected, discussion point emerged. Since many coaches see themselves as qualified, they are theorized to (a) not seek services of an RD and (b) unknowingly provide inaccurate information and/or go beyond their scope of practice. The latter might include recommending and assisting in weight loss and/or creating a dietary intake menu all of which can lead to DE behaviors and attitudes.

5.4 Concluding Remarks

The opening quote introduced that children have an irrational fear and misunderstanding of what appropriate food intake truly is supposed to be. Worth repeating, Manore (1999) elaborated that "Food should be thought of as the fuel for sport, not as something to be afraid of or avoided."[24] Unfortunately, almost two decades after Manore's plea, this culture of misunderstanding and intentional food avoidance continues flourish based on the present study's results. More specifically, whether intentional or not (e.g. unawareness), carbohydrate intake is

likely avoided among this sample's athletes; the results demonstrate limited understanding of carbohydrate's (a) daily needs, (b) functions (e.g. brain function), and (c) vital role in intense physical activity (e.g. sports performance). For the former, it is grossly underestimated.

The author must ultimately deduce that since the coaches did not, overall, know this information, they are not advocating carbohydrate as bulk of macronutrient intake, or even worse, not recognizing if or when it doesn't occur. Insufficient carbohydrate intake greatly increases probability of too little energy intake and associated energy deficiency, which has been repeatedly presented as a primary example of DWCB that can evolve into an ED.[2,5,6,11,19, 21, 23-25, 56,57]

The most serious component of this dilemma is that it appears to be unintentional; the coaches assume they are delivering appropriate information and/or do not recognize what they are failing to identify. Furthermore, the fact that the athletes unquestionably accept this information from their "secondary parent(s)", coupled with the coaches' discussed overconfidence would allow a culture of misguided intake to repeat season after season. The author would like to coin the phrase *Erroneous Food Intake* (EFI) for this phenomenon of when athletes consume food based on well-intended, but incorrect recommendations from a confident individual. Thus, the principal research recommendation would involve exploring effective methods to stop EFI.

5.5 Research Recommendations

In an ideal world, the first goal would be to prevent EFI. However, since there is no universal requirement to be labeled a nutritionist, there will always be someone providing incorrect information. This can exist in a variety of forms ranging from an on-line blog to an athletic department offering "nutrition education" led by an unqualified coach. So, one area of research could involve identifying populations where EFI is most prevalent. For example, does one sport type (LES, team, individual) or level (high school or college) exhibit a greater frequency or degree of EFI?

Another research recommendation entails interviews with coaches and subsequent qualitative analysis about their specific nutrition / education behavior. Recall that behavior refers

to what he/she actually teaches and/or recommends to athletes about dietary intake. While confident in the methods used in this study, the behaviors were inferred from indirect responses to scenarios. More detailed insight derived from more pointed questions as to what coaches would specifically say and why they feel qualified to say so, is greatly needed. Finally, while there were a large percentage of coaches who responded correctly to knowledge questions in Part 2 domains involving Scope of Practice and Etiology, the responses to scenarios indicated there is still some insufficient knowledge. A more comprehensive list of (a) what coaches feel they can and do perform along with (b) different types of triggers needs to be assessed. In other words, more questions than five per domain would provide more detail.

5.6 Implications

Based on the results of completed NET Surveys, the following implications have been determined:

Academic

> "As coaches generally have a great deal of influence on their athletes, increasing their knowledge of eating disorders and awareness of behaviors that may increase the vulnerability of their athletes is a logical step in prevention."[19]

The following recommendations stem from this assertion of Glover (2006.) So, these are directed at institutions and personnel devoted to providing education.

1. Since there is a lack of access to an RD coupled with considerably more unqualified individuals disseminating nutrition information, more educational opportunities are needed for those who are not an RD. Higher education institutions should consider offering evidence-based *DE and related nutrition curriculum for those tracks likely to become coaches.[19,42]
2. In this study, there were no coaches with a nutrition specific degree, which the author believes is likely typical of most coaches. Thus, it is recommended that higher education institutions offer annual, preseason educational workshops, taught by qualified personnel.

3. In consideration of above, when feasible, higher education institutions can create a certificate program that recognizes coaches and athletic departments that demonstrate appropriate knowledge.

   *Etiology, Signs/Symptoms, and Treatment

4. Those entrusted to teach any evidence – based *DE or nutrition curriculum should be appropriately qualified (e.g. RD).[19,41,42,110]

General Application

1. Any athletic department should create universal criteria for requisite *DE knowledge in order for any individual (paid or volunteer) to be a coach.
2. Any athletic department should develop and enforce a process that monitors what nutrition information is disseminated by coaches, with special attention directed to coach and/or team managed websites.
3. Any athletic department should be properly informed of what constitutes as appropriate scope of practice for a coach's given credentials, training, and education.
4. Any athletic department should provide a qualified medical professional in the place of an unqualified coach for any weight monitoring practice, especially determining if weight loss needs to be done in the first place. As previously detailed, most coaches are not appropriately trained (RDs) to recognize all the myriad of factors of weight loss.[19,41,42,110] Cookie cutter statements of you need to eat less to lose weight does not apply to everyone.[19,41,42,110] It is much more complex, especially for adolescent athletes. (e.g. Extra weight gain can be a natural part increased fat tissue from puberty and/or gain of lean tissue from training activities.)

APPENDIX A

Panel Recruitment Letter

Dear Content Expert:

You have been identified as an expert in physiology, nutrition, eating disorders (treatment, etiology, or diagnosis), and/or adolescence. Thus, you are formally being requested to serve as a panel expert to review the attached instrument, The Nutrition and Eating Disorders in Tennis (NET) Survey. This instrument is designed to assess a tennis coach's knowledge of disordered eating (e.g. etiology, identifying signs and symptoms) and related nutrition principles (e.g. Macronutrient intake). As an important note, The NET Survey is an amalgamation of questions borrowed or modified versions of those employed by Zemke , (2008) entitled *Wrestlers, Coaches and Parents Eating Disorders and Sport Nutrition Knowledge Questionnaire*, and Turk et al.'s (1999) entitled *Five Domains of Eating Disorders: A Survey for Collegiate Coaches*. When appropriate, original questions were designed to match the needs of this dissertation (i.e. created for specific domain).

The NET Survey is comprised of 3 parts: Demographics (Part I), Multiple Choice and Yes/No questions (Part II) and Open Ended response (Part III). Part II is comprised of 25 questions that are equally divided among 5 domains. These questions are designed to assess knowledge of respective domains (e.g. Macronutrients and Coaching Scope of Practice). The answer choices are labeled "Yes / No" versus the traditional "True / False" to minimize the appearance of taking a test, and thus, increase the likelihood of survey completion/submittal. The intent of Part III questions is to gain insight into a coach's behavior and rationale for such.

It is not necessary to comment on the appearance of the instrument, as it will ultimately be presented electronically (via email Qualtrics). In order to collect a standard format of feedback, please use the following system.

- Step 1 – Identify which domain OR domains you are reviewing.
- Step 2 – Identify key topics that you believe the respective domain should address. For example, if the domain was labeled "the anatomy of Circulatory System" I would identify Heart, Veins, Blood and Arteries as key topics.
- Step 3 – Identify how many of the questions (5 per domain) represent at least one of your identified key topics.
    - If appropriate, how many of your identified topics are not represented by any question?
- Step 4 – Rate question as "No Modification Needed," "Keep with Modifications" OR "Delete"
- Step 5 –If you select "Keep with Modifications" or "Delete", please provide the pertinent details of how the question can be modified to match your identified topics and rationale.
- Step 6 - Please email back within *2 weeks to me at provided email.

*(Or let me know if you need more time.)

Thank you for your time and consideration.

Brian Reagan, PTR, MS, ABD

APPENDIX B

Nutrition & Eating Disorders in Tennis (NET) Survey

PART I: TENNIS COACH DEMOGRAPHICS/BACKGROUND

1. Which title best describes you? Check ALL that apply.
   a. Head Coach b. Assistant Coach

2. Indicate the gender of tennis team that you CURRENTLY coach. Check ALL that apply.
   a. Boys b. Girls

3. What is your age in years?

4. What is your gender?
   a. Male b. Female

5. What is your high school's BASKETBALL classification in the Indiana High School Athletic Association?

a. 1A
b. 2A
c. 3A
d. 4A
e. 5A

6. How many years have you coached High School Tennis? _____

7. What is the highest level of education that you have completed?

a. Less than High School
b. GED
c. High School
d. Some college
e. Bachelor's degree
f. Graduate degree

- IF you have a Bachelor's degree, what is the discipline? (i.e. What was your major?)
- IF you have a graduate degree, what type (Master's, Doctorate) and in what discipline?

8. Are you currently certified by any of the following organizations? Check ALL that apply.

a. United States Professional Tennis Association (USPTA)
b. Professional Tennis Registry (PTR)
c. American College of Sports Medicine (ACSM)
d. National Strength and Conditioning Association (NSCA)
e. No, none of the above

9. What is your highest level of participation in competitive tennis?

a. Played Professional Tennis (ATP, WTA, Futures, or Challengers)
b. Played College Tennis
c. Played High School Tennis
d. I did not participate in any of the above.

10. Do your tennis players have access to a Registered Dietitian through the school system?
    a. Yes b. No c. Unsure

11. Are you a Registered Dietitian?
    a. Yes b. No

12. Are you currently a licensed school teacher?
    a. Yes b. No

13. What is your primary source of nutrition knowledge?

a. Fellow coach (es) b. College Course
c. Experience as an Athlete d. Certified Strength & Conditioning Coach
e. Registered Dietitian
f. Media
(i. Television ii. Internet iii. Radio iv. Magazine v. Academic research)

PART II: TENNIS COACHES' KNOWLEDGE

DOMAIN 1: MACRONUTRIENTS / ENERGY
Questions #1 – 5

DOMAIN 2: ETIOLOGY FOR EATING DISORDERS
Questions #6 – 10

DOMAIN 3: IDENTIFYING SIGNS & SYMPTOMS OF EATING DISORDERS
Questions #11 – 15

DOMAIN 4: TENNIS COACHES' SCOPE OF PRACTICE
Questions #16 – 20

DOMAIN 5: TREATMENT & PREVENTION OF EATING DISORDERS
Questions #21 – 25

For questions #1 – 5, select the letter that corresponds to your response.

AND, use the following scale to indicate the confidence in your response. Click on the circle that matches your confidence level.

Not At All Sure (1)

Not Very Sure (2)

Somewhat Sure (3)

Very Sure (4)

1. When high school athletes want to lose weight, they should: 1 2 3 4
A. Restrict daily Caloric intake to 1400-1500 Calories.
B. Consume meals that are composed mostly of protein.
C. Minimize carbohydrate intake.
D. Consult with a weight loss professional like a Registered Dietitian.
E. Exercise 2 hours each day before or after practice.

2. Which of the following is the primary energy source for intense physical activity? 1 2 3 4
A. Protein
B. Carbohydrate
C. Fat
D. Iron

3. How many Calories should high school athletes take in everyday? 1 2 3 4
A. 5,000 Calories a day
B. 3,500 Calories a day
C. 1,500 Calories a day
D. Depends on individual needs

4. With respect to protein intake among athletes, 1 2 3 4
A. The average high school athlete needs at least 3 grams of protein per kg of body weight each day.
B. 30% - 40% of total Calories should be from protein.
C. Supplements are important since you can't get enough protein through a regular diet.
D. A balanced diet provides all the protein that is needed.

5. What percentage of an athlete's diet should come from carbohydrates? 1 2 3 4
A. 20% - 30% of their daily Caloric intake
B. 35% - 45% of their daily Caloric intake
C. 40% - 50% of their daily Caloric intake
D. 55% - 65% of their daily Caloric intake

Use the following choices to respond to the statements below.

Yes, I Agree **No, I Disagree**

AND, use the following scale to indicate the confidence in your response. Click on the circle that matches your confidence level.

Not At All Sure (1)

Not Very Sure (2)

Somewhat Sure (3)

Very Sure (4)

6. The physiological changes from puberty can lead to behaviors of eating disorders.
Yes/No 1 2 3 4

7. A negative image of one's body is the most common trigger to eating disorders.
   Yes/ No 1 2 3 4

8. Coaches can significantly contribute to the development of an eating disorder.
   Yes/No 1 2 3 4

9. Weight monitoring by coaches can increase an athlete's risk for developing an eating disorder.
   Yes/No 1 2 3 4

10. A coach should provide a diet plan to players in cases where weight loss can improve performance.
   Yes/No 1 2 3 4

11. An obvious decrease in performance will be seen quickly in an athlete with an eating disorder.
   Yes/No 1 2 3 4

12. A fear of gaining weight is a natural part of adolescence.
   Yes/No 1 2 3 4

13. A person with an eating disorder can be above average in weight.
   Yes/No 1 2 3 4

14. Regular, intense exercise in addition to daily team practices, may be considered a behavior that is characteristic of an eating disorder.
   Yes/No 1 2 3 4

15. A key diagnostic criteria for Anorexia Nervosa is being 85% or less of one's ideal body weight.
   Yes/No 1 2 3 4

16. I am qualified to design dietary intake (a "menu") for my tennis players.
   Yes/No 1 2 3 4

17. One of my coaching duties is to provide recommendations on how many Calories to consume.
   Yes/No 1 2 3 4

18. I should recommend a low intake of carbohydrates to most of my tennis players.
   Yes/No 1 2 3 4

19. One of my coaching duties is to recommend weight loss for my tennis players.
   Yes/No 1 2 3 4

20. I should recommend a low Calorie intake to a tennis player who I identify as overweight.
   Yes/No 1 2 3 4

21. I am qualified to diagnose a player who has an eating disorder.
   Yes/No 1 2 3 4

22. Medical professionals should be the only individuals to weigh athletes.
   Yes/No 1 2 3 4

23. To improve athletic performance, coaches should emphasize the importance of achieving an ideal body fat percentage.
Yes/No 1 2 3 4

24. Treatment of an eating disorder typically requires a long time before recovery is complete.
Yes/No 1 2 3 4

25. If the school system does not offer education programs about eating disorders, then it is a coach's responsibility to educate him/herself on the topic.
Yes/No 1 2 3 4

Read the following two scenarios and respond with your opinions.

26. Max is the number one player for his high school tennis team. Along with practicing about 2 hours each day, he squeezes in rehearsal time for his role as the lead in the Fall Musical. His coach is a "health nut" and helps Max with his nutrition needs. Based on the coach's recommendations, this 150 pound senior keeps his Caloric intake around 1800. He now consumes around 140 grams of Carbohydrates and 300 grams of protein.

What are your thoughts on the behaviors and dietary intake described above?

27. At 6 foot, 150 pounds, Stephanie feels like she doesn't fit in. This straight A student and last year's MVP started reading online to learn about fitness and how to eat healthy. Also, she mimics Dawn, her doubles partner and best friend since the 4th grade, who eats salads for lunch and plain rice cakes after practice. When Stephanie complained about being more tired than usual and dizziness during practice, the coach recommended that she speak to a Registered Dietitian.

What are your thoughts on the behaviors and dietary intakes described above?

APPENDIX C

Indiana University Study Information Sheet for:

INVESTIGATION OF INDIANA TENNIS COACHES' KNOWLEDGE OF DISORDERED EATING AND NUTRITION AND THEIR CONFIDENCE IN SUCH KNOWLEDGE

You are invited to participate in a research study investigating high school tennis coaches' knowledge of Disordered Eating and related nutrition principles. You were selected as a possible participant since you are a head and/or assistant tennis coach in Indiana. I ask that you read this form and ask any questions you may have before agreeing to be in the study.

The study is being conducted by Brian Reagan at Indiana University - Purdue University, Indianapolis.

STUDY PURPOSE

The primary purposes are to (a) identify Indiana high school tennis coaches' knowledge of disordered eating (e.g. development, prevention), weight management, and related nutrition (e.g. macronutrient and energy needs) and (b) nutrition education practices.

NUMBER OF PEOPLE TAKING PART IN THE STUDY

If you agree to participate, you will be one of approximately 500 participants who are *eligible to participant in this research.

*Any Head / assistant high school coach of any Indiana High School Boys or Girls Tennis Team anytime from Spring 2014 to Spring 2016.

PROCEDURES FOR THE STUDY

If you agree to be in the study, you will do the following:

Visit the link presented in the email. Click "I Agree." Complete the Qualtrics survey. While this survey can be completed on a compatible cell phone, it is more easily viewed on a standard computer or tablet. (For example, using a cell phone will require more side scrolling to see all questions in their entirety.) The survey will take approximately 10-15 minutes to complete.

RISKS OF TAKING PART IN THE STUDY

This study represents minimal risk of feeling uncomfortable in answering the survey. You can choose not to participate. In addition, there is a risk of loss of confidentiality.

BENEFITS OF TAKING PART IN THE STUDY

There are no direct benefits for completing the study.

ALTERNATIVES TO TAKING PART IN THE STUDY

Instead of being in the study, you have these options: Do not participate in the study.

CONFIDENTIALITY

Efforts will be made to keep your responses confidential. Your responses may be disclosed if required by law. Otherwise, we will not share your personal information (e.g. email address) without your express written consent. Only the sole researcher will have access to the data, which is stored in a password protected database. However, absolute confidentiality cannot be

guaranteed. Your identity is only connected to your email, which is only used to communicate (e.g. the delivery of survey). There is no need to use it as a personal identifier (e.g. connect person to individual results). All data will be reported anonymously in reports in which the study may be published and databases in which results may be stored.

The Indiana University Institutional Review Board (IRB) or its designees, and (as allowed by law) state or federal agencies may inspect and/or copy the assessment data for quality assurance and data analysis.

COSTS

There are no known costs to participating in the study.

PAYMENT

Upon completion of the study, you can be entered into a drawing for one of 20 pre-paid $25 Amazon.com gift cards for completing the study (a "thank-you gift"). Simply enter your email at the end of the survey, and your gift card will be emailed to you if you are selected as a winner.

CONTACTS FOR QUESTIONS OR PROBLEMS

For questions about the study, contact the researcher Brian Reagan at provided email.

For questions about your rights as a research participant or to discuss problems, complaints or concerns about a research study, or to obtain information, or offer input, contact the IU Human Subjects Office at (317) xxx-xxxx [for Indianapolis] or (812) xxx-xxxx [for Bloomington] or (800) xxx-xxxx.

VOLUNTARY NATURE OF STUDY

Taking part in this study is voluntary. You may choose not to take part or may leave the study at any time. Leaving the study will not result in any penalty or loss of benefits to which you are entitled. Your decision whether or not to participate in this study will not affect your current or future relations with Indiana University.

E-SIGNATURE

Agreeing to take part in this research requires your signature. Since participation is done online (e.g. the emailed survey), clicking "I Agree" will be accepted as your electronic signature.

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supplements. *Journal of Nutrition.* 1997;127(5):869S-873S.
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CURRICULUM VITAE

Brian P. Reagan

EDUCATION

IUPUI, Indianapolis, IN
Doctor of Philosophy: Health & Rehabilitation Sciences
Cumulative GPA: 3.92
Received February 2016

IUPUI / Indianapolis, IN
Master of Science: Physical Education-Exercise Science Track
Cumulative GPA: 3.88
Received December 2006

Marian College / Indianapolis, IN
Bachelor of Science: Dietetics
Cumulative GPA: 3.92 (*Sum Cum Laude*)
Received May 2001

- Registered Dietitian Candidate: Pending Completion of ADA Internship

ACHIEVEMENTS

Academic

- Meets Expectations Evaluations: Current UIndy teaching position
- Exceeds Expectations Evaluation: Butler University (2010-11 & 2011-12)
- Marian College, Graduated *Sum Cum Laude (3.92 GPA)*
- Graduated #1 in Department & Dean's list each semester
- Marian College, *Dietetic Student of the Year* / 2000-2001
- Marian College, 4.0 in all Dietetic and Science courses
- Marian College, *Academic Athlete of the Year* (4.0 GPA) / 99-2001 (3 years – A school record)

Athletics

- NAIA Academic All – American 1999-2000 & 2000-2001
- Marian College, Varsity Tennis *Positive Attitude Award* / 2000 & 2001
- Advanced to NAIA *National Tennis Championships* / 1998 (Tulsa, OK) & 1999 (Boca Raton, Fl)
- National Junior Tennis League (NJTL), Indianapolis Instructor of the Year / 1999

PROFESSIONAL EXPERIENCE

University of Indianapolis, Indianapolis, IN
Title: Instructor in Kinesiology 12/13 to Present

Duties: Teaching – Devise & Implement curricular components for:

- KINS 180: Teaching of Individual Activities
- KINS 185: Teaching of Team Activities
- KINS 190: Introduction to Kinesiology
- KINS 235: Motor Learning
- KINS 249: Basic Sport & Community Nutrition

- KINS 252: Weight Management
- KINS 365: Worksite Health Promotion
- KINS 390: Comm/Social Marketing for Health Promotion
- KINS 410: Biomechanics

Healthy Diploma & Advising – Fulfill following roles as directed
- Assistant Coordinator of Healthy Diploma Program
- Wellness Coaching
- SMART Goal development and accountability
- Promotion and Recruitment
- Faculty Advisor

Internship Supervisor – Fulfill following roles
- Evaluate progress for graduation requirements
- Liaison between Kinesiology Dept. and Internship Site
- Record keeping and data collection

Plainfield High School, Plainfield, IN
Title: Head Coach: Boy's Tennis Team 03/15 to Present

Duties: Player Development – Devise & implement comprehensive skill development curriculum / programs.

Match Day – Standard pre- & post- season duties
- Promote academic success and integrity
- Nutrition education
- Practice design (based on motor learning theories)
- Parent communication
- IHSAA correspondence and adherence
- Transportation & scheduling
- Awards night & *Senior Night Recognition Party* Planning

Butler University, Indianapolis, IN
Title: Faculty: Physical Education & Health Department 08/07 to 12/12

Duties: Teaching – Devise & Implement curricular components for:
- RX618: Nutrition Support
- Core Curriculum (CC) 13: Learning Golf Through Games (**Course author)
- CC 15: Weighing In On Optimal Health (**Course author)
- PE 101: Lifetime Fitness
- PE 202: Skill Series-Soccer & Basketball
- PE 203: Skill Series-Pickleball & Golf
- PE 204: Skill Series-Tennis & Badminton
- PE 253: Motor Learning
- PE 297: Orientation to Internship in Physical Education
- PE 322: Nutrition for Educators
- PE 324: Physiology of Exercise

- PE 325: The Adapted Program in Physical Education & Sport
- PE 444w: Organization & Leadership in Physical Education
- PE 445: Internship in Physical Education
- PE 446: Seminar in Internship in Physical Education

Internship Coordinator

- Create conceptual structure/framework that aligns to the student teaching model and expectations of College of Education
- Devise assessments and criteria for successful completion
- Supervisor of each semester's intern cohort

Course Innovations / Development

- Developed Inaugural *Physical Education Program* Annual Olympics
- Develop **courses for university core (*all* components from learning objectives to assessments)
  (**Learning Golf Through Games & Weighing In On Optimal Health)

NCATE & SPA Preparations

- Develop, implement, & evaluate Health SPA assessments (*Nutrition for Educators*)
- Develop, implement, & evaluate PE SPA assessments (*Skill Series courses*)
- Compose NCATE course improvement reports

Indianapolis Tennis Center, Indianapolis, IN
Title: Certified PTR Teaching Professional, 01/01 to 08/10 (Date of its closing)

Duties: Annual Curriculum Development & Teaching

- Junior Clinics (Pee Wees, Hot Shots, Future Stars, Satellite Stars, Elite)
- Nutrition Education
- Adult Clinics (Beginner – Advanced, Cardio Tennis)
- Cardio Tennis Specialist

USTA Regional Training Center (1 of 4 in Nation)

- Tennis Nutrition Advisor
- Student Video Profiles

Director – Summer Junior Tennis

- Curriculum development & implementation
- Nutrition Education
- Community Liaison

National Institute for Fitness & Sport, Indianapolis, IN
Title: Health Fitness Instructor, 8/05 to 08/06

Duties: Development, Implementation, & Evaluation of Fitness Programs

- Founder of Weight Loss Membership (Introduced 6 month rotation with Dietitians)
- Resting Metabolic Rate Testing Specialist (Test Administration & Education)
- Sole VO_2 Max specialist
- BodPod Testing
- Conduct Fitness Assessments
- Individualized Exercise Prescriptions
- *College of Education Seminars*
  (Devise practical labs/college visits for college courses)

SCHOLARLY ACTIVITY

Presentations

Reagan, B. (2015)
Educating Coaches: Knowing What You Don't Know
IAHPERD State Conference, Nov. 2015. Indianapolis, IN

Welch, M., Strawbridge, M., Reagan, B., Farley, L. (2012).
Fitnessgram: Doing it the Butler Way.
IAHPERD Regional Conference: Purdue University, Nov., 2012
Lafayette, IN

Reagan, B. (2008).
Applying Deliberate Practice iin a Skills Series Curriculum and a Physically Active Lifestyle
IAHPERD State Conference, November 17, 2011.
Indianapolis, IN

Research Interests

- Nutrition Education
- Coaching Preparation
- Biomechanics of Skill Development
- Skillfulness and Correlation to Physically Active Lifestyle

Professional Affiliations / Certifications

- Academy for Nutrition and Dietetics (Formally American Dietetic Assoc.)
- Indiana Alliance for Health, Physical Education, Recreation, and Dance, IAHPERD
- Professional Tennis Registry (PTR)
- United States Golf Teachers' Federation (USGTF)