ASSESSING THE NUTRITION KNOWLEDGE OF YOUNG ATHLETES:

DEVELOPMENT OF AN EVIDENCE-BASED QUESTIONNAIRE

By

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ASSESSING THE NUTRITION KNOWLEDGE OF YOUNG ATHLETES: DEVELOPMENT OF AN EVIDENCE-BASED QUESTIONNAIRE

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Abstract

In the midst of the American overweight and obesity crisis, statistics describing adolescents' dietary habits, physical activity levels, and organized sport participation suggest that young athletes have suboptimal nutritional knowledge and habits specific to their sports. The objective of this research was to develop an evidence-based questionnaire tool that could effectively address gaps in nutritional knowledge, thereby providing coaches and nutritionists with a starting point for developing an educational intervention program for young athletes. A review of the scientific literature revealed that common areas of concern for adolescent athletes included the intake of macronutrients (fats, proteins, and carbohydrates), calcium, iron, and fluid. Based on this evidence, a questionnaire was developed to gauge subjects' knowledge in these areas, as well as to provide insight into their attitudes and beliefs about sports nutrition. The implementation of this questionnaire is suggested in the context of a multifaceted nutrition intervention/education program that incorporates assessment of diet and physical activity (especially through technology-based methods), open discussion and learning activities, and one-on-one nutrition counseling to maximize the potential for individualization of the program. All components of this approach are evidence-based and highly customizable.

INTRODUCTION

While overweight and obesity in American adults have reached epidemic proportions, a parallel problem in the child and adolescent population has also become a major public health concern. According to the 2007-2008 National Health and Nutrition Examination Survey (NHANES), approximately 17 percent of children and adolescents between the ages of 2 and 19 years old are obese, which is about three times greater than the rate recorded prior to 1970[1]. Since then, the rate of obesity, defined by body mass index (BMI) values of greater than or equal to the 95th percentile in the Center for Disease Control's sex-specific BMI-for-age-growth charts, has risen sharply in all child and adolescent age groups. This rate of increase is greatest among 6-to-11-year-olds and 12-to-19-year-olds. It should be noted that this statistic does not include all youth who are overweight, which is defined as a BMI greater than the 85th percentile and less than the 95th percentile in these growth charts[1]; thus, it is implied that an even greater portion of American children and adolescents are at a greater weight than appropriate for their height, age, and gender, putting them at risk for obesity and its related health consequences in their adult years.

Recent data regarding the diet and physical activity of youth may offer some insight into these alarming trends. According to a study examining the eating habits of more than 4,700 adolescents aged 11 to 18, significant disparities were seen between the recorded intake of calcium, fat, fruits, vegetables, and grains, and the recommendations set forth by Healthy People 2010, which provides objective dietary goals for attenuating the rate of obesity in the United States[2]. Furthermore, a study published by the American Academy of Pediatrics observed that, on average, youth aged 2 to 19 consumed less than the minimum recommendations for all food groups including, fruit, vegetables, meat, grains, and dairy products. Approximately one-third of

the more than 3,000 youth surveyed met minimum recommendations for fruit and vegetable intake; 16 percent of the participants did not meet any minimum recommendations, and only 1 percent met all recommendations. On average, total fat and added sugars accounted for 35 percent and 15 percent of caloric intake, respectively. Based on this data, it appears that the dietary habits of youth in general fall short of recommendations and venture into intake behaviors that are associated with health risks (i.e., increased fat and sugar consumption).

Compounding these issues of inadequate or inappropriate dietary intake is the Center for Disease Control's report that only 18% of high school students had engaged in 60 minutes of physical activity daily, which is the baseline recommendation for children and adolescents by the U.S. Department of Health and Human Services, prior to their participation in a nationally representative study[4]. Additionally, 23% of the participants in this study reported doing no physical activity in the seven days leading up to the study. Thus, data suggests that youth also fall short of guidelines for regular physical activity.

While these surveys and related research suggest that American adolescents in general display poor nutrition and physical activity habits, there is less explicit information to show how youth participating in school-sanctioned sports compare to those who do not. Data compiled from the CDC's 1997 Youth Risk Behavior Survey showed that 62.4% of high school students reported participation in one or more organized sporting activities, with males (69.9%) being more likely than females (53.4%) to participate in sports[5]. Additionally, younger students were more likely than older students to participate in sports, while those identifying themselves as white had a higher rate of participation than those who were African-American or Hispanic. Students participating in sports were significantly less likely to engage in risky behaviors such as smoking and drug use. The likelihood of high school athletes to make better nutrition choices

than their peers appeared mixed, especially among the different ethnicities. There was no significant difference in the consumption of fatty foods between athletes and non athletes, and only white males and females were more likely than their peers to consume fruits and vegetables. Fruit, vegetable, and fat intake were the only concerns related to nutrition addressed in the report. Despite this study's report that children and adolescents who play sports make healthier lifestyle choices as well as its findings of a majority participation rate of adolescents in sports, the previously mentioned CDC data showed that less than one fourth of all high school students met physical activity recommendations. Additionally, it is recalled that recent NHANES data found that the 12-to-19-year-old age group had some of the sharpest increases in overweight and obesity compared to other age groups. Assuming that these data sets are reflective of the habits of American adolescents, a possible explanation for their seemingly contradictory nature is that some disparity exists in the amount of physical activity actually taking place in organized sports. Also, when it is assumed that some overlap exists between the overweight/obese adolescent demographic and the athletically-involved adolescent demographic, it is possible that poor nutrition habits counteract the tendency of sports participation to keep youth within a healthy weight range.

OBJECTIVES

Given the discrepancies between observed dietary and physical activity patterns in adolescents versus their reported rates of participation in sports, it is clear that the nutrition needs of young athletes must be addressed. One of the key steps in determining the needs of this target population is to measure existing nutritional knowledge; proper education and intervention

cannot be appropriately designed without a baseline assessment of the audience's existing fund of knowledge.

The assumption that the typical adolescent lacks sufficient knowledge to adopt appropriate nutritional habits for sports is founded in scientific literature. A study published in 2001 regarding the nutrition knowledge of competitive athletes at 16 Division I universities found that less than 30% of the participants surveyed could identify recommendations for macronutrient intake[6]. Additionally, a review article of similar studies found that college and high school athletes (as well as their peers) scored poorly on questions regarding general nutrition knowledge[7]. An important finding by the authors of this article was that nutritional knowledge is correlated with improved dietary habits; so, when it is stated in the article that college-level and elite athletes tend to have better nutrition knowledge, and when the knowledge of those groups is marginal at best, it is reasonable to infer that younger athletes (i.e., high school sports participants) have suboptimal nutrition knowledge, which is correlated with suboptimal dietary habits.

Since energy requirements and nutritional habits may vary widely across sporting activities, it is important that any assessment and subsequent intervention be tailored to the needs of teams and individual players. A simple method for this assessment is a questionnaire, based on known "problem areas" and scientific recommendations, which can be used to determine the existing knowledge of individual athletes and to formulate an effective educational approach for individuals and teams. Due to its simplicity and low cost, such a tool would be indispensible to coaches, athletic trainers, and others with a vested interest in adolescent sports.

The purpose of this research is to develop an evidence-based questionnaire that will assess the nutrition knowledge of adolescents aged 13 to 19 years old as it relates to their

participation in sports. Administering and analyzing these questionnaires will allow nutritionists and authorities in organized sports programs to determine areas where participants' knowledge may be lacking, therefore introducing risk for inadequate or inappropriate sports nutrition. From there, interventional programs can be developed to meet the needs of individuals. Such programs could include in-depth analysis of dietary intake (through methods such as verbal recall, digital record-keeping, and food frequency questionnaires), physical activity monitoring, and varying approaches to nutrition education that might consist of peer-to-peer counseling, group discussion, and hands-on learning. A combination of these components may be more effective for meeting nutritional goals than the use of materials that emphasize a "one-size-fits-all" approach across diverse sporting events.

METHODOLOGY

An evidence-based questionnaire will be developed that comprehensively addresses possible areas of concern for adolescent athletes. The questionnaire will allow educational approaches to be tailored to individuals and groups. Evidence for the questionnaire meets the following criteria:

- Published in English in a peer-reviewed journal.
- Regarded as being consistent with current professional practices in nutrition.
- Established within a recent timeframe (i.e., no earlier than the year 2000).
- Targeted specifically towards males and females aged 13 to 19 years old.
- Geared towards adolescents participating in sports or other physical activity, but not focused exclusively on one sporting event.

Evidence will be gathered through online search within WorldCat.org, which will yield results from multiple databases as well as from institutions other than the University of Arizona. The chosen keyword search phrase for this research is kw:adolescent | teen | "high school" + "sports nutrition." Resulting articles should contain either the words "adolescent" or "teen" or "high school" AND the exact phrase "sports nutrition." The specificity of the search phrase will maximize the efficiency of acquiring relevant evidence.

RESULTS

Review of Literature

The keyword search yielded 60 peer-reviewed articles published between 2000 and 2012. Of these articles, five were determined to be relevant as outlined by the criteria above (Table 1). Due to the limited results of the search, other selected evidence (articles by Bramstedt[8]; Gidding et al.[11]; and Turner[14]) was included based on literature review concerning general dietary recommendations for children and adolescents. Main areas of concern include misuse of caffeine; consumption of adequate carbohydrates, fats, calcium, and iron; fluid status; and appropriate consumption of protein, as it is sometimes assumed that all athletes should use a protein supplement.

Table 1: Dietary Recommendations and Concerns for Adolescent Athletes

Citation	Nutrition Concerns and/or Recommendations
Bramstedt[8]	Caffeine consumption is increasing among children and teens. While caffeine can benefit performance, overuse can have detrimental effects.
Cotugna, Vickery, and McBee[9]	Young athletes must consume adequate carbohydrates to maintain energy. ▪ Recommended: 50% total kcals from carbs.

	There is an upper limit for protein utilization; excess can contribute to dehydration and calcium loss. ▪ Recommended: 10-15% total kcals from protein OR 1.2-2.0 g protein per kg body weight. Low fat diets can be detrimental to growth and performance. ▪ Recommended: 20-25% total kcals from fats. Timing of nutrition before, during, and after exercise is important to performance. ▪ Recommended: Consume a small meal 3 to 4 hours prior to exercise that is low in fat, fiber, and caffeine with moderate protein and complex carbohydrate content. ▪ Recommended: During endurance events, intake of 30-60 g carbohydrate (e.g., from sports drinks). ▪ Recommended: After exercise, consume a meal containing moderate protein and carbohydrates. Youth are more prone to dehydration. ▪ Recommended: Consume 10-12 cups of fluid daily for maintenance. ▪ Recommended: Consume 12-20 oz. fluid 2-3 hours before exercise; 6-12 oz. every 15-20 minutes during exercise; and after exercise, 16-24 oz. fluid per pound lost. Common misconceptions among young athletes involve acceptable levels of calories for exercise; consumption of meat, bread, or potatoes; and limiting intake of fluids during training.
Duellman et al.[10]	Many misconceptions exist surrounding protein, including: ▪ Protein is necessary for weight gain ▪ Protein stops fat gain. ▪ All athletes should take protein supplements. ▪ Protein supplementation carries no risks.
Gidding et al.[11]	Baseline daily recommendations for individuals aged 14-18 years (based on sedentary lifestyle): ▪ Calories: 2200/male, 1800/female ▪ Fat: 25-35% of total calories ▪ Dairy: 3 cups ▪ Lean meat and beans: 6 oz./male, 5 oz./female ▪ Fruits: 2 cups/male, 1.5 cups/female ▪ Vegetables: 3 cups/male, 2 cups/female ▪ Grains: 7 oz./male, 6 oz./female ▪ Half of all grains should be whole grains.
Meyer et al.[12]	Children and adolescents must consume sufficient protein for growth and development. They must also receive adequate

	calcium for bone health. Youth have a higher relative energy expenditure for physical activity, and use relatively more fat for energy. Other concerns are dehydration and electrolyte losses during physical activity.
Petrie et al.[13]	Young athletes may be less active during non-training periods and compensate for increased energy expenditure. Additionally, since adequate protein is generally acquired in a balanced diet, protein is less of a dietary concern than athletes perceive. Restricting fat intake can be detrimental to growth. Iron and calcium are frequent deficiencies in teenage athletes, especially in females.
Turner[14]	Calcium intake in adolescents is below recommendations, particularly in females.

Sports Nutrition Questionnaire

Based on the evidence found in the literature review, a 34-question survey was written. The target demographic of this survey is high school athletes (both male and female) aged 14 to 18 years. The questionnaire consists of three main sections: the first five questions allow participants to indicate age, gender, sport, and rough training patterns; questions 6-12 are designed to assess participants' attitudes and beliefs about nutrition; and the remaining questions are meant to evaluate participants' knowledge about nutrition with concrete questions.

Section I (Questions 1-5)

1. Sport
    a. Cross Country
    b. Football
    c. Volleyball
    d. Soccer
    e. Cheer / Dance / Gymnastics
    f. Basketball
    g. Wrestling
    h. Swimming
    i. Baseball / Softball
    j. Track and Field
    k. Golf

l. Other (Please specify):

2. Gender
    a. Male
    b. Female

3. Age
    a. 14
    b. 15
    c. 16
    d. 17
    e. 18

4. How many days per week do you train / compete (physically active) for your sport?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5
    f. 6
    g. 7

5. On the days that you train / compete, how much time are you practicing or competing on average?
    a. Less than 1 hour
    b. 1-2 hours
    c. 2-3 hours
    d. 3-4 hours
    e. More than 4 hours

Questions 1-5 in the questionnaire were included to increase the possibility for customization of a nutrition intervention. Specifically, nutritional requirements vary between different sporting events; between males and females of different ages; and according to the duration of certain physical activities.

Section II (Questions 6-12)

6. On a scale of 1-5 how important do you consider sports nutrition to be in your sporting success? (1 being highest and 5 being lowest)

7. Do you believe nutrition could improve your performance in sports?
    a. Yes

b. No
c. Unsure

8. How well do you feel you are able to make food choices that are beneficial to your athletic performance?
    a. Very well
    b. Somewhat well
    c. Unsure
    d. Somewhat poorly
    e. Very poorly

9. Rate your knowledge about sports nutrition on a scale of 1-5 (1 being highest and 5 being lowest).

10. How much do you feel you learn from your coaches or other athletic staff about food choices that are beneficial to your athletic performance?
    a. Very much information
    b. Some information
    c. Unsure
    d. Little information
    e. No information

11. Who do you go to for information on sports nutrition? (Please circle all that apply)
    a. Coach
    b. Teacher
    c. Parent
    d. Friend
    e. Television
    f. Internet
    g. Doctor or other healthcare professional
    h. Magazines and books
    i. Other (Please specify):

12. How would you prefer to learn more about sports nutrition?
    a. Supermarket guidance
    b. Lectures or classes
    c. Interactive website
    d. Meeting with a dietitian
    e. Flyers and handouts
    f. Other (Please specify):

Questions 6-12 were included to provide a gauge for the survey takers' pre-existing beliefs about nutrition and how they would prefer to learn about nutrition. Responses to these questions

can provide coaches and other educators insight into audience attitude and how to best approach nutrition education.

Section III (Questions 13-34)

Test your nutritional knowledge…choose the best answer:

13. Carbohydrates are mainly found in which food group?
    a. Meats, poultry, fish, etc.
    b. Fruits
    c. Vegetables
    d. Milk, yogurt, cheeses
    e. Breads, cereals, rice, etc.

14. Approximately how much of your diet should consist of carbohydrates?
    a. Less than 10%
    b. 20%
    c. 50%
    d. 75%
    e. 100%

15. True / False: The main source of grains in the diet should be refined grains rather than whole grains.

16. Which food component has the most calories per gram?
    a. Protein
    b. Fat
    c. Alcohol
    d. Carbohydrates

17. The main source of fuel for the body is:
    a. Protein
    b. Fat
    c. Carbohydrates

18. What type of fuel do muscles use for energy?
    a. Protein
    b. Fat
    c. Carbohydrates
    d. All of the above
    e. None of the above

19. True / False: All athletes should take a protein supplement.

20. True / False: Protein does not contribute to weight gained as fat.

21. Proteins are mainly found in which food group?
    f. Meats, poultry, fish, etc.
    g. Fruits
    h. Vegetables
    i. Milk, yogurt, cheeses
    j. Breads, cereals, rice, etc.

22. Approximately how much of your diet should consist of protein?
    a. Less than 10%
    b. 10 - 20%
    c. 50 - 60%
    d. 80 – 90%
    e. 100%

23. True / False: Totally eliminating fat from your diet will improve performance.

24. Which of the following is calcium important for?
    a. Muscle contraction
    b. Bone growth
    c. A and B
    d. None of the above

25. Calcium is mainly found in which food group?
    a. Meats, poultry, fish, etc.
    b. Fruits
    c. Vegetables
    d. Milk, yogurt, cheeses
    e. Breads, cereals, rice, etc.

26. True / False: Tiredness / fatigue can be one of the symptoms of iron deficiency.

27. Which of the following is a good source of iron? Circle all that apply.
    a. White rice
    b. Red meat
    c. Leafy green vegetables
    d. Fish
    e. Soy milk

28. True / False: Caffeine can benefit performance.

29. True / False: Caffeine should be limited to prevent detrimental effects.

30. True / False: Eating carbs 2 - 4 hours before an event will benefit your performance.

31. True / False: Eating protein during an event will benefit your performance.

32. True / False: You should not consume fluids during a game or practice session.

33. True / False: Sports drinks are better than water for exercise lasting less than one hour.

34. True / False: You do not need to replace weight lost during exercise with water.

Note: Text highlighted in yellow indicates the correct answer for the question.

The questions # 13 to #34 are the core of the questionnaire and seek to assess participants' knowledge and beliefs about nutrition in general and as it relates to sports. Because nutrition knowledge has been found to be correlated with dietary habits in young athletes, it is essential to identify gaps in knowledge in these individuals in order to promote nutrition for their optimal health and performance[7]. Common areas for concern identified by the literature include: carbohydrate intake, reflected by questions 13, 14, 15, 17, 18, and 30[9,11]; fat intake, reflected by questions 16, 18, and 23[9,11,13]; protein intake, reflected by questions 18, 19, 20, 21, 22, and 31[9,10,11,12,13]; calcium intake, reflected by questions 24 and 25[9,11,12,13,14]; iron intake, reflected by questions 26 and 27[13]; caffeine intake, reflected by questions 28 and 29[8]; and fluid intake, reflected by questions 32, 33, and 34[9,12]. The recurring concerns over protein and calcium in the literature suggest that they are the most likely areas for misunderstanding or inappropriate consumption in young athletes.

The questionnaire takes roughly 25 minutes to complete; all or part of the questionnaire could be administered by coaches, athletic trainers, school staff, or nutritionists depending on the needs of their athletes.

DISCUSSION

Survey Development

The primary objective of this research was to create an evidence-based assessment tool for adolescent sports nutrition in the form of a questionnaire. This type of tool is simple, inexpensive, and conducive to the development of a custom nutrition education program by nutritionists, coaches, and other individuals. Despite the relatively limited number of articles available for use as "evidence," it was possible to develop a rather comprehensive questionnaire that addressed the most common concerns for young athletes as outlined in the scientific literature (Table 1). Each component of this questionnaire can be broken down to reflect specific concerns for this target population. The questionnaire could be used in whole or in part by coaches, athletic trainers, school staff, or nutritionists, depending on the areas of concern that they wish to address with their athletes.

While the idea of using a questionnaire to complete a needs assessment is not in and of itself a novel idea, the strength of this particular questionnaire is that it is based on scientific evidence rather than anecdotal evidence or "common perceptions" as to what constitutes actual needs and gaps in knowledge of young athletes. Nutrition education based on unfounded assumptions runs the risk of repeating already known concepts at best and ignoring important areas of risk at worst. While the survey tool resulting from this research is guided by problem areas identified by research, there is still the potential for individualization due to the wide range of areas addressed, as well as the opportunity for athletes to indicate their attitudes towards nutrition as it pertains to their performance in sports.

Weaknesses of this questionnaire include limited availability of evidence with which to support it. Additionally, the questionnaire lacks testing, so it cannot act reliably on its own to

provide a total nutrition assessment. One way to test the effectiveness of this questionnaire would be to administer it to a group of young athletes, implement a course of nutrition education, then test the participants' knowledge after the educational intervention to determine whether knowledge gaps were successfully identified and incorporated into an educational plan. The reliability of the questionnaire could be tested by repeated assessments of the same participants.

Assessment of Dietary Habits and Physical Activity

Ideally, a complete nutrition education assessment and intervention in this target population including this questionnaire would consist of multiple facets, some of which have been the subject of recent scientific inquiry. Total individual customization of any nutritional intervention requires assessing current dietary habits and needs through dietary recall and anthropometric/metabolic measurements, respectively. Of the existing instruments that assess dietary intake in adolescents and adults, many utilize some form of a food frequency questionnaire (FFQ). While this method is relatively easy, inexpensive, and requires little time for data collection, some issues exist that call into question the reliability of the data. For example, one article that discusses error in dietary measurement methods states that "subjects may find it difficult to recall and average their intakes over the long term, reported intakes may be influenced by psychological factors such as social desirability, and consumption frequencies and average portion sizes of food groups…may be imperfectly translated to specific nutrient amounts"[15]. Another article states that "[deriving] individual usual food intake data from a combination of methods seems to be a promising approach, and its methodological value has to be further explored"[16]. The combination of a FFQ, dietary recall, and food journal/food tracking could increase the reliability of the information gathered from individuals. Based on the literature, it is evident that a more accurate method of collecting information on dietary habits is

necessary to devise a realistic picture of what individuals eat. It also seems reasonable to assume that a method tailored to a specific demographic (i.e., adolescents and children) would optimize the reliability of the data collected. Evidence suggests that technologically-based collection methods such as photo and video could play a role in successfully assessing the dietary habits of younger individuals, such as our target population[17].

As physical activity is key in determining nutritional needs, the reliability of estimated, self-reported physical activity data is called into question. A report on data collection issues in research for the Healthy People 2010 Physical Activity Objectives suggests that future research incorporate accelerometry, or motion-sensitive technology, with self-report surveys; the authors state that "[complementary] data sources have acceptable accuracy and precision for researchers and practitioners"[18]. A recent Belgian study with adolescent subjects also found that significant differences in data appeared when an accelerometer was used alone for recording physical activity versus using a "non-wear activity diary" alone[19]. Essentially, research suggests that physical activity data collection is optimal when accelerometry and self-report are used in tandem.

Educational Approaches

The method of delivering sports nutrition information according to identified knowledge gaps deserves consideration. In addition to efficacy, the resources of teams, coaches, and schools must be considered in designing an optimal nutrition intervention. Several studies address the challenges of implementing such a program in this population, as well as effective methods that have been used for reaching young athletes. One proposed nutrition education program incorporates inclusion of family members, skill building (i.e., demonstrations for meal planning, cooking, and taste-testing), and self-assessment and feedback allowing for open discussion

between individuals and nutrition educators about their current habits, goals, and questions[20]. This type of program would be ideal for a group that has plentiful resources and parental involvement.

Another successful program utilized an intervention consisting of three 10-to-20-minute DVDs including information on basic nutrition principles, the importance of adopting healthy behavioral habits, hydration, and "eating for optimal health and performance;" handouts were also used to reinforce video concepts and were related to macronutrient function, food sources, and developing menus for optimal health and performance[21]. This approach might be useful for a group with less time and fewer resources, as coaches and/or staff could easily facilitate these short viewing and discussion sessions.

Additionally, peer-to-peer programs have been explored as an option for providing nutrition education. In one study, students from a Didactic Program in Dietetics (DPD) were responsible for meeting with athletes either individually or in groups, taking into consideration the participants' schedules and convenience[22]. A faculty advisor met with the educators once per week to discuss topics to be presented to the athletes; content was based largely on the USDA's MyPyramid. Results of this study indicated that peer educators were able to tailor information to the needs of individual athletes, and that athletes who had access to one-on-one sessions with educators appeared to be more interested in nutrition. This approach could be viable in a high school setting with college nutrition students acting as educators, although it would not constitute a true "peer-to-peer" program. Such a program would be favorable on two levels: first, most Dietetics students actively seek nutrition education volunteer opportunities in preparation for application to professional internships. Sanctioned opportunities for sports nutrition experience are fairly limited. Second, high school students may be more receptive to hearing from an

educator that is closer to them in age, which could facilitate more open discussions and asking questions.

CONCLUSIONS

In summary, the questionnaire developed through this research will ideally be used in a nutrition assessment and education program consisting of the following components: first, assessment of attitude and nutrition knowledge gaps among participants using the questionnaire; second, assessment of dietary intake combining one-on-one dietary recall and a technology-based collection method, such as pictures of food taken with mobile phones; third, assessment of individual nutrition needs through the measurement of physical activity based on self-report in tandem with accelerometry (i.e., a pedometer that is calibrated with an individual's weight and height); and, finally, an education program that includes open discussion between athletes, coaches, and counselors; presentation of information that addresses identified knowledge gaps; and individual nutrition counseling where time and resources permit to maximize the individualization of the intervention. The questionnaire and this suggested strategy are unique in that, unlike fitness magazine articles and some internet resources, they are evidence based and allow for a thorough, individualized approach to educating young athletes on nutrition for their optimal health and performance. All components of the intervention are based on scientific evidence.

Implementing these aspects together will foster a team learning experience while strengthening individual knowledge and habits. In any team sporting event, the success of the team is dependent on the attitude, dedication, and performance of individual team members; the same will hold true when it comes to nutrition education for young athletes. It is hoped that

exploration of the assessment and education methods proposed in this research will have a cascading effect. Increased nutrition knowledge will lead to improved dietary habits; improved diet will lead to better health; and better health will lead to optimized individual and team performance in sports.

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Appendix: Evidence-Based Questionnaire for Assessing the Nutrition Education Needs of Young Athletes

Sports Nutrition Questionnaire

Tell us about yourself…

1. Sport
    a. Cross Country
    b. Football
    c. Volleyball
    d. Soccer
    e. Cheer / Dance / Gymnastics
    f. Basketball
    g. Wrestling
    h. Swimming
    i. Baseball / Softball
    j. Track and Field
    k. Golf
    l. Other (Please specify):

2. Gender
    a. Male
    b. Female

3. Age
    a. 14
    b. 15
    c. 16
    d. 17
    e. 18

4. How many days per week do you train / compete (physically active) for your sport?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5
    f. 6
    g. 7

5. On the days that you train / compete, how much time are you practicing or competing on average?
    a. Less than 1 hour
    b. 1-2 hours
    c. 2-3 hours
    d. 3-4 hours
    e. More than 4 hours

6. On a scale of 1-5 how important do you consider sports nutrition to be in your sporting success? (1 being highest and 5 being lowest)
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

7. Do you believe nutrition could improve your performance in sports?
    a. Yes
    b. No
    c. Unsure

8. How well do you feel you are able to make food choices that are beneficial to your athletic performance?
    a. Very well
    b. Somewhat well
    c. Unsure
    d. Somewhat poorly
    e. Very poorly

9. Rate your knowledge about sports nutrition on a scale of 1-5 (1 being highest and 5 being lowest).
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

10. How much do you feel you learn from your coaches or other athletic staff about food choices that are beneficial to your athletic performance?
    a. Very much information
    b. Some information
    c. Unsure
    d. Little information
    e. No information

11. Who do you go to for information on sports nutrition? (Please circle all that apply)
    a. Coach
    b. Teacher
    c. Parent
    d. Friend
    e. Television
    f. Internet
    g. Doctor or other healthcare professional

h. Magazines and books
i. Other (Please specify):

12. How would you prefer to learn more about sports nutrition?
    a. Supermarket guidance
    b. Lectures or classes
    c. Interactive website
    d. Meeting with a dietitian
    e. Flyers and handouts
    f. Other (Please specify):

Test your nutritional knowledge…choose the best answer:

13. Carbohydrates are mainly found in which food group?
    a. Meats, poultry, fish, etc.
    b. Fruits
    c. Vegetables
    d. Milk, yogurt, cheeses
    e. Breads, cereals, rice, etc.

14. Approximately how much of your diet should consist of carbohydrates?
    a. Less than 10%
    b. 20%
    c. 50%
    d. 75%
    e. 100%

15. True / False: The main source of grains in the diet should be refined grains rather than whole grains.

16. Which food component has the most calories per gram?
    a. Protein
    b. Fat
    c. Alcohol
    d. Carbohydrates

17. The main source of fuel for the body is:
    d. Protein
    e. Fat
    f. Carbohydrates

18. What type of fuel do muscles use for energy?
    a. Protein
    b. Fat
    c. Carbohydrates
    d. All of the above
    e. None of the above

19. True / False: All athletes should take a protein supplement.

20. True / False: Protein does not contribute to weight gained as fat.

21. Proteins are mainly found in which food group?
    a. Meats, poultry, fish, etc.
    b. Fruits
    c. Vegetables
    d. Milk, yogurt, cheeses
    e. Breads, cereals, rice, etc.

22. Approximately how much of your diet should consist of protein?
    a. Less than 10%
    b. 10 - 20%
    c. 50 - 60%
    d. 80 – 90%
    e. 100%

23. True / False: Totally eliminating fat from your diet will improve performance.

24. Which of the following is calcium important for?
    a. Muscle contraction
    b. Bone growth
    c. A and B
    d. None of the above

25. Calcium is mainly found in which food group?
    a. Meats, poultry, fish, etc.
    b. Fruits
    c. Vegetables
    d. Milk, yogurt, cheeses
    e. Breads, cereals, rice, etc.

26. True / False: Tiredness / fatigue can be one of the symptoms of iron deficiency.

27. Which of the following is a good source of iron? Circle all that apply.
    a. White rice
    b. Red meat
    c. Leafy green vegetables
    d. Fish
    e. Soy milk

28. True / False: Caffeine can benefit performance.

29. True / False: Caffeine should be limited to prevent detrimental effects.

30. True / False: Eating carbs 2 - 4 hours before an event will benefit your performance.

31. True / False: Eating protein during an event will benefit your performance.

32. True / False: You should not consume fluids during a game or practice session.

33. True / False: Sports drinks are better than water for exercise lasting less than one hour.

34. True / False: You do not need to replace weight lost during exercise with water.

Note: Text highlighted in yellow indicates the correct answer for the question.