

**Coach-Facilitated Nutritional Behavior Change
in the Context of Organized Youth Sports**

By

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ABSTRACT

Anthony McClenny: Coach-Facilitated Nutritional
Behavior Change in the Context of Organized Youth Sports
(Under the direction of Cynthia Feltner)

African American (AA) adolescents have the highest rates of obesity in the United States. AA males have the highest cardiovascular disease (CVD) burden of any ethnic subgroup; yet paradoxically, they have higher or equal rates of youth sports participation compared to their peers. As a prevention effort against obesity and CVD, pediatric lifestyle behavior counseling is delivered during outpatient clinic visits. However, whether clinic-based counseling creates sustainable positive behavior change is not clear. A partial-systematic review of the literature on coach-facilitated behavior change in the context of youth sports demonstrated promising results for creating sustainable lifestyle change in children. A primary study revealed that coach-lead nutritional behavior change in youth athletes has the potential to create sustainable health behavior change. Greater than eighty percent of children participate play sports. Therefore, a behavior intervention in this context may demonstrate sustainable and positive health effect for AA male youth and all children.

Table of Contents

Background	1
Problem: Lack of Effective Nutritional Behavior Counseling.....	1
Problem: The Youth Athletes Health Paradox.....	2
Solution: Nutrition Behavior Development in Youth Sports.....	4
Methods.....	7
Partial-Systematic Review.....	7
Data Sources and Searches	7
Study Selection	7
Data Extraction	9
Primary Study.....	10
Recruitment.....	10
Study Design	11
Data Analysis Method	11
Results	13
Partial-Systematic Review.....	13
Results of Literature Searches	13
Study Characteristics	13
Study Results.....	14
Primary Study.....	16

Participants.....	16
E-Survey Results.....	16
Interview Results.....	17
Coaches Attributes.....	18
Organized Sports Atmosphere.....	18
Purpose of Sports.....	19
Sports and Nutrition Philosophy.....	20
Natural Coaching Behavior.....	20
Discussion.....	22
Partial Systematic Review.....	22
Literature Quality.....	22
Limitations.....	23
Future Directions.....	23
Primary Research Study.....	X
Product.....	25
Price.....	25
Place.....	28
Promotion.....	29
Precautions Regarding Nutritional Behavior Change	31
Inconsistent Perspectives Sports and Nutrition.....	31
Limitations and Future Directions.....	32
Conclusion.....	33
References.....	34

Appendix A – Search Algorithm.....	37
Appendix B – Quality Assessment Criteria from USPSTF experts.....	38
Appendix C – Codebook.....	39
Appendix D – Individual Risk of Bias and Assessments	45
Appendix E – Health and Youth Sports: Personal Significance.....	51
Appendix F – Social Marketing Framework	53
Appendix G – Nutritional Short Course and Activity Log.....	54

BACKGROUND

Problem: Lack of Effective Nutritional Behavior Counseling

In 2017, a study of over 21,000 10-19 year olds revealed that African Americans (3.1%) and Hispanics (2.7%) adolescents have the highest rates of obesity. (Cheung et al., 2017).

Obesity in adolescence has a significant influence on future morbidity. A 2015 systematic review concluded that “elevated childhood BMI is moderately associated with increased risk of adult morbidities such as diabetes and coronary heart disease (CHD) (Llewellyn, Simmonds, Owen, & Woolacott, 2016). Moreover, studies have also shown that there is a positive association between obesity in teenagers and obesity in adulthood (Chen & Brogan, 2012).

Traditionally pediatric obesity prevention counseling, which is referred to more commonly as lifestyle behavior counseling, is delivered during annual outpatient clinic visits. Bright Futures, the national health promotion and prevention resource lead by the American Association of Pediatrics (AAP), endorses the use of clinic-clinic based lifestyle behavior counseling stated that motivational interviewing should be tailored to child developmental levels and family readiness for change (AAP, 2017). The AAP Committee on Nutrition also recognizes that “education and advice are unlikely to be effective in most cases of obesity prevention” and that pediatricians should utilize a variety of resources to shape patient and family lifestyle behaviors (Daniels & Hassink, 2015). Unfortunately, wellness visits are short, and decrease in frequency as children age (National Center for Health Statistics, 2015). Additionally, pediatricians have limited time during well visits to address health behaviors specifically related to nutrition or weight management (Hammig & Jozkowski, 2015; AAP 2017). Furthermore, an evaluation of current clinical practice using data from the 2007-2010 National Ambulatory

Medical Care Survey (N= 4837 well-child visits) found that nutritional counseling is being implemented at a low level; whether clinic-based counseling can create sustainable behavior change and improve health is not clear (Hammig & Jozkowski, 2015).

Environmental factors play a substantial role in influencing health behavior, especially in terms of promoting poor nutritional behaviors. Although they are pervasive in the United States, these adverse environmental factors are not equally distributed. For example, one study estimated that the amount of advertisements promoting foods of low nutritional value is 13 times denser in predominantly Black neighborhoods than White neighborhoods (Yancey et al., 2009). African American children view twice as many fast food ads on television than their white peers (Harris et al., 2010). Higher exposure to these advertisements adversely affects health since fast food marketing works. For example, one survey found that 40 percent of parents reported that their child asks to go to McDonald's at least once a week (Harris et al., 2010). The need for effective and consistent health behavior counseling or, even better, "counter-marketing" is essential for helping children develop healthy nutritional behaviors. Counseling in primary care, even if delivered effectively, is likely not sufficient given the environmental factors that influence health. Interventions in multiple settings relevant to child health are needed.

Problem: The Youth Athlete's Health Paradox

Whether pediatricians recommend organized sports participation as a form of physical activity or not, many families utilize organized sports to fulfill their children's needs for physical activity. Previous evidence has shown that an overwhelming majority – approximately 84% – of children (grades 3-12) in the United States participate in youth athletics (Larkin, Lopiano, Messner, Miller, & Roche, 2008). In the United States, participation in youth sports is estimated

in the millions, ethnically diverse, and generally assumed to produce health benefits for participants later in life (Kelley & Carchia, 2013). African American males have equal or higher rates of youth sports participation than their peers, but also have the highest adult rates of cardiovascular disease (CVD) and lowest life expectancy of any ethnic sub-group in the United States (Kochanek, Murphy, Xu, & Tejada-Vera, 2014; Larkin, Lopiano, Messner, Miller, & Roche, 2008; National Center for Health Statistics, 2017). Sixty-nine percent of African American men are overweight or obese, and African Americans continue to have a high prevalence of Type II Diabetes Mellitus (Skinner & Skelton, 2014) (CDC 2017). These diseases manifest themselves later in life, but the groundwork for development of these conditions begins much earlier. If young African American males who are exposed to organized sports and exhibit near peak fitness cannot maintain health benefits after the sport has ended, what hope can we have for those without this early beneficial health state and exercise routine?

This paradoxical relationship between youth sports participation and adult health is potentially explained by research showing that youth organized sports participation is associated with poor food choices by children and families (Bean, Fortier, Post, & Chima, 2014; Chircop et al., 2015). Research suggests that the excess calories consumed by youth athletes come from fast food and sugar-sweetened beverages (Nelson et al., 2011). For example, a study of middle school and high school athletes showed a positive association between organized sports and fast food consumption in males (French, Story, Newmark-Sztainer, Fulkerson, & Hannan, 2001). The concern is that this combination of physical activity and poor nutritional choices could create a false impression that dietary choices are inconsequential when exercising, and potentially reinforces poor nutritional behaviors.

A potential inverse relationship between organized sports participation and physical health seems counterintuitive. The common expectation is that sports participation should translate into better health habits during childhood and adulthood. Surprisingly, a study of former Division I college athletes, with mean age approximately 50, performed more poorly than non-collegiate athletes in percent body fat, mile time, sit-to-stand test, and push-up test. (Simon & Docherty, 2017). Of the members in the college athlete group, 30% were former football players and 70% non-football players. This study implies that even if children continue sports past adolescence and into adulthood, this does not guarantee sustained fitness; developing good nutritional habits are important to maintaining a healthy weight and lifestyle as mobility in adulthood declines.

Solution: Nutritional Behavior Development in Youth Sports

Childhood eating habits shape adult eating habits (Nelson et al., 2011). Nutritional behaviors are key modifiable components that contribute to the onset of chronic diseases in adulthood. Although other factors, such as genetics, are important contributors to diabetes and CVD, special attention should be given to the development of good nutritional behaviors during childhood when habits are generally easier to influence. A systematic review questioning the protective effects of youth sports found that organized sports, as it is currently structured, may not protect children from becoming overweight or obese (Nelson et al., 2011). Some have suggested addressing this problem by developing training and educational materials for youth coaches in an accessible format (Nelson et al., 2011). In addition, another study suggested that both healthy nutritional habits and sports participation should be promoted together. (Cavadini, Decarli, Grin, Narring, & Michaud, 2000)

The ultimate success of any program shaping the nutritional habits of children will rely on the collaborative efforts of a community of coaches, administrators, parents, and other community stakeholders (i.e. policymakers, public health practitioners, schools); nonetheless, coaches will be the key component of any nutritional program implemented in the context of sports. In Sydney, Australia, coaches of organized sports teams for young girls felt that they had the potential to influence physical activity and were also described as underestimating and not realizing the level of their potential influence (Guagliano, Lonsdale, Rosenkranz, Kolt, & George, 2014). Provided the right tools, coaches could realize their potential to influence other areas of health such as nutritional behaviors. Suggested by another study in Belgium, these tools should include nutritional prioritization from athletic administration and educational training (Meganck, Scheerder, Thibaut, & Seghers, 2015). These studies describe insight among coaches from the international community, but how do volunteer sports coaches and youth sports administrators in the United States feel about their ability to shape the nutritional behaviors of children, and could they be effective social marketers of a nutritional behavior change program for youth athletes? The level of importance children place on organized sports participation, the consistent contact coaches have with their players, and coaches equipped with the tools necessary to be social marketers of nutritional behavior change could alter youth eating habits in a sustainable way.

An intervention targeting nutritional behaviors among children in the context of organized sports could be particularly effective in young African American males given the already integral, and sometimes controversial, role of sports in the development of the African American male identity (Harrison, Harrison, & Moore, 2002). Research on African American male college athletes demonstrates an overemphasis of sports participation relative to other

elements of their early lives (Beamon, 2010). Another study suggests that interventions directed at improving healthy food choices of African American teenage males should consider how several cultural elements, including athletics, may influence food choices (Savoca et al., 2011). Organized sports can be leveraged to influence the nutritional behaviors that last beyond the inevitable end of sports participation. Even though these conclusions describe the potential for this type of program to influence young African American male nutritional behaviors, it is possible that success of a widely implemented nutritional program in the context of youth sports will have a positive influence on all ethnic populations in the United States given high rates of organized sports participation among all groups.

Designing a nutritional behavior change intervention for youth athletes requires understanding the perspective, beliefs, level of willingness, and barriers to behavior change in organized youth sports. This paper will address some of these factors using two methods. First, a partial systematic review of the literature was conducted to identify studies assessing coach-facilitated nutritional behavior change interventions in the context of organized youth sports. Secondly, primary research involving stakeholder interviews and surveys will address the following aims: 1) explore how youth sports coaches think about the purpose of sports and its relationship to nutrition; 2) understand beliefs about the atmosphere of organized youth sports and how coaches and others perceive their role; 3) determine the potential of coaches as effective facilitators of a nutrition behavior intervention on youth athletes; and, 4) understand barriers to nutritional behavior change in the organized sports context.

METHODS

Partial-Systematic Review

Data Sources and Searches. I adapted a systematic review protocol from the PRIMSA-P 2015 reporting guidelines to produce a partial-systematic review (Moher, Liberati, Tetzlaff, Altman, & Group, 2015). PubMed and Scopus were searched and identified relevant studies meeting the eligibility criteria summarized in Table 1. Library science experts assisted in developing the search algorithms. Search terms included “coaches”, “sports”, “nutrition”, and “children”. Relevant search term limiters were also used to produce a targeted search, such as “NOT elderly” and “NOT injury”. The exact search algorithms for both PubMed and Scopus can be found in Appendix A. Additionally, Clinicaltrials.gov (CTG) was searched to identify relevant unpublished studies. The researchers searched CTG with the key term “nutrition” and with an intervention specific search term that included “coach”. The only filter term was “child (birth-17)”. All three databases were searched from inception through April 16th, 2018.

Study Selection. Titles and abstracts searched in PubMed and Scopus were screened for relevance against the criteria listed in Table 2. Eligible studies were those that enrolled youth athletes, assessed a nutritional intervention delivered in the context of sports involving a sports coach, and reported on outcomes of nutritional improvement and/or lifestyle behaviors. The full-text of articles marked as potentially relevant were reviewed again against the same criteria.

Table 1. Eligibility Table

	Inclusion Criteria	Exclusion Criteria
Population(s)	Children ages 5-17 years old who play organized sports	Adult ages 18+
Intervention	Nutritional behavior change intervention facilitated by sports coaches	health coaches, nutrition coaches, lifestyle coaches
Comparators	Sports participation with no nutritional behavior change component	N/A
Outcomes	Nutritional Behaviors (i.e. increased nutrient dense foods, increased protein intake, decreased fast food intake)	
Timing	No limits	N/A
Settings	Organized sports programs, leagues, or clubs	Clinic-based studies
Study Designs	Observational studies, randomized control trials, case studies, non-randomized control trials, systematic reviews, narrative reviews	N/A

Abbreviations: N/A= not applicable

The strictest inclusion criterion was that sports coaches intervened on the nutritional intake of athletes. The study was excluded if a sports coach was not directly involved or could not be interpreted as having active involvement in the intervention. The study aim had to assess an intervention involving sports coaches that influence the nutritional behaviors of youth athletes. Studies were not included where the coach was described as a nutritional coach, wellness coach, or lifestyle coach. Coaches had to be interpreted as individuals that provided or who would provide direct instruction to players on the field or court during gameplay.

Articles solely primarily on increasing or understanding “positive youth development” (PYD) were excluded. PYD is loosely defined as intangible, positive characteristics, and social skill development that people believe can be associated with sports participation such as teamwork, perseverance, and confidence (Falcão, Bloom, & Gilbert, 2012).

If an article did not directly state or suggest that the intervention intended to influence the nutrition of athletes as a part of PYD, it was not included.

Table 2. Selection criteria for study inclusion

Technical Criteria	Is the article written in English?
	Is there a full-text article available?
Substantive Criteria	Are the research participants children (under 18 years of age)?
	Are the research participants athletes?
	Are sports coaches facilitating the intervention?
	Does the intervention take place in the context of sports?
	Is this study related to nutritional intake?
	Is the aim of the study to improve nutritional intake of youth athletes?

Data Extraction. All studies meeting full inclusion criteria were appraised using study quality criteria recommended by experts on US Preventative Service Task Force (USPSTF) critical appraisal methods (Appendix B). All studies were included in the final discussion regardless of the quality assessment rating. Data extraction variables included qualitative and quantitative elements related to study design, population, intervention, and outcomes (Table 3). Data extraction were used in the data synthesis stage to allow discussion of the comparability of studies and whether or not qualitative, summative statements relative to the outcomes of coach-facilitated nutritional interventions could be made on the body of literature as a whole.

Table 3. Data Extraction Variables

Study Design	Drop-out Rate
Purpose of Study	Missing Data
Sport Type(s)	Average Age
Funding Source	Sample Size
Study Setting	Difference in Effect Measure
Target Nutritional Behavior(s)	Outcome and Confidence Intervals
Recruitment Method(s)	Outcome and Statistical Significance Value(s)
Randomization	
Method of Measurement	
Description of Intervention	
Relevant Results	
Sub-analyses Outcomes	
Conclusions	
Implications	

Primary Study

Recruitment. The principal investigator (PI) contacted the athletic supervisor at Town of Chapel Hill Parks and Recreation (TOCPR) in Chapel Hill, NC and was granted approval to recruit coaches to be study participants from the organization. A scripted email and introductory video accessible on YouTube was created and circulated to encourage coaches to participate. The TOCPR marketing department forwarded the email to a listserv containing 50 youth sports coaches and 16 administrators. The recruitment email was circulated twice, during late April and mid-May. Interested coaches were directed to a digital consent form. After consenting, participants were able to sign-up for interview time slots. Interviews were held at the TOCPR administrative offices or another private meeting place convenient for the interviewees. At the end of each interview as an additional recruitment method, coaches were asked if they would be willing to contact other coaches who may be interested in sharing their experiences about coaching and nutritional behavior change.

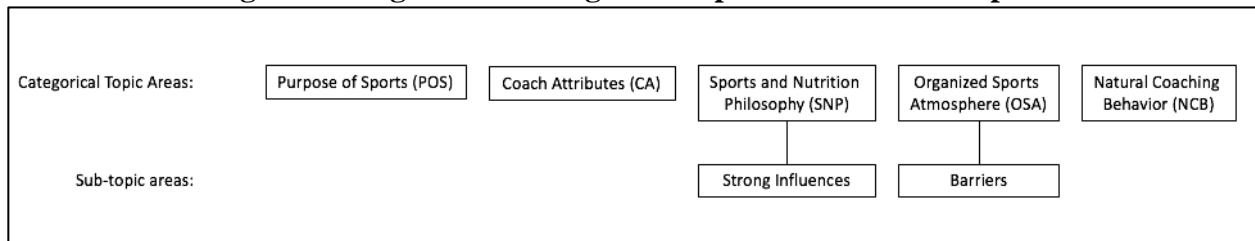
Study Design. The research inquiry was based upon a grounded theory study design and was comprised of in-depth interviews and e-surveys. Grounded theory studies utilize deductive and inductive reasoning “grounded” in the data in order to generate conclusions (Nieswiadomy, 2011). Interview slots were 60 minutes in length to allow for extended discussion and ample time to complete e-surveys. A PI-designed semi-structured interview protocol encouraged rich discussion regarding organized sports culture and nutrition behavior development in children. A semi-structured interview guide containing 16 open-ended questions and 5 closed-ended questions was used to facilitate the interview. After each interview, participants were asked to complete a 5-minute e-survey containing 41 closed-ended questions. The survey was administered through Qualtrics, an online survey software. All results were anonymous and password protected. The researcher recorded each interview, upon participant consent, except for one due to a technology malfunction. As a backup, notes were taken during every interview and verified for accuracy by the interviewee. Interviews were transcribed verbatim and coded by the PI, de-identified and saved to a password protected computer.

Data Analysis Method. Interview transcripts were managed and coded in Microsoft Word and Excel. Transcripts were coded using a mixed methods approach, combining conventional and summative qualitative content analysis approaches. A conventional qualitative content analysis approach derives emerging themes from collected data. A summative qualitative content analysis approach utilizes code frequency counting and comparisons of themes to derive meaning from interviews. Transcripts were first read to develop data familiarity; all reads thereafter were to develop codes. The PI organized transcripts to determine overall code frequency as if an interview transcript had been generated combining all responses from coaches. The PI also organized code worksheets to determine which codes had been assigned during 60,

80, and 100% of coach interviews. The relative significance of themes was then determined quantitatively by frequency of code assignment.

Individual codes were assigned and grouped into 5 categorical topic and sub-topic areas (Figure 1). Codes with an overall frequency of 10 times or greater during were considered “heavily mentioned codes”. Codes that arose 5-9 times were labeled “often mentioned codes” and those mentioned 3-4 times were labeled “commonly mentioned codes”. Ten was selected as the lower cutoff for the highest category of significance based on the following reasoning: if a code was assigned 10 times or greater, the average mentioning of that particular code per coach would be two or greater. Themes that are reiterated twice during an interview for two distinct questions have greater significance. A relative higher level of significance was given to these themes compared to other that arise less than 10 times. For instance, an overall code frequencies of 3 and 4 guarantees that not every coach mentioned this theme; therefore, suggesting a lower relative significance. A coach could mention a code more than once during an interview but it was only counted multiple times if mentioned in response to two or more distinct questions. The PI did not repeat codes if a discussion point was repeated in response to follow up questions within the same parent question. A codebook can be found in Appendix C.

Figure 1. Diagram and categorical topic areas and sub-topics



RESULTS

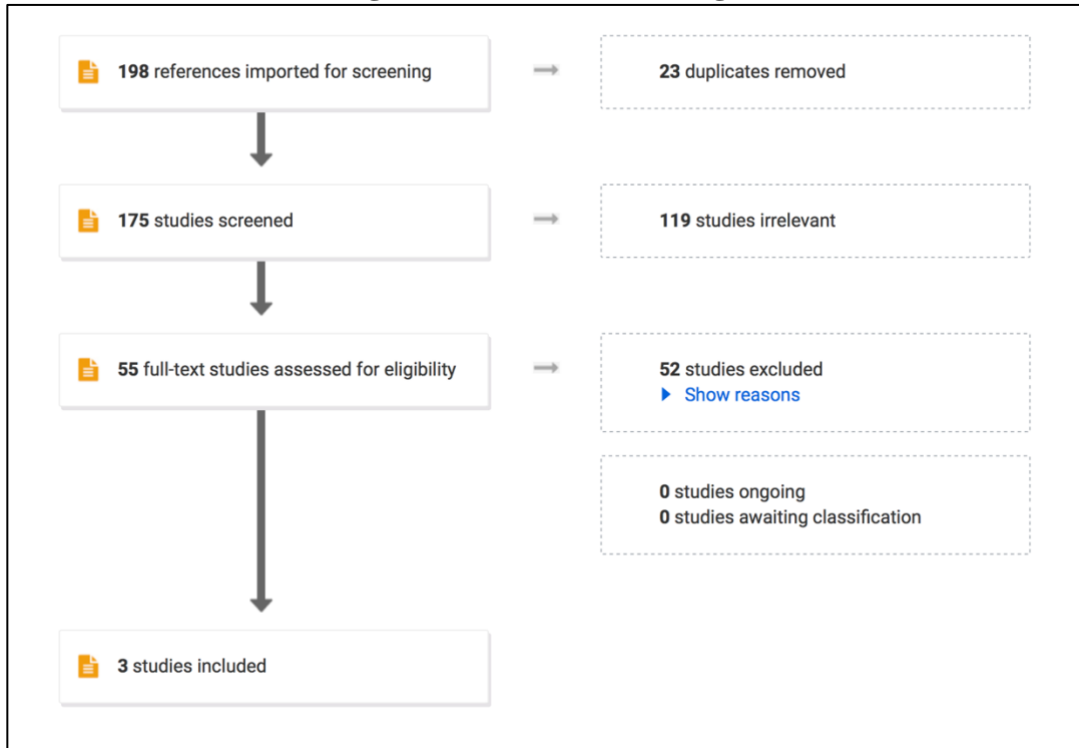
Partial-Systematic Review

Results of Literature Searches. Two hundred and twenty references were imported for screening from PubMed and Scopus. A total of 163 studies were excluded at the title-abstract stage because they did not explicitly state or imply an aim of nutritional improvement, state youth athletes as the target population, and directly mention or imply involvement of a coach. Fifty-seven studies were eligible for full text assessment. Fifty-three studies were excluded in the full text review because of one or more of the following: wrong intervention, wrong aim, no full text availability, wrong outcomes, or wrong target population. After full text review, 4 articles were left for inclusion and full data extraction. Two of the four articles were published on the same study and there for 3 studies were included in the review (Figure 1).

Study Characteristics. Overall, the three included studies were heterogeneous. Two articles were prospective observational studies (Regina Belski et al., 2017; Falcão et al., 2012). The third study analyzed results of a randomized control trial titled, the Adolescent Training and Learning to Avoid Steroids (ATLAS) study (Goldberg et al., 2000). The age of the participants ranged from 5 to 17 years of age. Ethnic diversity was limited in the ATLAS study (Hispanic 3.7%, African American 5.6%, Asian 3.8%). The other studies did not report race. Behavioral interventions for adolescents and teenagers were education focused while interventions for younger children involved providing tangible healthy food options in the sports context. Across studies coaches were primarily facilitators of the intervention and were not directly educating athletes about nutrition. Measurement of outcomes utilized interviews and survey data. Of the 3 studies, one was rated as good quality and two were rated as poor. Individual study quality

ratings are described in Appendix D. Common sources of bias include selection bias, social desirability bias, and confounding.

Figure 1. PRISMA flow diagram*



*Does not include 44 studies from ClinicalTrials.gov that was excluded at the abstract and screening stage, and 1 clinical trial that was excluded at the full-text screening stage. 4 total studies had “wrong target population”

Study Results. Overall outcomes were positive. As a result of the heterogeneous outcome of the studies, the results of each study will be described individually. The primary aim of The Adolescent Training and Learning to Avoid Steroids (ATLAS) Study was to reduce new anabolic steroid use among high school football players. A secondary outcome improved nutritional behaviors. Compared to baseline surveys, outcomes measured immediately post-intervention showed a statistically significant reduction in the percent of students who intended to use steroids and percent of new steroid users among the intervention group compared to the

control group. P-values for these changes in Standard Deviation (SD) units were less than 0.05 (% change in SD units 1.5 vs 2.5) and 0.04 (% change in SD units 7.5 vs. 11.0) respectively. At 1-year post-intervention, there was no significant difference between intervention and control groups in the percent of new steroid users ($p < 0.08$). However, the percent of students who reported an intention to use was significantly lower in the intervention group compared to controls ($p < 0.02$). Improved nutrition behaviors (increased consumption of carbohydrate, protein dense, and low fat foods) at the 1-year follow up were maintained (% change in SD units 11.2 vs. -5.7; $p < 0.02$).

The primary results of the study titled, The impact of coaches providing healthy snacks at junior sport training, were positive: youth participants increased consumption of healthy snacks and coaches reported improvements in attention and sports participation during sporting sessions when healthy snacks were available. However, neither were statistically significant. The majority of parents (67%), who reported making changes to their child's food intake before netball sessions (post intervention season), referenced either healthier snacks or providing the kinds of snack given during the intervention period.

The final study included in the review titled, Coaches' Perceptions of a Coach Training Program Designed to Promote Youth Developmental Outcomes, examined the impact of a 2-hour coach workshop on development of various positive youth development outcomes, one of which included youth athlete awareness and the importance of health. The result of a component of the intervention, a healthy team meal chosen by the players during a grocery store visit with the coach, showed improved team cohesiveness. However, no reference to improved nutrition in youth athletes was reported.

Primary Research Study

Participants. Ten percent of the coaches receiving the recruitment email participated in an interview and e-survey (N=5). No administrators participated in the study. The sports represented in the study were basketball, baseball/softball, football, and soccer. The average age of coaches was 38.6 and the age range of the youth athletes led by these coaches was 7 to 17 years of age. Four coaches were White and one was Black; two coaches were female and three were male. The average number of years spent coaching was 4.8. The following professions and learner levels were represented in the study sample: accounting, pediatric medicine, medical school administration, medical student, and undergraduate student. The average income of coaches reporting an income (N=4) was \$156,250; one coach was an undergraduate student. All study participants had been actively coaching over the last 6 months except for one who had 10 years of coaching experience but not currently coaching. All coaches owned smart phones.

E-Survey Results. The 4 coaches currently coaching were collectively interacting with 73 youth athletes and 30% of those athletes were perceived as members of minority ethnic groups. In this study, a minority ethnic groups were explicitly defined as African American, Hispanic, and Asian American, and non-White individuals as perceived by the coach. Coaches believed that approximately 11% of their players were overweight. Sixty percent (N=3) of coaches thought that being overweight negatively impacted the performance of players. Forty percent (N=2) of coaches were aware of parents who were concerned about their child's weight and had specifically mentioned wanting their child to play sports as a method for losing weight.

The average amount of weekly time coaches spent with teams during the season was seven hours. This included about 2.8 hours of practice time per week with each practice session lasting for 71.8 minutes. The average amount of time coaches currently spent talking about

nutrition with their players during practice time is 3.5 minutes, with the majority of coaches not spending any time at all (N=3). The lowest average amount of time that coaches were willing to spend talking about nutrition with players during practice time was 8.4 minutes (range 2 to 15 minutes).

In relation to coaches' observations about their own behavior regarding nutrition in the sports context: 80% (N=4) coaches said their players see them eating healthy; 40% (N=2) of coaches told players to avoid poor food choices; and, 80% of coaches told players to avoid poor beverage choices. All coaches reported believing they would receive personal benefit from sharing nutritional information with their players.

Regarding coaches' beliefs about players and families, one coach thought that players knew what to eat to optimize their performance. Only one coach recalled parents or athletes asking them questions about nutrition. Few coaches (N=2) thought parents knew what players should eat to optimize their sports performance, and all coaches thought that parents would be supportive of improving the nutritional habits of their child to improve the child's performance.

Interviews Results

Sixty-five individual codes were assigned and grouped into 5 categorical topic and sub-topic areas. Two heavily mentioned codes (assigned ≥ 10 times) were *Organized Sports Atmosphere (OSA): Barriers - Financial Limitations on Accessing Nutritious Food* and *Sports Nutrition Philosophy (SNP): Strong Influence - Family Nutrition*. Often mentioned and commonly mentioned codes can be found in Table 4. The codes most mentioned in each categorical topic area can be found in Table 5. Codes that were mentioned by 60, 80, and 100 percent of coaches can be found in Table 6.

Coaches Attributes (CA). The most frequently assigned code was *CA: Positive*. This code was assigned when a coach described him- or herself as “positive” or when they believed that players or parents would describe them as such. One coach said the following about how parents described him, “*So I will tell you the feedback that I have gotten from my parents. The parents have said, you know, that they appreciate my positive style of coaching.*” Another coach described herself as “*positive, and easy, more cheerleader-y*”. Often mentioned codes regarding coach attributes include *CA: Fair/Equitable* and *CA: History of Personal Sports Involvement*. A history of personal sports involvement was the only coach attribute mentioned by all coaches.

Organized Sports Atmosphere (OSA). The most frequently assigned code was *Barriers – Financial Limitations on Accessing Nutritious Food*. This code was assigned when a coach referred to financial limitations as a barrier to successful nutritional behavior change in youth athletes. One coach said the following:

“Resources, in my eyes that’d be a big one. Financial resources to make it happen. I mean, we also got to call a spade a spade man. And you know quality nuts, quality meats, quality fruits, and vegetables, like that’s not the cheapest stuff you can find in the grocery store.”

Often mentioned codes in this category can be found in Table 4. Often mentioned codes identified within the *Barrier* sub-topic were athlete/parents lacking interest in nutrition, lack of nutrition knowledge among athletes and parents, parental habits, and time. *OSA: Barrier - Financial limitations*, *OSA: Barrier - lack of nutrition knowledge among parents and athletes*, and *OSA: Barrier - parental habits* codes were mentioned by all coaches (Table 6).

Table 4. Frequency of Leading Code Assignments

Heavily Mentioned (>= 10)	Often Mentioned (5-9)	Commonly Mentioned (3-4)
<ul style="list-style-type: none"> OSA: Barriers - Financial Limitations on Accessing Nutritious Food, 	Coach Attribute (CA): <ul style="list-style-type: none"> CA: Fair/Equitable CA: History of Personal Sports Involvement CA: Positive 	Coach Attribute (CA): <ul style="list-style-type: none"> CA: Competitive CA: Humorous CA: Teacher CA: Passionate about coaching
<ul style="list-style-type: none"> SNP: Strong Influence - Family Nutrition Habits 	OSA Organized Sports Atmosphere (OSA): <ul style="list-style-type: none"> OSA: Barriers - Lack of Interest in nutrition by athlete/parent OSA: Barriers - Lack of Nutrition Knowledge OSA: Barriers - Parental Habits OSA: Barriers – Time Limitations on Accessing Nutritious Food 	OSA Organized Sports Atmosphere (OSA): <ul style="list-style-type: none"> OSA: Poor Nutritional Habit Development OSA: Intense Sports Environment (~7-17)
	POS Purpose of Sports (POS): <ul style="list-style-type: none"> POS: Positive Social Development 	SNP Sports and Nutrition Philosophy (SNP): <ul style="list-style-type: none"> SNP: Affirmation of Coach Potential Influence on Nutrition SNP: Teaching Good Nutrition is part of Coaches Responsibility
	SNP Sports and Nutrition Philosophy (SNP): <ul style="list-style-type: none"> SNP: Good Nutrition supports Sports Performance SNP: Affirmation of Coach Potential Influence on Nutrition SNP: Affirmation of Coach Potential Influence on Nutrition as Kids Grow older SNP: Positive Role Modeling SNP: Strong Influence - Peers 	

Purpose of Sports (POS). The most frequently assigned code was *POS: Positive Social Development (Table 5)*. This code was assigned when coaches mentioned that sports developed positive life skills related to socializing with others. One coach stated, “*we have to make sure our kids are normalized early on to engaged in face-to-face real-life relationships and sports is a nice medium for that.*” *POS: Positive Social Development* is an often-mentioned code (Table 4) and was the only code mentioned by all coaches in this category.

Sports and Nutrition Philosophy (SNP). The most frequently assigned code in this categorical topic area was *SNP: Affirmation of Coach Potential Influence on Nutrition as Kids Grow Older*. This code was assigned when coaches would express beliefs about the increasing influence of coaches on players as they age. One coach said, “*coach influence increases as kids age. Some kids may also resent parents as they age and look to the coach as an outlet.*” This topic was mentioned by one coach many times. A tie occurred in the second most frequently assigned code in this category which was *SNP: Positive Role Modeling* and *SNP: Barriers – Peers*. Examples of these two codes are the following:

SNP: Positive Role Modeling: “*Yes, kids are always watching you.*”

SNP: Barriers – Peers: “*The schools. Because schools are where peers congregate. Peers are a huge influence on kids. The data shows that they’re far bigger influence on kids than I am as a parent, and certainly as a coach. And schools are where kids congregate. Watching my own kids grow up man, I see you know, the influence that the playground has. I tell you man, that playground [laughing]. It invades, it just dominates man, it just dominates.*”

Often mentioned codes in this category can be found in Table 4. *SNP: Positive role modeling* and *SNP: peers as strong influences* were the codes that arose during all coach interviews in this category (Table 4).

Natural Coaching Behavior (NCB). This categorical topic area only had two codes assigned and they only occurred once or twice. This categorical topic area will not be explored due to the low number of codes assigned from in this categorical topic area.

Table 5. Highest overall frequency codes by categorical topic area

Category	Code
Coach Attributes (CA)	CA: Positive
OSA Organized Sports Atmosphere (OSA):	OSA: Barriers - Financial Limitations on Accessing Nutritious Food
POS Purpose of Sports (POS)	POS: Positive Social Development
SNP Sports and Nutrition Philosophy (SNP):	*SNP: Affirmation of Coach Potential Influence on Nutrition as Kids Grow older
NCB Natural Coaching Behavior (NCB):	**N/A

*Mentioned by one coach many times. Second place tie - SNP: Positive Role Modeling and SNP: Barriers – Peers.

**N/A – codes were only mentioned once or twice in this category.

Table 6. Codes mentioned by 60, 80, and 100 percent of coaches

Mentioned by 100% coaches	Mentioned by 80% coaches	Mentioned by 60% coaches
*CA: History of Personal Sports Involvement	CA: Fair/Equitable	CA: Humorous
**OSA: Barriers - Financial Limitations on Accessing Nutritious Food	OSA: Barriers - Lack of Interest in nutrition by athlete/parent	CA: Positive
OSA: Barriers – Lack of Nutrition Knowledge	OSA: Barriers – Parental Habits	CA: Teacher
POS: Positive Social Development	***SNP: Strong Influence – Family Nutrition Habits	OSA: Barriers - Time Limitations on Accessing Nutritious Food
SNP: Positive Role Modeling	SNP Sports and Nutrition Philosophy (SNP): Good Nutrition supports Sports Performance	SNP: Affirmation of Coach Potential Influence on Nutrition
SNP Strong Influence – Peers		OSA: Poor Nutritional Habit Development
		SNP: Teaching Good Nutrition is part Coaches Responsibility

*CA – Coach Attributes. **OSA – Organizes Sports Atmosphere. ***SNP – Sports and Nutrition Philosophy

DISCUSSION

Partial Systematic Review

Literature Quality. Overall, a limited number of studies exist exploring coach-facilitated nutritional behavior change interventions in the context of organized youth sports. The three included studies assessed heterogeneous interventions and reported on different outcome measures. The potential for selection bias was medium to high for across all studies because participants who did not have a favorable predisposition to the purpose of the intervention could easily opt out. Another weakness in the majority of studies is small sample size. A unique positive aspect of the ATLAS study worth mentioning it did have a large sample size and controlled confounding well. When differences in baseline characteristics and drop-out rates of the interventional and control group were controlled outcomes were unchanged. However, the other studies made no attempt to control for confounders. Pressure to provide social desirable answers about child nutrition with researchers was also a likely confounding factor as well across all studies. Generalizability for the studies was also somewhat limited given the homogeneity of study participants and likelihood of positively biased beliefs in the efficacy of the nutritional behavior intervention. Perhaps study participants who did not believe very passionately in the benefits of improved nutrition would not respond as positively by an intervention to change habits. Unfortunately, outcomes of the interventions were short-term limiting the observance of long-term effects of behavioral interventions.

The quality of the body of literature as a whole due to its limitations was therefore at best poor to fair. The heterogeneity of the outcomes and study type do warrant mentioning that the largest study, The ATLAS study and only randomized control trial, was of good quality given the sample size, length of study, and number of controlled variables. The other two studies were

poor in quality given their small sample size which results in increasing the risk of biases described above (Regina Belski et al., 2017; Falcão et al., 2012). Individual critical appraisals for risk of bias are found in Appendix D. Ultimately, these two articles lowered the quality rating of the body of literature on this topic. Nonetheless, results from this partial systematic review suggested that longitudinal health behavior interventions, combined with greater access to nutritious foods, and a supportive behavior change environment in organized sports have a positive influence on the adoption of positive nutrition behaviors in youth athletes.

Limitations. Several limitations exist within this partial systematic review that could be improved upon in later reviews. Title, abstract, and full-text screening processes were performed by one individual. Unfortunately, articles that did not have English translation were not included in the review. No meta-analysis could be performed given the heterogeneity of outcome measures. The low number of articles published on this topic could be a result of the ethical difficulties of studying the benefits of positive nutrition behaviors on youth athletes and future morbidity, a topic that does not lend itself easily to a randomized control trial format.

Future Directions. Despite the promising results, more research is needed in this area of sustainable youth nutritional behavior development in the context of youth sports. Next steps in this field of research is to better understand the culture of the sports environment and beliefs about nutrition. Understanding how coaches, parents, and players think about nutrition and sports performance would be helpful in shaping how messaging and informative lessons should be framed in a nutritional behavior change intervention. Another future area of inquiry should seek to understand the barriers to successful behavior change in the organized sports environment such as time, finances, and nutritional knowledge. Understanding these factors will assist in developing a well-designed nutritional behavior intervention that will be successfully adopted

and supported by all stakeholders in organized youth sports. Future research is needed to clarify whether certain intervention types are more effective than others, and whether results differ by participant characteristics (e.g., type of sport, age of athletes) or other factors. Future studies should also investigate the cost-effectiveness of comparable interventions. The next section of this paper will discuss a primary study with Town of Chapel Hill Parks and Recreation (TOCPR) coaches aimed to uncover a number of these important factors shaping the design of a nutritional behavior change intervention in the context of organized youth sports.

Primary Research Study

The partial-systematic review of the literature did not reveal any paradigm models for coach-facilitated nutritional behavior change interventions in the context of organized youth sports. However, each study suggested potential intervention elements that could be combined to create a nutritional behavior change program for children. In this section, we will discuss the results from the primary study from a social marketing perspective which has promise of being an effective approach to understanding the necessary elements for successfully changing the nutritional behaviors of youth athletes. Social marketing is “the application of commercial marketing technologies to the analysis, planning, execution, and evaluation of programs designed to influence the voluntary behavior of target audiences in order to improve their personal welfare and that of their society” (Andreasen, 1994). This behavior theory will help communicate implications of the results of the primary study on the future design of an intervention improving the nutritional behaviors of children in the organized sports context. Discussion of the results of this primary study is organized by a simplified social marketing framework known as the 4P’s:

Product, Price, Place, and Promotion. Note, the names of children in quoted remarks from coaches have been replaced with letters to protect their identities.

Product. The core product in the social marketing framework is typically the behavior the audience is ultimately intended to adopt which in this primary study are nutritional behaviors that optimize sports performance, nutritional intake, and health of youth athletes. According to the results of the primary study, coaches and parents appear to be predisposed to a positive outlook on the product. The majority of coaches believe that good nutrition supports athletic performance and all of the coaches believed that parents would be supportive of improving the nutritional habits of their child in order to improve sports performance. Despite the positive predisposition, additional tools may be needed to help facilitate the adoption of new nutritional behaviors for youth athletes and their families. In the social marketing framework, interventions or tools that enable target audiences to obtain their desired core product are called “augmented products.” Augmented products are similar to catalytic enzymes in chemistry that reduce the energy required to perform and likelihood of a successful chemical change. Augmented products reduce the energy required for audiences to change one behavior to another. Results from the primary study suggest that the following augmented products will help youth athletes adopt new nutritional behaviors: sports coaches armed with behavior change tools and resources, an incentivized activity log, and organizational grants for sports leagues. Further detail of how these augmented products are implied by the study results and the barriers they will help overcome will be addressed in the next section (Price).

Price. In the social marketing framework, price is a general term that represents the barrier audiences must overcome to attain their desired product which can include monetary cost, competing behaviors, established habits, and other barriers. The augmented products must be

designed in a way to lessen the burden of the price and increase likelihood that the audiences attain their desired product. According to results of the primary study financial limitations, time limitations, and low nutritional knowledge were the greatest barriers to successful nutritional behavior change for players.

Among these three barriers, financial burdens were the most frequently mentioned barrier to behavior change suggesting that it is the most challenging for athletes and families to overcome. One of the augmented products to promote adoption of nutritional behaviors should provide financial support for families seeking to purchase healthier food options or provide youth athletes with healthy meals during the season. This could be achieved through an organizational grant. Taking teams on grocery store visits to select foods for team meals could help provide healthy meals for athletes and serve as experimental learning component of a nutritional behavior change intervention (Whitley, Wright, & Gould, 2016).

Coaches also recognized that busy family schedules negatively impact healthy food choices. One coach stated, *“they’re [parents] running all over Gods green creation on a daily basis you know trying to get L to softball while dad’s got W at his high school baseball game.”* Coaches would serve as an augmented product to motivate athletes and families to trial and establish meal prepping habits for the week which could help players consume more nutritious foods during busy weekdays.

Time is also limited during practices. Coaches have many goals to accomplish each practice and therefore spend limited or no time during practice promoting nutrition. However, results from the primary study also show that the average amount of practice time and length of practice time per week was 2.8 hours and 71.8 minutes respectively. Coaches were willing to spend an average of 8.4 minutes per practice. If teams have two sporting sessions during the

week (one game and one practice) coaches are suggesting that they would like to spend approximately 17 minutes discussing nutritional behaviors. Seventeen minutes equates to approximately 10% of total interaction time per week which could be the target amount of time coaches will consistently spend promoting healthy nutritional behaviors. Perhaps more total time could be spent on positive nutritional behavior promotion in more competitive leagues such as the Amateur Athletic Union (AAU) and United States Specialty Sports Association (USSSA). Coaches and teams in these leagues spend more time practicing each week.

An augmented product must also address low nutrition knowledge among parents and youth athletes. Results of the e-survey showed that few coaches believed that parents and players knew what to eat to optimize their sports performance. This implies that an augmented product must also contain elements that address a knowledge gap about appropriate foods to fuel and recover the body before and after sporting events. Coaches would facilitate the closing of knowledge gaps. Few coaches named low nutrition knowledge as a barrier for themselves, but this may be confounded by the professions represented in the study sample. Nonetheless, providing nutrition education materials to coaches would also be beneficial. Digital resources will be most convenient given that all coaches in the study possessed smart phones. Additional coach resources need to include a short nutrition behavior curriculum as in the ATLAS study; coaches in the intervention group of this study were provided an anti-anabolic steroid use prevention curriculum (Goldberg et al., 2000).

Another set of barriers to successful nutritional behavior change are competing behaviors such as parental habits and bringing unhealthy snacks to sporting events. Parental habits were mentioned by 80% of coaches as barriers to behavior change in athletes and was in the often-mentioned category. These results imply that an augmented product must contain components

that reduce this barrier and harness the influence of parental eating habits to positively shape those of youth athletes. Coaches are positioned well to facilitate how youth athletes view their parents' nutritional choices and motivate parents to eat better as a form of role modeling for their children. Fundamentally, coaches will need to make parents active participants in nutritional behavior change of their child; but more specifically, encourage parents to eat healthier when visible by their children as a form of role modeling.

Also, stopping the distribution of unhealthy snacks during sporting events must be enforced by coaches. Some of the most common sporting event snacks observed by coaches were Fruit Roll-ups, fruit chews, cookies and Goldfish. Coaches observed certain beverages as well when asked about common snacks. One coach stated the following in regards to common beverages, "*And of course Gatorade. Like Capri-Suns or something, the staple of post-game snacks*". Another said, "*and the things that drive me the most crazy are the juice boxes*". During a baseline assessment of foods being eaten at youth netball recreation sessions cake and ice cream were the most common items being consumed (R Belski et al., 2017). Using grant money to demonstrate healthy snacks and beverages for youth athletes would discourage parents from bringing unhealthy snacks to the games and provide an example of food choices children should emulate.

Place. The studies in the partial systematic review suggest that the organized sports context is an optimal space for facilitating nutrition behavior development. The primary study suggests that practice time is the most convenient time to confer nutrition information to players and reinforce habits, given its weekly recurrence. Practice time should be where the introduction, endorsement, and reinforcement of nutritional behavior change occurs and the home environment should be where athletes and families practice behaviors.

The age at which nutritional behavior concepts are introduced is also important. One particular coach stated about her time as a tee-ball coach, *“I don’t think I as a [recreation] league coach, I was ever at a point of power, but my son’s travel baseball coach was at a point of power. He would have done anything he said. And now his high school coach.”* Implications from this direct quote, and many others, would suggest an optimal age for introducing nutritional behavior change in the sports context should be during late elementary and middle school. Additionally, in this primary study, coaches described that the late elementary and middle school age is when athletes become more serious about sports and some even begin playing for traveling teams. The intensity, or high level of importance, of organized sports atmosphere could also be utilized to encourage parents and players to maximize their competitive edge by improving their child’s nutritional behaviors. A behavior activity log for recording the adoption and maintenance of new behaviors would allow families and players to track progress and allow coaches to encourage and congratulate athletes during their behavior change journey. A detailed description of the activity log is in Appendix G. Parents and athletes would need to be coached in doing this in a healthy way so not to encourage the development eating disorders, which will be discussed later in this section.

Promotion. Increasing the interest of parents and athletes in positive nutrition behaviors should be another goal of an augmented product as 80% of coaches suggested athletes’ and families’ low interest in nutrition was a major barrier to behavior change. The crux of successful nutritional behavior change among youth athletes is sports coach facilitation. The body of literature in the partial systematic review supports the involvement of this key influential figure in the intervention. Several study outcomes suggest the central role of coaches in successful nutritional interventions of athletes. The primary study also revealed various personal

characteristics of coaches suggesting they should be the prime facilitators of nutritional behavior change in youth athletes. Coaches are strong believers in positive role modeling for youth athletes. The e-survey revealed that 80% of coaches observed that players saw them eating healthy. This would suggest that coaches could serve as positive role nutritional modeling for their athletes. All coaches had a history of personal sports involvement which serves as a source of credibility when recommending positive nutritional behaviors to improve athletic performance and health. Pedagogical characteristics were commonly mentioned regarding coach attributes which could make them quality educators regarding nutritional behaviors.

Most importantly, coaches were described as positive. One coach said about herself, *“when I have the opportunity to coach, I would try to be inspirational, motivating and positively-framed coach.”* One coach said this about parents, *“So I will tell you the feedback that I have gotten from my parents. The parents have said you know that they appreciate my positive style of coaching.”* Being positive about nutritional behavior change is a key characteristic for facilitators. Youth athletes will find adoption of new nutritional behaviors challenging; therefore, facilitators of behavior change must be capable of encouraging and motivating athletes to continue practicing new behaviors even when they find themselves struggling to remain disciplined. These motivational skills are already inherent to coaches.

A special emphasis should be placed on communicating the benefits of nutritional behaviors on performance in areas such as endurance, strength, speed, and scoring. Perhaps coaches could use Olympians or professionals as examples of athletes who use their nutrition to maximize their sports performance. Promotional messaging from coaches should be designed to create an internal desire for youth athletes and families to make positive changes to their nutritional behaviors in hopes of maximizing sports performance and health.

Precautions Regarding Nutritional Behavior Change

The importance of positivity regarding eating habits in youth extends beyond the need for simple encouragement for behavior change; more importantly, it is critical in preventing food disorders in children in the behavior change process. Two experts in nutrition were consulted about the design of a nutrition behavior change curriculum for youth athletes ages 8-10 years old. Among the many topics discussed, conversation focused on avoidance of language that would promote the development of eating disorders in children. Coaches and families should be encouraged to describe food as “fuel” and tools for “recovery” in association with sporting events. Furthermore, body shape and weight goals, discussion about calories, and food descriptions as “good or bad” should be avoided and deemphasized. This type of reframing may encourage athletes and families to consider foods more purposefully and appropriately in order to help optimize both the athlete’s performance and health while reducing the risk of developing disorders of eating.

Inconsistent Perspectives Sports and Nutrition

Question order during the interviews intended to elicit honest answers about coaching philosophies regarding sports and their association with nutrition. Even though coaches knew they were being interviewed about sports and nutrition, nutritional-related questions were saved until the latter part of the interview to determine how coaches naturally felt about the purpose of sports and how they viewed themselves as coaches. When coaches were asked about why organized sports participation was valuable for children no coaches ever mentioned nutrition development. However, most coaches generally endorsed how sports and nutrition were closely related. Moreover, 60% (N=3) three coaches even agreed that teaching good nutrition to athletes

was part of their responsibility as a coach. Therefore, helping coaches fully integrate nutrition into their sports framework will be a key philosophical change needed to ensure sustained success of a nutritional behavior change in youth athletes.

Limitations and Future Directions

Despite the richness of the interviews several limitations exist in the primary study. The sample size of coaches interviewed was suboptimal. However, a recruitment rate of 10% is not surprising given the time constraints that volunteer coaching places on working adults and parents. As a result of the low recruitment rate, participants could not be screened based on profession which in this study may have biased the responses by coaches. No prior health behavior theory was formally used to develop the interview guide. A directed analysis approach, a technique which uses existing theories to guide questions development and analyses, could have helped characterize common social phenomenon such as relationship dynamics between coaches, players and families. However, a grounded theory and mixed methods qualitative content analysis approach– combining both conventional and summative analysis – seemed appropriate for this study because of the paucity of prior studies on this topic and the need for creating a foundation for a new research area. Another limitation of the study is that only one individual transcribed the interviews making it challenging to crosscheck errors in coding and interpretation of unclear interview responses. Future studies should include interviewing middle and high school youth athletes to determine barriers and motivational factors that would shape the design of a nutritional change program in these age groups. Interviewing parents of late elementary school children may be most appropriate in for this age group. This investigation makes clear the need for further study into the potential population health benefit of coach-facilitated nutritional behavior change interventions in the context of organized youth sports.

Conclusion

Pediatric clinic-based counseling should be supported by community resources and programs to help youth develop and maintain healthy lifestyles. Without community support, pediatric obesity and poor nutritional behaviors will continue to be challenging for pediatricians and families to manage. As demonstrated by the primary study, nutritional behavior change in the organized youth sports context can be an effective community resource that enables youth athletes and families to overcome motivational, knowledge gaps, and external barriers to sustained nutritional behavior change. Given the large population of children involved in sports, a well-designed nutritional behavior change intervention for youth athletes will have far reaching positive effects on pediatric populations disproportionately affected by pediatric obesity, the health of all children, families, and health of future adults.

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APPENDIX A: SEARCH ALGORITHM

Scopus

TITLE-ABS-KEY (*coach**) AND TITLE-ABS-KEY (*nutrit** OR *obes** OR *eating* OR *eat* OR *food* OR *prevent** OR *promot**) AND TITLE-ABS-KEY (*youth* OR *adolescen** OR *pediatric** OR *child** OR *juvenile* OR *teen** OR *minors* OR *minor*) AND TITLE-ABS-KEY (*sport** OR *athlet**) AND (*behav** OR *habit* OR *choice** OR "nutrition behavior" OR "nutritional behaviors" OR "nutrition behaviors") AND NOT TITLE-ABS-KEY ("Health coach" OR "Nutrition coach" OR "lifestyle coach") AND NOT (*elderly*) AND NOT (*colleg** OR *campus*) AND NOT (*disab**) AND NOT TITLE-ABS-KEY (*injury*)

PubMed

(((((((((coach*[Title/Abstract]) AND (nutrit* [Title/Abstract] OR obes* [Title/Abstract] OR eating [Title/Abstract] OR eat [Title/Abstract] OR food [Title/Abstract] OR prevent* [Title/Abstract] OR promot*[Title/Abstract])) AND (youth [Title/Abstract] OR adolescen* [Title/Abstract] OR pediatric* [Title/Abstract] OR child* [Title/Abstract] OR juvenile [Title/Abstract] OR teen* [Title/Abstract] OR minors [Title/Abstract] OR minor)) AND (sport* [Title/Abstract] OR athlet*[Title/Abstract])) AND (behav* OR habit OR choice* OR "nutrition behavior" OR "nutritional behaviors" OR "nutrition behaviors"))) NOT ("Health coach" [Title/Abstract] OR "Nutrition coach" [Title/Abstract] OR "lifestyle coach"[Title/Abstract])) NOT elderly) NOT (colleg* OR campus)) NOT disab*) NOT injury[Title/Abstract]

APPENDIX B: QUALITY ASSESSMENT CRITERIA

Citation
Study question and research design
Source population
Study population (descriptive: demographics, eligibility criteria) and how chosen (volunteers, recruitment, tertiary care clinics, population-based, etc.)
Initial comparability of groups (including randomization or method of group assignment; group composition; allocation concealment)
Drop outs (no endpoint data), adherence, cross-overs (other terms: attrition; loss to follow-up)
Potential for selection bias (rate as Low, Medium, or High, and explain)
Measurement (of exposure/intervention; outcomes; potential confounders): reliability and validity of measurement instruments; how measurements were performed; include blinding, if needed
Potential for measurement bias (rate as Low, Medium, or High, and explain)
Potential confounders (name what they are and how each was controlled: i.e., by randomization, restriction, statistical adjustment, stratification, etc.)
Potential for confounding (rate as Low, Medium, or High, and explain)
Analysis (intention to treat if applicable, other adjustment, etc.)
Overall judgment of risk of bias/internal validity (good, fair, or poor – explain)
Applicability (external validity): To whom do the results apply?
Results: Magnitude and direction (point estimate); Certainty/random error/precision (confidence interval); statistical significance
Significance/Clinical/public health importance of the result (explain) for the source population and wider populations
Comments and your interpretation of the information from the study (include consistency with other studies if you can)

APPENDIX C: CODEBOOK

Variable Name/Label	Reason for Assignment	Total Freq.	% of total assigned codes
Coach Attributes (CA): Competitive	Assigned when coach described him- or herself as competitive in nature. Also assigned when competitive characteristic could be implied as well. Assigned when coach perceived others described him or her as competitive.	3	1.69
CA: Energetic	Assigned when coach described him- or herself as energetic in nature. Also assigned when energetic characteristic could be implied as well. Assigned when coach perceived others described him or her as energetic.	2	1.12
CA: Fair/Equitable	Assigned when coach described him- or herself as fair/equitable in nature. Also assigned when fair/equitable characteristic could be implied as well. Assigned when coach perceived others described him or her as fair/equitable.	5	2.81
CA: Forgiving	Assigned when coach described him- or herself as forgiving nature. Also assigned when forgiving characteristic could be implied as well. Assigned when coach perceived others described him or her as forgiving.	1	0.56
CA: Fun-loving	Assigned when coach described him- or herself as fun-loving nature. Also assigned when fun-loving characteristic could be implied as well. Assigned when coach perceived others described him or her as fun-loving	1	0.56
CA: Good Mediator of Conflict	Assigned when coach described him- or herself as a good mediator of conflict. Also assigned when good mediator of conflict characteristic could be implied as well. Assigned when coach perceived others described him or her as good mediator of conflict.	1	0.56
CA: History of Personal Sports Involvement	Assigned when coach described him- or herself as a history of personal sports involvement.	5	2.81

CA: Humorous	Assigned when coach described him- or herself as humorous. Also assigned when humorous characteristic could be implied as well. Assigned when coach perceived others described him or hers as humorous.	3	1.69
CA: Inspirational	Assigned when coach described him- or herself as inspirational. Also assigned when inspirational characteristic could be implied as well. Assigned when coach perceived others described him or her as inspirational.	1	0.56
CA: Lacking Nutritional Knowledge	Assigned when coach described him- or herself as lacking nutritional knowledge. Also assigned when lacking nutritional knowledge characteristic could be implied as well. Assigned when coach perceived others described him or her as lacking nutritional knowledge.	2	1.12
CA: Motivational	Assigned when coach described him- or herself as motivational. Also assigned when motivational characteristic could be implied as well. Assigned when coach perceived others described him or hers as motivational.	2	1.12
CA: Outgoing	Assigned when coach described him- or herself as outgoing. Also assigned when outgoing characteristic could be implied as well. Assigned when coach perceived others described him or her as outgoing.	2	1.12
CA: Patient	Assigned when coach described him- or herself as patient. Also assigned when patient characteristic could be implied as well. Assigned when coach perceived others described him or her as patient.	1	0.56
CA: Playful	Assigned when coach described him- or herself as playful. Also assigned when playful characteristic could be implied as well. Assigned when coach perceived others described him or her as playful.	1	0.56
CA: Positive	Assigned when coach positive him- or herself as patient. Also assigned when positive characteristic could be implied as well. Assigned when coach perceived others described him or her as positive.	6	3.37

CA: Relaxed	Assigned when coach described him- or herself as relaxed. Also assigned when relaxed characteristic could be implied as well. Assigned when coach perceived others described him or her as relaxed.	1	0.56
CA: Teacher	Assigned when coach described him- or herself as teacher-like. Also assigned when teacher-like characteristic could be implied as well. Assigned when coach perceived others described him or her as teacher-like.	3	1.69
CA: Trustworthy	Assigned when coach described him- or herself as trustworthy. Also assigned when trustworthy characteristic could be implied as well. Assigned when coach perceived others described him or her as trustworthy.	1	0.56
CA: Understanding	Assigned when coach described him- or herself as understanding. Also assigned when understanding characteristic could be implied as well. Assigned when coach perceived others described him or her as understanding.	1	0.56
CA: Wants Discipline	Assigned when coach described him- or herself as wanting discipline. Also assigned when "wanting discipline" characteristic could be implied as well. Assigned when coach perceived others described him or her as wanting discipline.	2	1.12
CA: Passionate about coaching	Assigned when coach described him- or herself as passionate about coaching. Also assigned when passion about coaching characteristic could be implied as well. Assigned when coach perceived others described him or her as passionate about coaching.	3	1.69
NCB Natural Coaching Behavior (NCB): Improving Nutritional Behavior	Assigned when coach took action, outside of talking to players and families, to encourage nutritional behavior change.	1	0.56
NCB: Discusses health with players	Assigned when coach took stated that they talked to players and families about changing nutritional behaviors.	2	1.12
Organized Sports Atmosphere (OSA): Intense Sports Environment	Assigned when coach stated or implied that the youth organized sports atmosphere was intense.	4	2.25

OSA: Barriers - Financial Limitations on Accessing Nutritious Food	Assigned when coach stated or implied that financial resources were a barrier for families accessing nutritious foods.	12	6.74
OSA: Barriers - Lack of Interest in nutrition by athlete/parent	Assigned when coach stated or implied that low interest in nutrition was a barrier for athletes and families improving nutritional behaviors.	7	3.93
OSA: Barriers - Lack of Nutrition Knowledge	Assigned when coach stated or implied that low nutritional knowledge was a barrier for athletes and families improving nutritional behaviors.	7	3.93
OSA: Barriers - Parental Habits	Assigned when coach stated or implied that parental habits were a barrier for athletes and families improving nutritional behaviors.	6	3.37
OSA: Barriers - Time Limitations on Accessing Nutritious Food	Assigned when coach stated or implied that time limitations were a barrier for athletes and families accessing nutritious food.	8	4.49
OSA: Captive Audience	Assigned when coach stated or implied youth athletes were a captive audience for nutritional advice.	1	0.56
OSA: Common Sports Snacks	Assigned when coach stated when common types snacks eaten at sporting sessions.	3	1.69
OSA: Geographical Limitations to Accessing Nutritious Food	Assigned when coach stated or implied that geographic limitations were a barrier for athletes and families accessing nutritious foods.	1	0.56
OSA: Lacking Credibility to Discuss Nutrition	Assigned when coach stated or implied that lack of credibility was a barrier for athletes and families listening to their recommendations about nutritional behaviors.	2	1.12
OSA: Overzealous Parents	Assigned when coach stated or implied that parents were overzealous in the organized sports atmosphere.	1	0.56
OSA: Poor Nutritional Habit Development	Assigned when coach stated or implied when the organized sports atmosphere was developing poor nutritional habits in children.		0.00
OSA: Discuss nutrition during break times	Assigned when coach stated or implied that nutrition could be discussed during breaks in practice time.	2	1.12
Purpose of Sports (POS): Physical Development	Assigned when coach stated or implied that purpose of sports included improving physical conditioning of youth athletes.	2	1.12
POS: Positive Family Development	Assigned when coach stated or implied that purpose of sports included improving family functioning.	1	0.56

POS: Positive Social Development	Assigned when coach stated or implied that purpose of sports included improving the social development of youth athletes.	6	3.37
POS: Teamwork	Assigned when coach stated or implied that purpose of sports included improving the teamwork skills of youth athletes.	1	0.56
Sports and Nutrition Philosophy (SNP): Good Nutrition supports Sports Performance	Assigned when coach stated or implied that proper nutrition improved or optimized sports performance.	5	2.81
SNP: Affirmation of Coach Potential Influence on Nutrition	Assigned when coach stated or implied that coach have the potential to shape the nutritional behaviors of athletes.	4	2.25
SNP: Affirmation of Coach Potential Influence on Nutrition as Kids Grow older	Assigned when coach stated or implied that a coach influence on their youth athletes' nutritional behaviors increases as children grow older.	8	4.49
SNP: Availability of Food Determines Eating Patterns	Assigned when coach stated or implied that child eating patterns are determined by what foods that are available to them.	2	1.12
SNP: Moderation not Absolutes	Assigned when coach stated or implied that all foods can be eaten in relative moderation.	1	0.56
SNP: Need for Athlete's Ownership of Nutrition Choices	Assigned when coach stated or implied that youth athletes should take some ownership of their nutrition choices.	1	0.56
SNP: Negative Belief of Measurable Influence of Nutrition on Sports performance in age group	Assigned when coach stated or implied that the sports performance of youth athletes is not influenced by nutrition.	1	0.56
SNP: Nutrition Increases in importance as athletes age	Assigned when coach stated or implied that nutrition becomes more important to athletes as they age.	2	1.12
SNP: Positive Role Modeling	Assigned when coach stated or implied that positive role modeling helps athletes improve nutritional behaviors.	5	2.81
SNP: Strong Influence - Administrative Alignment on Importance of Nutrition	Assigned when coach stated or implied that organizational alignment of coach and administration regarding the importance of nutrition helps athletes improve nutritional behaviors.	2	1.12

SNP: Strong Influence - Celebrities	Assigned when coach stated or implied that celebrities influence athletes' nutritional behaviors.	2	1.12
SNP: Strong Influence - Consistency of Messaging from Coach	Assigned when coach stated or implied that consistent messaging from coach are a strong influence on nutritional behaviors of athletes.	1	0.56
SNP: Strong Influence - Experts	Assigned when coach stated or implied that nutrition experts could be a strong influence on nutritional behaviors of youth athletes.	1	0.56
SNP: Strong Influence - Family Nutrition Habits	Assigned when coach stated or implied that family nutritional habits have a strong influence on the nutritional behaviors of youth athletes.	10	5.62
SNP: Strong Influence - Food Flavors	Assigned when coach stated or implied that food flavors had a strong influence on the nutritional behaviors of youth athletes.	2	1.12
SNP: Strong Influence - Gamification of Nutritional Behavior	Assigned when coach stated or implied that gamification of nutritional behaviors would have a strong influence on the nutritional behaviors of youth athletes.	1	0.56
SNP: Strong Influence - Marketing	Assigned when coach stated or implied that commercial marketing has a strong influence on the nutritional behaviors of athletes.	2	1.12
SNP: Strong Influence - Peers	Assigned when coach stated or implied that peers are a strong influence on nutritional behaviors of youth athletes.	6	3.37
SNP: Strong Influence - School Personnel	Assigned when coach stated or implied that school teachers could be a strong influence on nutritional behaviors of youth athletes.	2	1.12
SNP: Target Behavior - Increased Water Intake	Assigned when coach stated or implied that increasing water intake would be beneficial target behavior youth athletes should practice more often.	2	1.12
SNP: Teaching good nutrition is part of coach's responsibility	Assigned when coach stated or implied that teaching good nutrition to their players was a part of the coach's responsibility.	2	1.12
SNP: Teaching good nutrition is not a part of the coach's responsibility	Assigned when coach stated or implied that teaching good nutrition to their players was not a part of the coach responsibility.	2	1.12

APPENDIX D – INDIVIDUAL RISK OF BIAS ASSESSMENT

The Athletes Training and Learning to Avoid Steroids (ATLAS) study supports the likelihood that coach-facilitated nutritional behavior change interventions effectively influence nutritional habits in youth athletes. It is structured as a randomized control trial which strengthens the credibility of its conclusions. Nonetheless, several aspects of the study increase its overall risk for bias which will be explained below.

The potential for selection bias is medium to high in this study because of several factors. Several baseline factors differed between the experimental and control groups. The experimental group was statistically worse in several baseline characteristics and therefore the tendency to “regress to the mean” phenomenon could have contributed to the improvement in these areas. These areas included higher baseline normative steroid use and worse nutritional behaviors. When these baseline differences were controlled for, outcomes were not changed. Another major contributing factor includes a drop-out rate of 20% and 30% at short-term and long-term follow up questionnaire administrations, respectively. Moreover, during the first year of the study, group characteristics and rates of drop-outs for the short-term survey differed between experimental and control groups. Control group drop-outs had a higher measured propensity to use anabolic androgenic steroids than drop-outs from the experimental group. However, this difference in attributes of dropouts would have strengthened the case for the effectiveness of the intervention. Additionally, at the 1-year survey follow up, there was no difference in the drop-out rate between study groups which helps favor the difference between groups is a true observed difference.

The potential for measurement bias is low. Nonetheless, the 168-item survey used is not validated. However, the authors mentioned that survey was developed and utilized for a national

survey measuring drug use in the past (Johnston, O'Malley, & Bachman, 1999). Both the experimental and control group were measured by the same survey and responses were kept confidential.

The potential for confounding is medium given several factors. The difference in parental education status between groups suggested that students in the experimental group may have had a home environment that reinforced some of the ideas promoted by the intervention in regards to avoiding steroid use. This type of confounding would favor rejection of the null hypothesis. Another confounder for improved nutrition habits could be home income level, an unmeasured baseline characteristic. If the experimental group had higher average family income, the ability to adopt nutritional recommendations would occur with greater ease than in the control group, thus falsely inflating the success of the intervention. Also, the incentives for experimental school participation in the study was \$3000 worth of lifting equipment being added to the football team weight room. This equipment was intended to encourage students to use the school-based workout facilities instead of private gyms where there is greater access to steroid use. Though the purpose of the new equipment was to encourage participation, it could confound the results of the intervention. The new equipment in the experimental schools was not considered part of the intervention and could explain some of the differences in new anabolic steroid use, increasing bias toward rejection of the null hypothesis.

The generalizability of the ATLAS intervention to other high school football player populations has promise despite the study sample being majority white, located in Portland, Oregon, and consisting of volunteer students. The kinds of students that volunteer to play football are likely to be similar in many ways. However, to apply this intervention to another sport or the general high school population not involved in an organized sport may not prove to

be as impactful. It may be more difficult to capture the attention of non-athletes and maintain their consistent attendance to sessions without the support of the sports environment. Even in other sports like track and field which is more individualized it may be difficult for “peer leaders” leading the workshops to have the same influence over other students.

Nevertheless, the length of follow up time (1 year) and large sample size (N=2516) improve the applicability of the study and the likelihood that outcomes represent the behavior of most high school athletes. Even though improved nutritional intake was not the main goal of the study intervention, it was maintained for more than a year after the 14-week intervention. Implications from this outcome suggest that a well-designed curriculum regarding nutritional behaviors delivered in a sports context has the ability to shape and maintain health nutritional behaviors in youth. Even if a Bonferroni correction is applied to the study given multiple comparisons, -- 31 to be exact – a p-value of 0.0016 would still be greater than the p-value of the difference in short-term post-season improvement in nutrition behaviors in the experimental group, reported as $p < 0.001$. However, the 1-year follow up of improved nutrition behavior difference would no longer be significant ($p < 0.02$) along with many other differences measured in this study.

The overall risk of bias for study at minimum is medium given the high potential for selection bias, types of confounding unaccounted for, and high number of comparisons made. Despite medium level of risk of bias designing, this study implies that a nutritional behavior change or development program similar to ATLAS for athletes prior to secondary school targeting the development of positive nutritional behaviors may create more lasting nutritional behavior change, reach a larger population of youth, and have a wider applicability.

The next study, The impact of coaches providing healthy snacks at junior sport training, possess several areas of increased risk for bias. The potential for selection bias is high. Among the major factors contributing to this bias are the small sample size and self-selecting method used recruit netball programs and their constituents. Drop-out of parents, coaches, and children is not documented, therefore determining if the same parents were interviewed or children were observed at pre- and post-intervention during the study is not possible. This is a concern because the article states that the coaches interviewed were different at the pre- and post-interview time points in the study. Only 3 of the 5 coaches who received the baseline survey responded in the follow-up survey regarding child attention and participation level changes. The potential for measurement bias is rated high given the lack of blinding during observation periods, the potential for recall bias of parents regarding pre-practice meals, and unspecified procedure for observation of the frequency of pre- and post-intervention nutritional intake of the youth athletes during netball sessions. What counted as a positive observation of a snack being eaten? Did the child have to eat the entire snack, partake in a portion of the snack, or simply have it in his or her hand? Healthy snacks were provided during the fall netball season however, observations of healthy snack eating were obtained once during the season, which creates an environment vulnerable to Hawthorne effects. Parents knowing there are observers at practice may change the level of encouragement given to children to eat the healthy snacks available. The potential for confounding is also high as a result of the pressure on parents and coaches to provide researchers with socially desirable answers regarding the impact of the intervention. The increase in consumption of healthy snacks could also be partially explain by unaccounted factors such as the child not haven eaten before practice. The positive increase in attention/participation published by the study could also be explained by acquiescence bias. For example, the presence of healthy

snack at practice and common beliefs that sugary snacks promote hyperactivity in children could positively biased coaches to the idea that attention spans have improved during post-intervention.

The overall risk of bias in this study is high given the shortcomings in various areas of internal validity and overall small sample size. The ability to generalize that coach-provided healthy snacks at sporting sessions actually increases healthy food consumption and attention span of youth athletes in larger pediatric populations is questionable. The self-selecting status of all participants and financial feasibility of youth sports organizations to consistently funding coaches with \$40 per week to buy snacks for their youth sports teams lower the applicability of the study results. Nonetheless, the value of this study is that it shows the relative ease of introducing a nutritional intervention in the sports context and high level of parental and coach support for such interventions.

The final study included in this partial systematic review is titled, Coaches' Perceptions of a Coach Training Program Designed to Promote Youth Developmental Outcomes, which contains many concerns for risk of bias. The potential for selection bias is high in this study given the small, self-selected study sample of coaches and players. Minimal characteristics about the coaches and players were published in this study. The potential for measurement bias is also high given the risk for social desirability shaping coaches' responses to interview questions and surveys. The potential for confounding is also high. The small group of coaches who volunteered to take part in the study may already possess attributes that would make them open and likely to respond favorably to a positive youth development intervention in the context of sports.

The generalizability of this study is limited by the small sample size, limited baseline characteristics of participants, and lengthy time requirement. Even though this study did not publish any results related to changing nutritional behaviors of youth athletes it did demonstrate

an intervention titled the “healthy team meal”. This activity both served as a team bonding and health promotional opportunity that provided a concrete lesson in meal decision making in a sports context. A potential problem for this type of intervention activity is demonstrated by the fact that several coaches declined to participate in the overall positive youth development intervention anticipating the that it would require an unsustainable time commitment during the sports season. Nonetheless, coaches and players responded positively to this nutrition related intervention and could be integrated in to future nutritional behavior change programs for athletes. Even though the risk of bias for this study is high, an important lesson from that intervention is that it demonstrated how time-consuming interventions can deter coaches from being willing to integrate health promotional interventions into the sports context, a factor that should be considered in future interventions.

APPENDIX E: HEALTH AND YOUTH SPORTS – PERSONAL SIGNIFICANCE

Sports dominated the majority of my young life and the lives of many childhood friends, most of whom were African American. While, some continued to play sports during their college years, the majority of these athletes ended their athletic journey in high school. During this period of transition, many of them were no longer involved in any form of organized sports activity and began to show signs of poor nutritional habits. Habits that could put them at a higher risk for developing CVD and diabetes. Despite their relatively young age and prior fitness level, signs of poor nutritional habits have continued into adulthood.

As I continued to observe my athletic friends' nutritional behavior choices, I began to wonder if this was an isolated trend or, if a small sample of a larger population of former athletes quickly find their health status changing shortly after discontinuing organized sports participation. Though my experiences were anecdotal, I began to consider the idea that perhaps organized sports acts as a temporary shield against the consequences of poor nutritional behaviors, essentially reinforcing previously formed nutritional habits – be it good or bad. My interest in health and medicine lead me to pursuing a career in medicine which gave me closer view of how health care was addressing nutritional behavior in children.

During my first 3 years in medical school, I began examining the nutritional behavior counseling provided by pediatricians and exploring the literature on its effectiveness during pediatric visits. Both my anecdotal experiences as a medical student and literature review suggested that there was lack of effective nutritional counseling provided during pediatric clinic visits and I wondered if there were any solutions for helping many young African American male athletes and their contemporaries capture and maintain the health benefits of many years of sports participation. After considering this problem for some time, I began to wonder about the

effectiveness of an appropriately designed intervention that intentionally integrates practical nutritional behavior into organized sports during the formative years of life. Such an intervention could effectively target young African American males – a population which in adulthood bears one of the heaviest burdens of CVD, stroke, and diabetes. Not to mention, this context could serve as an effective conduit for nutritional information and a bedrock for positive nutritional behavior development for all youth. Upon completing a comprehensive literature review, I found data that suggested my anecdotal experiences were not unique, and rather part of a larger pediatric problem.

APPENDIX F – SOCIAL MARKETING FRAMEWORK

Social Marketing Framework. Social marketing is “the application of commercial marketing technologies to the analysis, planning, execution, and evaluation of programs designed to influence the voluntary behavior of target audiences in order to improve their personal welfare and that of their society” (Andreasen, 1994). The social marketing framework puts a special emphasis on influencing behavior instead of marketing products. Consumers benefit from the use of a product or adoption of a behavior sold by the producer; this is the reversed in traditional commercial marketing. It also places a special emphasis on analyzing and accounting for barriers, competing behaviors, enhancing benefits, capitalizing on motivators, and influential role models. The social marketing framework suggests properly aligning motivations, incentives, and conduit for these outcomes will increase the likelihood that the audience will attain them.

APPENDIX G – NUTRITIONAL SHORT COURSE AND ACTIVITY LOG

The primary study and partial systematic review both support the creation of an augmented product that includes a mini-longitudinal nutrition curriculum that will attempt overcome the knowledge gap barriers and harness influential factors. The curriculum would be designed to educate athletes and families about ways to increase consumption of healthy foods to optimize sports performance, suggest affordable healthy food changes, help athletes and families make the connection between nutrition and optimized performance, and frame nutritional behavior change in a positive manner. The curriculum would need to be broken into small lessons that could be integrated into 5-8 minutes lessons that could be delivered during practice, perhaps at the end or during water breaks.

The effectiveness of the curriculum and method of rewarding consistent healthy behaviors would be accomplished through a nutrition activity log that would provide a system for tracking certain nutritional behaviors of youth athletes (Figure 3). A future study should investigate which nutritional behaviors would be most advantageous for and successfully adopted by youth athletes in adolescence. This activity log would allow athletes to visibly track behaviors and provide a monitoring and reward system for coaches and teams. A series of target nutrition behaviors would be implemented each week and carried forth through the season that correlate with concepts introduced during practice. Parents would verify the athlete was successfully achieving certain behaviors and the coach would recognize those athletes who achieved their goals, and encourage those who did not, at each practice. This log could even be used to track the performance of teams competing against each other. Players on the same team could also encourage each other to improve nutritional behaviors for a collective goal. An

example of a tracking log can be found in Figure 3. The tracking log would be a way for coaches and parents to monitor the adoption of certain behaviors and reward players accordingly.

Figure 3. Example of Incentivized Nutritional Behavior Tracking Log

Sports Nutrition Activity Log

1

2

3

4

5

Purpose: To promote the optimal sports performance and nutrition of all athletes

I, _____ hereby commit to becoming the best athlete that I can be. I understand that my athletic performance is connected to my nutrition and I plan to do my best to improve both! My parent(s), _____, and Coach _____ will help me in accomplishing this goal. I will follow my coach's advice to improve my nutrition so I can reach my full potential as an athlete.

Athlete _____ Date _____
 Parent _____ Date _____
 Coach _____ Date _____

Week	Parent Signature	Coach Initials
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

6

7

8

9

10