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Title: The Nutrition Knowledge, Attitudes and Body Composition of Adolescent Swimmers

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THE NUTRITION KNOWLEDGE, ATTITUDES AND BODY COMPOSITION OF ADOLESCENT SWIMMERS

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The University of the West Indies

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ABSRACT

Background – Nutrition is a very important factor in the performance and health of all athletes. In addition to nutrition, body composition plays a role in the performance of athletes. Unfortunately, there is no current information about the level of nutrition knowledge among adolescent swimmers in Trinidad and Tobago.

Purpose – The purpose of this study was to assess the level of nutrition knowledge, attitudes, and body composition of adolescent swimmers, aged 11-21 years who train competitively in private clubs in Trinidad and Tobago. However, relatively little research exists about the nutrition knowledge, attitudes, and body composition of athletes.

Methodology – A questionnaire composed of 21 nutrition knowledge statements and 11 attitude statement was used. Anthropometric data were also collected. The data were analyzed using SPSS 21.0. Descriptive statistics, analysis of variance and Pearson's correlation analysis were used.

Results – The mean nutrition knowledge score for the population was 10.97 ± 2.897 (52.25 ± 13.795%) and the mean attitude towards nutrition score was 41.69 ± 6.215 (75.79 ± 11.300). The means for the body composition variables measure felling within recommended ranges.

Conclusion – Athletes lack the nutrition knowledge however have a positive attitude towards nutrition, further nutrition knowledge and attitudes were positively correlated. Athletes were also found to be at low nutritional risk based on anthropometric data.

CHAPTER I

INTRODUCTION

Statement of the Problem

Nutrition is a very important factor in the performance and health of all athletes (Hornstrom, Friesen, Ellery, & Pike, 2011). In addition to nutrition, body composition plays a role in the performance of athletes. Adolescent athletes need to be well nourished to support normal growth, development and performance. However, relatively little research exists about the nutrition knowledge, attitudes, and body composition of athletes. Further, the existing studies are constant in their findings that athletes lack the nutrition knowledge they need in order to gain the benefits of increased performance and health (Ozdogan & Ozcelik, 2011; Beals, 2001). This may be due to misconceptions and deficiencies in knowledge being provided to them by one or more unreliable source (Cupisti, D'Alessandro, Castrogiovanni, Barale & Morelli, 2002; Hornstrom et al., 2011). Moreover, nutritional knowledge and attitudes seldom translate into proper dietary practices (Beals, 2001).

Observations of nutrition status and proper growth and health can be evaluated using body composition (Abreu de Almeida & Abreu Soares, 2003). Consequently, lack of knowledge irrespective of a positive attitude toward nutrition can have a negative impact on body composition if dietary practices are not supportive. In Trinidad and Tobago, it is hypothesized that most athletes lack nutrition knowledge, which leads to poor performance since their nutritional needs are higher than non-athletes. However, studies have shown that athletes have a positive attitude towards nutrition and so may be open to acquiring nutrition information (Zawila, Steib & Hoogenboom, 2003; Davar, 2012).

Rigorous education interventions should be aim at the athlete, their parents and coaches to contest the fads, falacies, and myths that are targeted to these athletes (Beals, 2001; Henry, 2001). Areas in which adolescents typically lack nutrition knowledge include the dietary roles of protein and carbohydrates, role of vitamin and minerals, carbohydrate loading, glycemic index, muscle energy sources, energy expenditure and nutritional requirements, nutrient sources and nutrients and performance (Beals, 2001; Davar, 2012; Zawila et al., 2003). Currently, there is no scientific data documentation of energy and nutritent needs of adolescent athletes in Trinidad and Tobago. Therefore, making it difficult to give assured recommendations. With reference to athletes attitudes toward nutrition, most studies have investigated the attitudes about nutrition from the point of view that some foods are healthier than others, or food can help performance (Hansen, 2010). Studies have suggested that attitudes may have a greater impact on dietary practices than actual knowledge about nutrition (Hansen, 2010).

An athlete's body significantly affects athletic performance. Body shape, size, composition, and physiological characteristics are influenced by age, sex, environmental conditions, and genetics (USA Swimming & The U.S. Ski and Snowboard Association, 2006). Nutrition is one of major environmental conditions that can affect body composition (USA Swimming & The U.S. Ski and Snowboard Association, 2006). Adolescents experience major change in the body due to growth and maturation, which causes increase nutritional needs. Height and weight are other factors that determine an athlete's potential success. Although success or failure is assured by having a particular body type (Zawila et al., 2003), athletes that are successful in the chosen sports usually have similar physiques, which are compatible with their physical requirements. The

relative amount bone, muscle, and fat that contribute to body mass influences body composition. In most sports, a higher muscle mass increase an athlete's advantage and in contrast a higher fat mass may potentially hinder performance. Males usually have more bone and muscle tissue and less fat than female (USA Swimming & The U.S. Ski and Snowboard Association, 2006). In this context, this study assesses the level of nutrition knowledge, attitudes, and body composition of adolescent swimmers training competitively in Trinidad and Tobago.

Purpose of the Study

The purpose of this study was to assess the level of nutrition knowledge, attitudes, and body composition of adolescent swimmers, aged 11-21 years who train competitively in private clubs in Trinidad and Tobago.

Objectives of the Study

The objectives of this study were as follows:

1. To assess the level of nutrition knowledge possessed by adolescent competitive swimmers.
2. To compare the level of nutrition knowledge between male and female adolescent competitive swimmers.
3. To compare the level of nutrition knowledge between the different age groups of adolescent competitive swimmers.
4. To evaluate the attitudes toward nutrition held by adolescent competitive swimmers.
5. To compare the attitudes toward nutrition held by male and female adolescent competitive swimmers.

6. To compare the attitudes toward nutrition in different age groups of adolescent competitive swimmers.
7. To evaluate the nutrition status and body composition of adolescent competitive swimmers using anthropometric measurements.
8. To determine the relationship between nutrition knowledge and attitudes.

Hypotheses

It was hypothesized that:

1. Adolescent competitive swimmers will lack nutrition knowledge.
2. Male adolescent competitive swimmers will have a higher level of nutrition knowledge compared to their female counterparts.
3. Adolescent swimmers in older age groups will have a higher level of nutrition knowledge compared to their younger counterparts.
4. Adolescent competitive swimmers will have a positive attitude toward nutrition.
5. Male adolescent competitive swimmers will have a better attitude toward nutrition compared to female swimmers.
6. Adolescent swimmers in older age groups will have a better attitude toward nutrition compared to younger swimmers.
7. Adolescent competitive swimmers will be at low nutrition risk based on anthropometric measurements taken.
8. There will be a positive correlation between nutrition knowledge and attitudes.

Significance of the Study

High levels of nutrition knowledge and positive attitudes toward nutrition can result in tremendous increase in performance and health. Most of the literature focuses on elite and college level athlete with few articles on their adolescent counterparts. Further, insufficient studies focused on solely on swimmers. Additionally, there is no current information about the level of nutrition knowledge among adolescent swimmers in Trinidad and Tobago. Therefore, in an effort to increase the amount of elite level swimmers in Trinidad and Tobago, nutrition knowledge, attitudes and body composition need to be assessed and the results acted upon accordingly.

CHAPTER II

LITERATURE REVIEW

Introduction

Sport nutrition is the study of the nutritional factors that affects performance, recovery, and health of athletes (Department of Sport Nutrition, Australia Institute of Sport, n.d.). It uses nutritional knowledge to create effective pre-, during, and post- exercise nutritional strategies (Department of Sport Nutrition, Australia Institute of Sport, n.d.). In light of this, optimal nutrition is important in reducing fatigue, allowing for longer periods of training and competing and faster recovery (Ozdogan & Ozcelik, 2011). Genetics, proper training, and good nutrition are important factors that can make a swimmer's true potential possible or stop it from happening (Maglischo, n.d.). Yet, there are many misconceptions about nutrition and its importance to health and performance among athletes, which can be attributed to deficiencies in nutrition knowledge, misguided, or incorrect information given by various sources (Abreu de Almeida & Abreu Soares, 2003; Burigo, 2006; Azizi, Rahmani-Nia, Malaee, Malaee, & Khosravi, 2010; Hornstrom et al., 2011).

Adolescence is the stage of life between ages 11–21 years (Stang, 2011). During this time significant biological, psychosocial, and cognitive changes occur which prepares a child for adulthood. The biological changes that taking place during this stage include sexual maturation, increases in height and weight, accumulation of skeletal muscle mass and changes in body composition (Stang, 2011). These changes have a direct effect on nutritional status of an adolescent and increase the need for energy, protein, vitamins, minerals and fluids (Abreu de Almeida & Abreu Soares, 2003; Stang, 2011). As such, to

sustain proper growth, development and health while improving performance, adolescents engaged in sport have to be aware of the importance of good nutrition.

Many adolescents are involved in extracurricular sport and physical activity. Consequently, these activities combined with normal biological changes cause these adolescent to have greater energy and nutrient needs than average. If these needs are not met growth and development may be negatively affected (Stang, 2011). Therefore by assessing the height, weight and body composition of these adolescents it can be determined if energy and nutrient needs are being met (Stang, 2011).

A joint position paper by the American College of Sport Medicine, the American Dietetic Association and the Dietitians of Canada (2009), reported that exercise in its various forms and recovery from that exercise is enhanced by optimal nutrition. These organizations recommend that suitable choice of food, fluid, supplements, and timing of meals should be made to encourage the best possible health and performance. This cannot be fully achieved without proper nutrition education. Adequate caloric intake is needed to maintain body weight and to prevent unwanted weight loss, gain and loss of muscle mass or other dysfunctions of the body. Proper nutrition depends on the sport, athlete's sex, environment, and total energy expenditure (American College of Sports Medicine, American Dietetic Association, and Dietitians of Canada, 2009).

Nutrition Knowledge

Almost every process in the body involves some aspect of nutrition. Knowledge of how the body utilizes the nutrients consumed and application of this knowledge will ensure efficient functioning of the body and prevent disease. In Ozdogan & Ozcelik (2011)

evaluation of sports department students, at 3 universities in Ankara, Turkey, the mean knowledge score was 12.247±3.525 out of a possible 21, which was considered low and showed insufficiency of knowledge from the participating student. There was no significant difference between genders ($p > 0.05$) but there was a significant difference between year groups ($p < 0.001$). The students in the higher year group on average had a higher score than the students in the lower year group. Similarly, Hornstrom et al. (2011) revealed the mean nutrition knowledge score of Mid-American Conference College softball players was 45.7 ± 4.7 (57.1%). When a standard 60% cut of point was set as the failing mark, two thirds (n = 120, 62%) of the softball players we judged as having failed the questionnaire, indicating a low level of nutrition knowledge. However unlike Ozdogan & Ozcelik (2011), Hornstrom et al. (2011) discovered no significant difference ($p = 0.074$) in nutrition knowledge scores by years in school.

Torres-McGehee, Pritchett, Zippel, Cellamare, and Sibilia (2012) reported that athletes were receiving information from more dependable sources, however, 91% of the athletes had an inadequate nutrition knowledge scores of less than 75%. Hoogenboom, Morris, Morris, and Schaefer (2009) found that on average female collegiate swimmers in divisions I, II, and III, had a nutrition knowledge score of 54.53 ± 4.34 (71.75%), which was considered fair, but these swimmers exhibited a lack of application of the knowledge they possessed. Moreover, there was no significant difference in nutrition knowledge between divisions ($p = 0.746$) (Hoogenboom et al., 2009).

In a study conducted on college athletes in Iran by Azizi et al. (2010), it was shown that these athletes had moderate nutrition knowledge, 52.36 ± 6.7 and 54.31 ± 6.3 (57.36% and 60.42%) respectively for males and females. Knowledge scores were not

significantly different between majors in male athletes. Although, females with physical education majors scored significantly higher than females in other majors. It was shown that females had a higher nutriton knowledge than males ($p = 0.05$) (Azizi et al., 2010). Even though the scores were classified as moderate it was reported that nutrition knowledge need to be improved in this population. Dunn, Turner, & Denny (2007) reported that college athletes in their study had a mean nutriton knowledge score of 51.49 ± 13.57% which corresponded to a lack of nutrition knowledge. There was a significant difference between male and female college athletes ($p < 0.001$), female athletes score slightly higher than male athletes (Dunn et al., 2007).

Female collegiate cross country runners found to have a resonable amount of knowledge for most parts of a nutriton knowledge questionnaire, however, there were parts in which there was an evident lack of knowledge (Zawila et al., 2003). Runners generally scored higher in sections related to sport nutrition than sections related to general nutrition. Further it was reported that those exposed to nutrition courses in college showed a greater score for nutrititon knowledge than those who have not be exposed to nutrition class. A positive but insignificant relationship was found between information sources and knowledge (Zawila et al., 2003). Contrastingly, a significant positive correlation was shown between female recreational athletes' stated number of nutrition sources and nutrition knowledge by Barr (1986). In the examination of female varsity athletes and university students, Barr (1987) showed that nutrition knowledge score among both team and non-team participants averaged around 34%, indicating lack of knowledge. Both groups had a better gerenal nutrition knowledge score than nutrition knowledge in relation to activity. Furthermore, age, education, and number nutrition sources were all

found to be positively assosciated with nutrition knowledge scores (Barr, 1987). Total mean score for female hockey players was 22.85 (38.8%) (Davar, 2012). Therefore, the overall conclusion was athlete's lack nutrition knowledge.

Sources of Nutrition Information

Nutrition information is important to an athlete's health and performance. Therefore, the source from which athletes obtain their nutritional information is also of utmost important. Zawila, et al. (2003) reported that female collegiate cross-country runners, top 4 source of information were magazines, parents, coaches and teammates. Less than half of this population identified physician and only 17% chose athletic trainers (Zawila et al., 2003). These sources differed to female college softball player (Hornstrom et al., 2011). It was reported that physicians, athletic trainers, college nutrition or health courses and dietitians were the top choices by these athletes.

Davar (2012) stated that the female hockey players admitted to not proactively seeking out nutrition information and nutrition education was never given to them. The top 4 sources used by these players were parents, magazines, TV and teammates. Athletic trainers were indicated by less than 15% of the players less than half reported parents or siblings. Dietitians were unknown to this population of athletes (Davar, 2012). Female Italian athletes and non-athlets reported obtaining information from their family, media (magazines, TV, advertising, etc.) and in school (Cupisti et al., 2002). It was theorized that the quality of nutrition sources should be more important than the quantity due to the low scores attained by the participants in the knowledge test (Zawila et al., 2003).

Attitudes toward nutrition

There is a growing body of knowledge that suggests athletes hold a positive attitude toward nutrition. Dunn et al. (2007) noted that the mean score for eating attitudes in college athletes was 6.04 ± 5.96, which was regarded as positive and there was no significant difference between male and female athletes in this study. Azizi et al. (2010) noted that the mean nutrition attitude score for males and females were 50.61 ± 5.1 and 52.03 ± 5.8 respectively, which also demonstrated positive attitudes toward nutrition. Females were found to have a significant higher attitude score than males, which corresponded to a better attitude toward nutrition. Nutrition attitudes were found to be significantly different in relation to majors for females; physical education majors had the higher attitude score. Attitude score for male physical education majors we also higher than other majors but the relationship was not significant (Azizi et al., 2010).

Zawila et al. (2003) conveyed that female collegiate cross-country runners had a mean total positive response for attitudes of 90.6% representing an overall positive attitude toward nutrition. The mean attitude toward nutrition score for in the investigation of college softball players by Hornstrom et al. (2011) was 1.9 ± 0.4 indicating a positive attitude (range 1-6, 1 signifying a more positive attitude and 6 signifying a more nevative attitude). Davar (2012) reported the mean players's total positive attiutde response was 90.6% and 93.3% of the player agreed that providing nutrition education would have a positve impact of food selection.

Relationship between nutrition knowledge and attitude

Most of the literature suggests that there is a relationship between nutrition knowledge and attitudes. According to Perron & Endres (1985), Hornstrom et al. (2011), and Azizi et

al. (2010) nutrition knowledge and attitudes toward nutrition are significant and positively correlated, that is, the more knowledge about nutrition the greater positive attitude toward it. However, it was understood that nutrition knowledge and attitudes had no impact on dietary practices (Perron & Endres, 1985; Hornstrom et al., 2011). Hornstrom et al. (2011) did however discovered that there was a significant relationship between attitudes and nutrition choice.

Body composition

Physical performance can be affected by body weight and composition. An athlete's age, sex, genetic makeup and choice of sport are factors that influence optimal body fat levels (American College of Sports Medicine, American Dietetic Association, and Dietitians of Canada, 2009). Optimal body fat may vary and so individualization is required. Swimmers usually have a higher body fat percentage when compared to athletes participating in other sporting disciplines (American College of Sports Medicine, American Dietetic Association, and Dietitians of Canada, 2009). Additionally, body fat to muscle mass ratio is also related to physical performance (Weatherwax-Fall, n.d.). Strength, power and agility increases in relation to a suitable percentage of muscle mass as indicated by research (Spaniol, 1997; Spanoil, 2002; Weatherwax-Fall, n.d.). Knowledge about body composition aids in meal planning, improvement in performance level, recovery form injury, and maintenance of health (Weatherwax-Fall, n.d.).

According to Juzwiak, Amancio, Vitalle, Pinherio, & Szwjnfeld (2008), in there study of male adolscent tennis players, it was seen that 89% of the athletes has appropriate body mass index (BMI), with only 5 of the them being classed as at risk for overweight. Body fat percent for this population was classes as ideal (6-17%)for 71% of the athletes. This

shows that involment in sport has a favourable impact of the body and can benefit these players performances. Addititonally, lean body mass to height ratios were determined for this population and the mean (0.25 for 10-13 and 0.30 for 14-18) was found to be lower than projected for young male tennis players. It was also observed that macronutrient intake was generally enough to sustain growth and training demands but there were some deficiencies in micronutritent intake which was of concern to the reseachers (Juzwiak et al., 2008).

In a study conducted on Brazilian adolescent female volleyball players it was found that athletes had a mean wieght of 64.35 ± 6.12 kg, a height of 174 ± 0.06 cm, a body fat percentage of 20.51 ± 2.43%, a mean total skin fold (7 sum of sites) of 109.91 ± 29.33 mm, abdomen circumference of 76.17 ± 5.18 cm and a hip circumference of 97.48 ± 3.72 cm (Abreu de Almeida & Abreu Soares, 2003). Using the marker of 19% as the ideal body fat percentage for the study, athletes were found to have 108% fat in comparison to the recommended value. Hence, it was suggested that volleyball ers should have a low fat mass and higher lean mass for improved performance (Azizi et al, 2010). Cupisti et al. (2002) reported that Italian female athletes had mean hieght, weight and BMI of 1.67 ± 0.06m, 55.8 ± 9.0kg and 19.9 ± 2.5kg/m^2 respectively. Tircep skinfold, mid arn circumferenc and mid arm muscle circumference were also measured, 10.9 ± 3.2mm, 237 ± 21mm and 203 ± 14 respectively (Cupisti et al., 2002). Gibson, Stuart-Hill, Martin, & Gaul (2011), stated that the female soccer player in there study had a mean weight of 60.9 ± 8.2kg, height of 163.8 ± 5.9cm, BMI of 22.7 ± 2.7kg/m^2 and a total skin fold (7 sum of sites) of 103.1 ± 35.2mm. Upon futher analysis of the data it was implied that the player

were not below age for height population ranges, underweight or overly lean by the World Health Organization's standards (2007).

CHAPTER III

METHODOLOGY

Research Design

In this cross sectional descriptive study, the target population was adolescent swimmers training in Trinidad and Tobago. All subjects were registered and trained with a competitive club at the time of data collection. The sample size was estimated using the formula ($n = \frac{1.96^2\ \hat{p}\ \hat{q}}{d^2}$). The formula was based on the predictive prevalence of those who would have a positive response (strongly agree or agree) to one of the statements in the attitude section. The statement was "the relationship between good eating habits and good health should be stressed to the athlete". The sample size calculated with a 5% level of significance was 246 swimmers.

Data were collected over a 3 week period in an attempt to meet the required sample size. Coaches were contacted via the telephone to explain the purpose of the research and methods to be used. The research data were collected through the questionnaire and taking anthropometric measurements at each club's training site. A day and time convenient to each club was arranged to allow for data collection. The selective purposive sampling method used was.

Subjects

Participants were recruited from private swim clubs in Trinidad and Tobago. The study sample consisted of 220 adolescent male and female swimmers, aged 11-21 years, who train competitively in Trinidad and Tobago. The study had a response rate of 89.43%. All of the clubs at the time of the study were registered with the Amateur Swimming

Association of Trinidad and Tobago (ASATT). The swimmers volunteered to participate in the study via a signed consent form.

Instrument

A structured questionnaire was utilized to evaluate the nutrition knowledge and attitudes of adolescent swimmers training in competitive clubs. The questionnaire comprised of three (3) sections. The first section was created to obtain information about demographics, to identify if the swimmers had any prior opportunity to learn about nutrition and to identify which sources they acquired nutrition information from. The second section contained statements related to nutrition knowledge and the third section had statements used to evaluate attitudes toward nutrition. The final part of the research involved collecting anthropometric data using a form, which was attached to the back of each questionnaire (Appendix A).

In order to determine the nutrition knowledge, 21 statements were given which could be replied as “true”, “false” or “not sure”. The correct answer was given a score of “1” and the incorrect or uncertain answers were given a score of “0”. Permission to used the statements were obtained from Ozdogan & Ozcelik (2011). The reliabilty of this questionnaire was found to be 0.71. To evaluate the attitudes toward nutrition, 11 statements were given, which could be replied using a Likert-scale with option ranging from “strongly agree” to “strongly disagree”. The scores ranged from “1-5”, where “5” was the most positive and “1” was the most negative. Permission to uses these statements were obtained from Zawila et al. (2003). The reliabiity of the combined questionnaire was not determined. A table was created to collect the anthropometric data which included height, weight, BMI, body fat percentage, muscle mass, viseral fat, waist

circumference, hip circumference and waist to hip ratio.

Procedure

The questionnaire was self-administered. The same instructions were read to each participant to ensure the questionnaire was completed correctly. Attached to each questionnaire was a cover letter and consent form to be signed by the participant or their parent/guardian. A stadiometer was used to measure height. The data collector ensured that the subject was facing directly ahead with there head in the Frankfurt plane, shoes were removed, feet together, arms by the sides, and heels, buttocks and upper back were in contact with the back of the stadiometer when the measurement was taken.

Weight, body fat percentage, visceral fat, BMI and skeletal muscle mass were all measured using a Full Body Sensor Body Composition Monitor and Scale. The participant's information, age, height, and gender, were entered into the machine. The participant was then allowed to stand on the scale, bare footed, knees and back straight, looking straight ahead and holding the display unit in front of them. To ensure the results were not skewed the participants were asked to remove any unnecessary objects (jewelry and cellular phones) on their person before the measurements were taken. After the machine registered their weight, the patient was asked to extend their arm 90˚ to their body and wait for the machine to register further measurements. Their measurements were then recorded.

Waist and hip circumference were taken using the non-stretch measuring tape. The waist measurement was taken at the narrowest waist level, or if this is not apparent, at the mid point between the lowest rib and the top of the hipbone (illiac crest). The hip

measurement was taken over minimal clothing, at the level of the greatest protrusion of the gluteal (buttock) muscles. The participant stood erect with their weight evenly distributed on both feet and legs slightly parted, making sure not to tense the gluteal muscles. When recording, it was ensured that the tape was not too tight or too loose, was lying flat on the skin, and was horizontal.

Statistical Analysis

All the data were evaluated using SPSS 21.0 software. Descriptive statistics were use to calculate frequencies, percentages and means the data collected. Analysis of variance (ANOVA) was used to compare nutrition knowledge and attitudes between sex, age range, highest level of education, and number of nutrition classes attended. Correlation was used to compare the relationship between nutrition knowledge and sources of information and between nutrition knowledge and attitudes. The level of statistical significance for all tests was $p < 0.05$.

CHAPTER IV

RESULTS

Demographics

The sample comprised of 220 swimmers, the majority, 122, being males and 98 being females participated in the study. This accounted for 55.5% and 44.5% respectively of all participants. The majority of participants were of mixed descent representing 58.6% (n=129) followed by Africans which accounted for 31.8% (n=70) of participants. Those of Indian, Caucasian and Asian decent were in the minority represented by 5.0%, 3.2% and 1.4%, respectively.

The most respondents made up the 15-17 age group accounting for 31.8% (n=70), while 27.7% (n=61), 26.8% (n=59) and 13.6% (n=30) represented the 11-12, 13-14 and 18-21 groups, respectively.

In relation to the highest level of education, 79.5% (n=175) of the respondents were in secondary school while 7.3% (n=16) were in primary. The remaining 13.2% (n=29) attended tertiary institutions.

With regard to nutrition education, 56.8% (n=125) of respondents have never had any form of nutrition education since beginning to swim, 35.0% (n=77) of respondents have had 1-3 classes, while a mere 8.2% (n=18) had 4 or more classes.

In reference to the most recent nutrition education opportunity, 53.5% (n=117) of participants have never had a nutrition class before. Participants have their last nutrition class within the years 2011 and 2012 accounted for 33.6% (n=74) of the sample, while

13.2% (n=29) had their last nutrition class more than 2 years ago. Table 1 summarizes all the demographic data.

Table 1: Demographic Data Obtained from the Sample Group

Variable	Classification	Frequency (n = 220)	Percentage (%)
Sex:	Female	98	44.5
	Male	122	55.5
Ethnicity	African	70	31.8
	Indian	11	5.0
	Caucasian	7	3.2
	Asian	3	1.4
	Mixed	129	58.6
Age Range	11-12	61	27.7
	13-14	59	26.8
	15-17	70	31.8
	18-21	30	13.6
Highest Level of Education	Primary	16	7.3
	Secondary	175	79.5
	Tertiary	29	13.2
Number of nutrition classes/ courses/seminars attended	None	125	56.8
	1-3	76	35.0
	4 or more	18	8.2
Most recent class/course/ seminar attended	Never	117	53.2
	2011-2012	74	33.6
	More than 2 years ago	29	13.2

Sources of Information

The mean total number of sources used by the respondents was 3.98 ± 2.404 (29.93 ± 18.490%). The most popular information sources were coaches and parents, who were reported to provide nutrition information to over half of the participants, 63.6% (n=140) and 55.9% (n= 123), respectively. The least popular source of information was dietitians/nutritionists, who provided information to only 7.7% (17) of the participants. Coaches and parents were followed by teaches, the Internet, doctors, athletic trainers and books, providing information to 44.1% (n=97), 41.4% (n=91), 40.5% (n=89), 35.5% (n=78) and 35.5% (n=78) of participants, respectively. The data showed that 18.6% (n=41) of respondents indicated obtaining information from friends and teammates, 13.6% (n=30) got information from magazines and 11.8% (n=26) acquired information from newspapers. Other sources of information provided by the respondents included DVD documentaries, the television and other family members (brothers, extended family), this accounted for 2.3% (n=5). This information is summarized in Table 2.

Table 2: Nutrition Information Sources used by Swimmers

Source	Frequency (n = 220)	Percentage (%)
Books	78	35.5
Magazines	30	13.6
Newspapers	26	11.8
Teachers	97	44.1
Coaches	140	63.6
Athletic trainers	78	35.5
Doctors	89	40.5
Dietitian/Nutritionist	17	7.7
Parents	123	55.9
Friends	41	18.6
Teammates	41	18.6
Internet	91	41.4
Other	5	2.3

Nutrition Knowledge

The questionnaire consisted of 21 nutrition knowledge statements; the highest potential score that could be attained was 21 and the lowest score was 0. The mean nutrition knowledge total score for the entire sample was 10.97 ± 2.90 (52.25 ± 13.795%). The high score was 20 (95.24%) whilst the lowest score was 2 (9.52%). Male participants had a mean score of 11.05 ± 2.793, which was higher than the female participants mean score of 10.88 ± 3.033. Participants in the age range of 18-21 score the highest out of the 4 specified age ranges with a mean score of 12.97 ± 2.735 (61.75 ±13.025%). The participants in the age range of 15-17 were next followed but those in 13-14 and those in the 11-12 age range score the lowest with 11.17 ± 2.823 (53.20 ± 13.444%), 10.78 ± 3.074 (51.33 ± 14.639%) and 9.95 ± 2.362 (47.38 ± 11.249%) respectively.

Under 25% of participants gave the correct response to the following statements, “During physical activity, feeling thirsty is enough to indicate the need for liquid” (20.5%), “Protein is the main energy source for the muscle” (20%), “Vitamins are good sources of energy” (13.2%) and, “Vitamin supplements are recommended for all physically active people” (10.5%), Only 6 statements were answered correctly by 25-50% of participant. This included the subsequent statements, “Basic sugars like brown or granulated sugar, jam and honey are the most suitable energy sources for sportsmen” (43.2%), “Carbohydrates are stored in muscles in the form of glycogen” (46.4%),“Iron-deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood” (38.2%), “Iron in meat is absorbed at the same rate as iron in a plant food” (37.7%), “Saturated and unsaturated oils both have an equal effect on the health” (31.4%) and, “Table salt is an essential part of a healthy diet” (30.0%).

Between 50-74% of participants gave accurate answers to the following questions, “Fats have important roles in the body” (75%), “Eating carbohydrates makes you fat” (56.8%), “Males and females of the same age group spend equal amounts of calories during the same exercise” (75.0%), “The last meal before a competition should be eaten 3-4 hours before the competition” (56.8%), “Alcohol consumption can affect absorption and utilization of nutrients” (64.1)%) and, “The body can make vitamin D upon exposure to the sun” (68.6%). While over 75% of the participants correctly responded to the remaining questions, which included; “Skipping meals is justifiable if you need to lose weight quickly” (84.5%), “Milk and milk products are the best sources of calcium” (84.1%), “Foods like chocolate, biscuits and chips are the most appropriate foods to be consumed soon after training” (76.4%), “Dehydration decreases performance” (85.9%), “Bananas are good sources of potassium” (79.1%).

Analysis of variance (ANOVA) was used to test for differences between means for sex, age range, highest level of education, and the number of nutrition classes attended since starting to swim. The means for sex, age range, and highest level of education were not significantly different. However, there was a significant difference in means in relation to the number of nutrition classes taken since starting to swim ($p = 0.039$), the more nutrition classes attended the higher the total score.

Table 3-5 summarizes the results stated above.

Table 3: Means and Standard Deviation for Demographic Variables and Nutrition Knowledge Score and Percentage

Variable	Category	Group	Means ± Standard Deviation
Nutrition Score	Sample	Total	10.97 ± 2.897
	Sex	Male	11.05 ± 2.793
		Female	10.88 ± 3.033
	Age Range	11-12	9.95 ± 2.362
		13-14	10.78 ± 3.074
		15-17	11.17 ± 2.823
		18-21	12.97 ± 2.735
Nutrition Score Percentage	Sample	Total	52.25 ± 13.795%
	Sex	Male	52.62 ± 13.299%
		Female	51.80 ± 14.445%
	Age Range	11-12	47.38 ± 11.249%
		13-14	51.33 ± 14.639%
		15-17	53.20 ± 13.444%
		18-21	61.75 ±13.025%

Table 4: Participants Who Correctly Responded to the Nutrition Knowledge Statements

Statement	Frequency (n = 220)	Percentage (%)
1. Protein is the main energy source for the muscle.	44	20.0
2. Fats have important roles in the body.	165	75.0
3. Iron-deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood.	84	38.2
4. Iron in meat is absorbed at the same rate as iron in a plant food.	83	37.7
5. The body can make vitamin D upon exposure to the sun.	151	68.6
6. Vitamin supplements are recommended for all physically active people.	23	10.5
7. During physical activity, feeling thirsty is enough to indicate the need for liquid.	45	20.5
8. Skipping meals is justifiable if you need to lose weight quickly.	186	84.5
9. Foods like chocolate, biscuits and chips are the most appropriate foods to be consumed soon after training.	168	76.4
10. Vitamins are good sources of energy.	29	13.2

11. Alcohol consumption can affect absorption and utilization of nutrients.	141	64.1
12. Saturated and unsaturated oils both have an equal effect on the health.	69	31.4
13. Eating carbohydrates makes you fat.	125	56.8
14. Dehydration decreases performance.	189	85.9
15. The last meal before a competition should be eaten 3-4 hours before the competition.	125	56.8
16. Males and females of the same age group spend equal amounts of calories during the same exercise.	165	75.0
17. Bananas are good sources of potassium.	174	79.1
18. Table salt is an essential part of a healthy diet.	66	30.0
19. Milk and milk products are the best sources of calcium.	185	84.1
20. Basic sugars like brown or granulated sugar, jam and honey are the most suitable energy sources for sportsmen.	95	43.2

21. Carbohydrates are stored in muscles in the form of glycogen.	102	46.4

Table 5: ANOVA Analysis of Total Nutritional Knowledge Percentage with Selected Independent Variables and the Accompanying F and p Values

Dependent variable: Total nutrition knowledge percentage

Independent variables	**F-value**	**p-value**
Sex	0.023	0.880
Age Range	1.750	0.158
Education	2.100	0.125
Number of Nutrition Classes	3.297	0.039*

* Significant ($p < 0.05$)

Relationship between Nutrition Knowledge and Nutrition Information Sources

The relationship between nutrition knowledge and reported number of nutrition sources was analyzed using Pearson correlation. It was found that nutrition knowledge was positively and significantly related to number of reported nutrition sources ($p = 0.005$).

Attitude towards Nutrition

The questionnaire consisted of 11 statements concerning attitudes toward nutrition; the highest possible score was 55 while the lowest possible score was 11. The mean score for attitude towards nutrition was for the entire sample was 41.69 ± 6.215 (75.79 ± 11.300%). The highest score was 55 (100%) even as the lowest score was 19 (34.55%). Male respondents had a slightly higher mean attitude towards nutrition score than female respondents, 41.96 ± 5.931 (76.29 ± 10.784%) and 41.35 ± 6.566 (75.17 ± 11.939) respectively. As the age range increased so did the attitude towards nutrition scores. The age range of "18-21" had the highest score of 43.83 ± 6.438 (79.70 ± 11.706%), followed by the "15-17" age range scoring 42.47 ± 6.236 (77.90 ± 11.338%). The "11-12" and "13-14" age range had similar scores of 40.48 ± 6.239 (73.59 ± 11.343) and 40.47 ± 5.618 (73.59 ± 10.215), respectively.

Over 75% of the participants responded positively to the following statements, "Coaches need to have good attitudes toward nutrition because of their close contact and influence upon athletes" (87.3%), "The type of food an athlete eats affects his/her physical performance" (87.2%), "The relationship between good eating habits and good health should be stressed to the athlete" (85%), and "Learning facts about nutrition is the best

way to achieve favorable changes in food habits" (79.5%). Only 16.3% of the participants responded positively to the question "Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need."

Between 50-75% of the respondents chose positive responses for the following statements, "The athlete should schedule his/her activities so he/she has time to eat" (72.5%), "Nutritional counseling would be important to the athlete who is trying to change his/her weight" (72.3%), and "It is the coach's responsibility to stress good nutritional practices" (62.7%). Fewer than 50% of the participants positively responded to the following, "Food advertisements are a very reliable source of nutritional information" (45.0%), "Nutrition is more important during the competitive season than during the off-season for the athlete" (35.0%), and "What the athlete eats is only important if the athlete is trying to gain or lose weight" (28.2%).

ANOVA analysis was used to test for differences between the means for sex, age range, highest level of education, number of nutrition classes attended since being to swim, and club. There was no significant difference between the means for any of the categories mentioned above.

Table 6-8 summarizes the results for the attitudes toward nutrition.

Table 6: Demographic Variables and Attitude towards Nutrition Score and Percentage

Variable	Category	Group	Means ± Standard Deviation
Attitude towards Nutrition Score	Sample	Total	41.69 ± 6.215
	Sex	Male	41.96 ± 5.931
		Female	41.35 ± 6.566
	Age Range	11-12	40. 48 ± 6.239
		13-14	40.47 ± 5.618
		15-17	42.47 ± 6.236
		18-21	43.83 ± 6.438
Attitude towards Nutrition Score Percentage	Sample	Total	75.79 ± 11.300
	Sex	Male	76.29 ± 10.784
		Female	75017 ± 11.939
	Age Range	11-12	73.59 ± 11.343
		13-14	73.59 ± 10.215
		15-17	77.90 ± 11.338
		18-21	79.70 ± 11.706

Table 7: Participants Attitude towards Nutrition

Statement	Grouping	Frequency (n = 220)	Percentage (%)
1. The relationship between good eating habits and good health should be stressed to the athlete.	Strongly Disagree (-)	7	3.2
	Disagree (-)	11	5.0
	Undecided	15	6.8
	Agree (+)	56	25.5
	Strongly Agree (+)	131	59.5
2. Coaches need to have good attitudes toward nutrition because of their close contact and influence upon athletes.	Strongly Disagree (-)	5	2.3
	Disagree (-)	5	2.3
	Undecided	18	8.2
	Agree (+)	80	36.4
	Strongly Agree (+)	112	50.9
3. The type of food an athlete eats affects his/her physical performance.	Strongly Disagree (-)	11	5.0
	Disagree (-)	10	4.5
	Undecided	7	3.2
	Agree (+)	66	29.5
	Strongly Agree (+)	127	57.7
4. What the athlete eats is only important if the athlete is trying to gain or lose weight.	Strongly Disagree (+)	25	11.4
	Disagree (+)	37	16.8
	Undecided	47	21.4
	Agree (-)	62	28.2
	Strongly Agree (-)	49	22.3

5. Nutrition is more important during the competitive season than during the off-season for the athlete.	Strongly Disagree (+)	30	13.6
	Disagree (+)	47	21.4
	Undecided	29	13.2
	Agree (-)	67	30.5
	Strongly Agree (-)	47	21.4
6. Food advertisements are a very reliable source of nutritional information.	Strongly Disagree (+)	19	8.6
	Disagree (+)	80	36.4
	Undecided	61	27.7
	Agree (-)	40	18.2
	Strongly Agree (-)	20	9.1
7. It is the coach's responsibility to stress good nutritional practices.	Strongly Disagree (-)	5	2.3
	Disagree (-)	34	15.5
	Undecided	43	19.5
	Agree (+)	81	36.8
	Strongly Agree (+)	57	25.9
8. The athlete should schedule his/her activities so he/she has time to eat.	Strongly Disagree (-)	5	2.3
	Disagree (-)	17	7.7
	Undecided	38	17.3
	Agree (+)	85	38.6
	Strongly Agree (+)	75	34.1
9. Learning about nutrition is not important for athletes because they eat so much food they	Strongly Disagree (+)	15	6.8
	Disagree (+)	21	9.5
	Undecided	33	15.0

always get the nutrients their bodies need.	Agree (-) Strongly Agree (-)	74 77	33.6 35.0
10. Learning facts about nutrition is the best way to achieve favorable changes in food habits.	Strongly Disagree (-) Disagree (-) Undecided Agree (+) Strongly Agree (+)	7 10 28 105 70	3.2 4.5 12.7 47.7 31.8
11. Nutritional counseling would be important to the athlete who is trying to change his/her weight.	Strongly Disagree (-) Disagree (-) Undecided Agree (+) Strongly Agree (+)	2 17 42 101 58	0.9 7.7 19.1 45.9 26.4

(-) – negative attitude and (+) – positive attitude

Table 8: ANOVA Analysis of Total Attitudes toward Nutrition Percentage with Selected Independent Variables and the Accompanying F and p Values

Dependent variable: Total attitude toward nutrition percentage

Independent variables	**F-value**	**p-value**
Sex	0.141	0.707
Education	0.561	0.572
Age Range	2.350	0.074
Number of Nutrition Classes	1.303	0.274
Club	0.531	0.913

Relationship between nutrition knowledge and attitudes towards nutrition

The relationship between nutrition knowledge and attitude towards nutrition was analyzed using Pearson correlation test. It was found that nutrition knowledge was positively and significantly related to the attitude of the respondents held towards nutrition ($p = 0.027$).

Body Composition

The anthropometric data obtained were height, weight, body mass index (BMI), waist circumference, hip circumference, mid-upper arm circumference, waist to hip ratio, body fat percentage, visceral fat and skeletal muscles mass percentage. The mean height for the population was 64.79 ± 5.160 inches (5 feet and 4.79 inches) and the mean weight was 128.02 ± 33.04lbs. The mean BMI for the sample was 21.25 ± 4.259lbs/inch^2. The mean for the waist, hip and mid upper arm circumferences were 27.49 ± 3.183in, 35.08 ± 3.873in and 10.80 ± 1.985in respectively. The sample's mean waist to hip ratio was 0.78 ± 0.449. The sample had a mean body fat percentage, visceral fat and skeletal muscle mass percentage of 21.20 ± 9.274%, 4.77 ± 2.897 and 38.33 ± 6.361% respectively.

The mean height and weight measurements were for males were 65.94 ± 6.227in and 135.95 ± 34.577lbs respectively, while for females they were 63.37 ± 2.837in and 118.15 ± 28.212lbs respectively. The mean waist circumference for males and females were 28.09 ± 3.216 and 26.75 ± 2.992 respectively. For the males and females the mean hip circumference measurement was 34.88 ± 3.891 and 35.33 ± 3.854 respectively. The mean mid upper arm circumference for males and females were 11.16 ± 2.304 and 10.35 ±

1.378 respectively. The mean waist to hip ratio for males and females were 0.80 ± 0.035 and 0.76 ± 0.045, respectively. For males the mean body fat percentage, visceral fat and skeletal muscle mass percentage measurements were 15.65 ± 6.929, 5.33 ± 3.291 and 41.40 ± 3.603 respectively, while for females the mean body fat percentage, visceral fat and skeletal muscle mass percentage measurements were 27.33 ± 7.523, 3.44 ± 0.727 and 31.17 ± 5.637, respectively.

Table 9 summarizes the results for the mean anthropometric measurements collected.

Table 9: Means and Standard Deviations of Anthropometric Variables for Males, Females and the General Population

Anthropometric Variable	**Mean ± Standard Deviation for Males**	**Mean ± Standard Deviation for Females**	**Mean ± Standard Deviation for the Sample**
Height (inches)	65.94 ± 6.227	63.37 ± 2.837	64.79 ± 5.160
Weight (lbs)	135.95 ± 34.577	118.15 ± 28.212	128.02 ± 33.04
BMI lbs/inches^2	21.40 ± 4.118	21.06 ± 4.443	21.25 ± 4.259
Waist circumference (inches)	28.09 ± 3.216	26.75 ± 2.992	27.49 ± 3.183
Hip circumference (inches)	34.88 ± 3.891	35.33 ± 3.854	35.08 ± 3.873
Mid upper arm circumference (inches)	11.16 ± 2.304	10.35 ± 1.378	10.80 ± 1.985
Waist to Hip Ratio (inches)	0.80 ± 0.035	0.76 ± 0.045	0.78 ± 0.449
Body fat percentage (%)	15.65 ± 6.929	27.33 ± 7.523	21.20 ± 9.274
Visceral fat	5.33 ± 3.291	3.44 ± 0.727	4.77 ± 2.897
Skeletal muscle mass (%)	41.40 ± 3.603	31.17 ± 5.637	38.33 ± 6.361

When BMI was further analyzed it was found 71.82% (n=158) of the participants had a normal BMI for their age (n=72 females and n=86 males). Only 2.72% (n=6) of the participants were underweight (n=3 participants from both sexes). In the overweight category there were 16.82% (n=37) participants (n=17 females and n=20 males). There were 19 (8.64%) of "obese" participants (n=6 females and n=13 males). The majority of participants, 97.89% (n=214) were classified as "low risk" based on waist circumference measurements for age (n=95 females and n=119 males). Only 2.72% (n=6) participants were classified as "high risk", (n=3 from both sexes).

Body fat percentages were only obtained for 198 of the participants. Upon further analysis of the body fat percentages it was established that 57.58% (n=109) participants had a normal body fat percentage for their age (n=52 females and n=57 males). The "under fat" category had 28.69% (n=37) of the participants (n=8 females and n=29 males), while the "over fat" category had 57.58% (n=31) participants (n=21 females and n=10 males). Those classifies as "obese" according to body fat percentage classifications made up 10.61% of the participants (n=13 females and n=8 males). Visceral fat and percent skeletal muscle mass measurements were only obtained for 30 of the participants. In the "normal" visceral fat classification were 96.67% (n=29) of the participants (n=9 females and n=20 males). Only 3.33% (n=1) of the participants had a high visceral fat measurement (n=0 females and n=1 male). For percent skeletal muscle mass, 50.00% (n=15) of the participants were classified as "high" (n=3 females and n=12 males), 30% (n=9) were classified as "normal" (n=5 females and n=4 males) and 16.66% (n=5) were classified as "very high" (n=1 female and n=4 males). Only 1 (44.44%) of the

participants was classified as having a low skeletal muscle mass percentage (n=0 females and n=1 male).

This information is seen in figures 1-5 below.

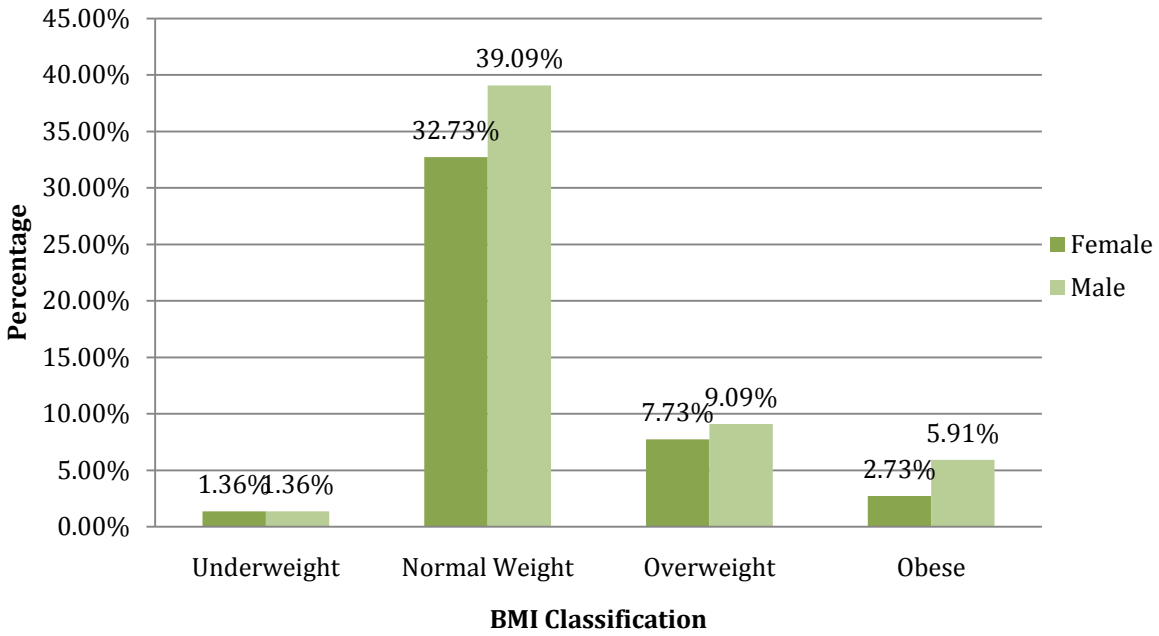

Figure 1. Bar Chart to Show the Percentage of Participant in each BMI Classifications

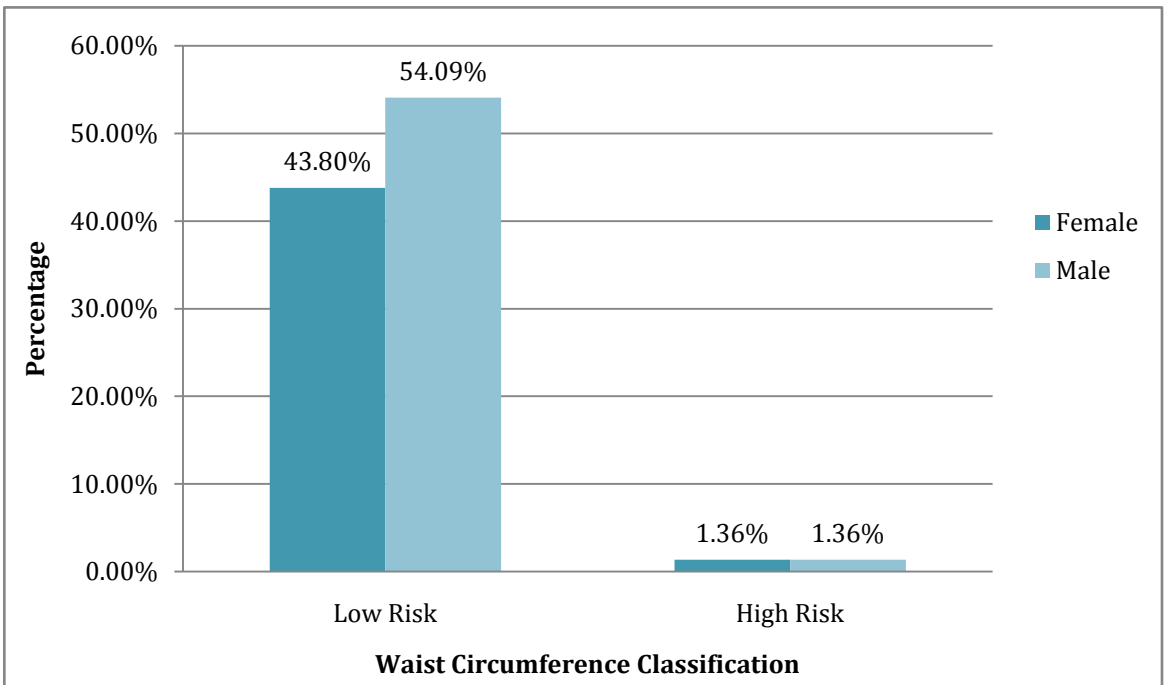

Figure 2. Bar Chart to Show the Percentage of Participants in each Waist Circumference Classification

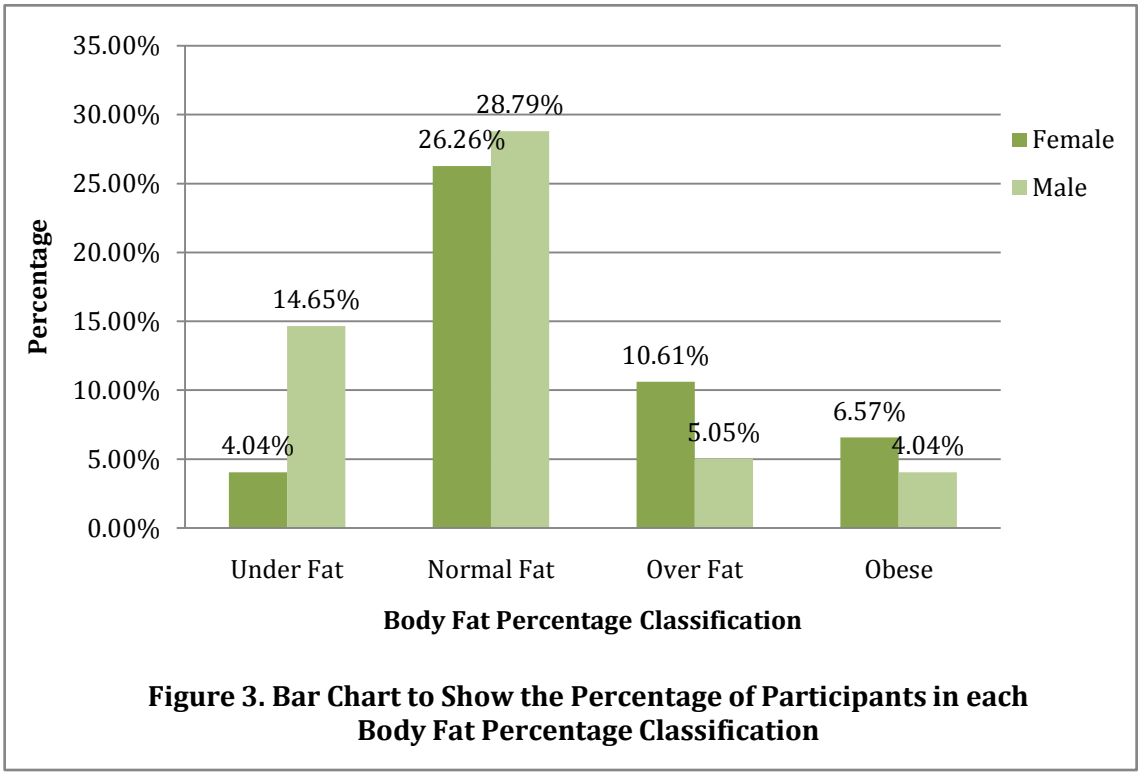

Figure 3. Bar Chart to Show the Percentage of Participants in each Body Fat Percentage Classification

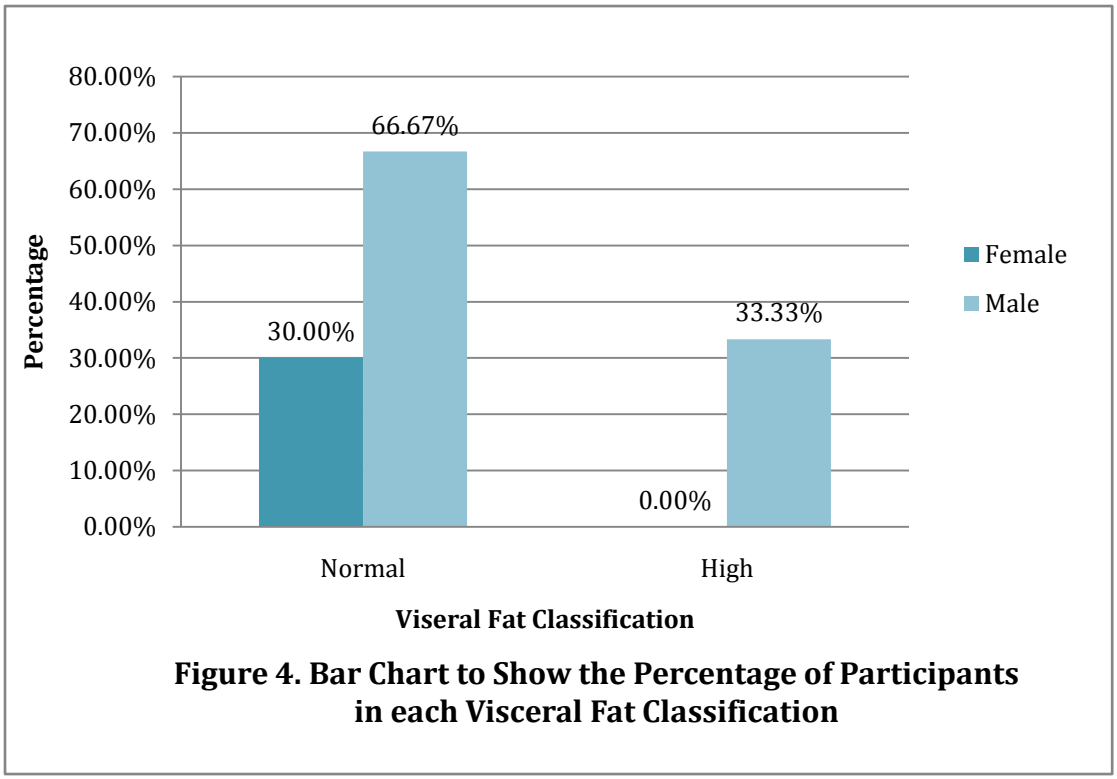

Figure 4. Bar Chart to Show the Percentage of Participants in each Visceral Fat Classification

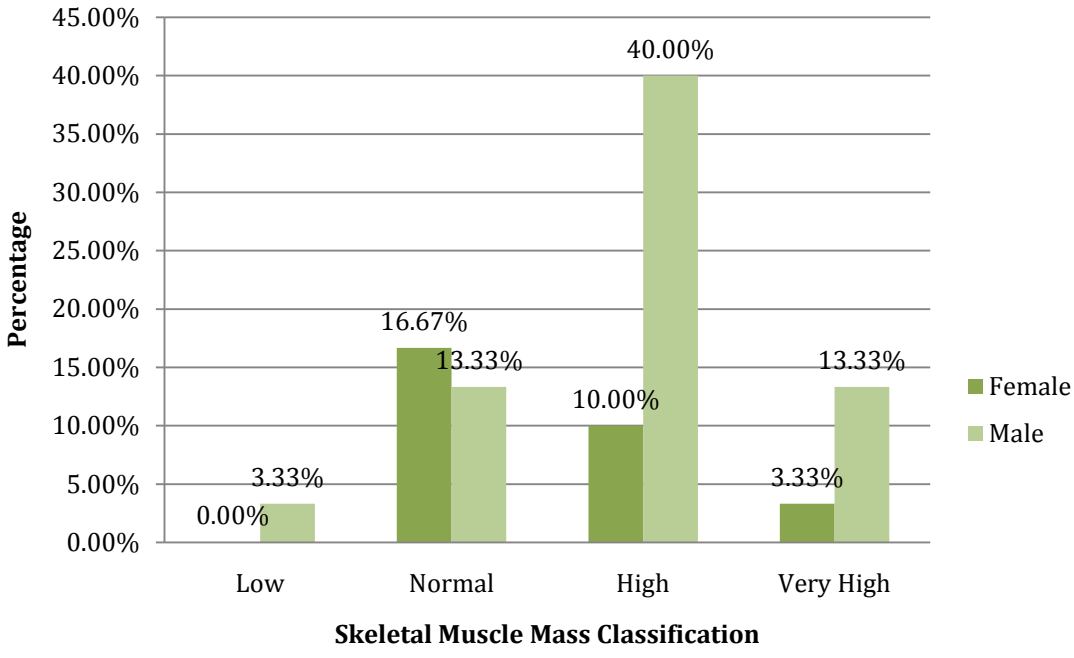

Figure 5. Bar Chart to Show the Percentage of Participants in each Skeletal Muscle Mass Classification

ANOVA analysis was used to test for differences between the means of body composition variables for sex, ethnicity, and actual age. For BMI there was no significant difference between means for sex (p=0.489) or ethnicity (p=0.517). However, there was a significant difference between the means for actual age (p=0.000), participants age 18 and 20 had higher BMI's than participants of other ages. For waist circumference there was no significant difference between means for ethnicity (p=0.513) however, there was a significant difference between the means for sex and actual age (p=0.035 and 0.001 respectively). Participants aged 18 and 20 had a higher waist circumference than participants of other ages and male had a higher waist circumference than females. Using body fat percentage it was found that there was no significant difference between means for ethnicity and actual age (p=0.968 and 0.064 respectively) but there was a significant difference between means for sex (p=0.000). Females had a higher body fat percentage when compared to males. There was no significant difference between means for visceral fat for any other the demographic variables (p= 0.490, 0.597 and 0.296 respectively). Skeletal muscle mass was not significant difference in means for ethnicity and actual age (p= 0.551 and 0.206 respectively) but showed a significant difference in means for sex (p=0.00), males had a higher muscle mass than females.

Table 10 below summarizes the above information.

Table 10: ANOVA Analysis of Dependent Body Composition Variables with Selected Independent Variables and the Accompanying F and p Values

Dependent variables	**Independent variables**	**F-value**	**p-value**
BMI	Sex	0.480	0.489
	Ethnicity	0.815	0.517
	Age	3.936	0.000*
Waist Circumference	Sex	4.514	0.035*
	Ethnicity	0.821	0.513
	Age	3.182	0.001*
Body Fat Percent	Sex	135.769	0.000*
	Ethnicity	0.139	0.968
	Age	1.795	0.064
Visceral Fat	Sex	0.492	0.490
	Ethnicity	0.528	0.597
	Age	1.309	0.296
Skeletal Muscle Mass Percent	Sex	37.805	0.000*
	Ethnicity	0.691	0.511
	Age	1.647	0.206

* Significant ($p < 0.05$)

CHAPTER V

DISCUSSION

The present study investigated the nutrition knowledge, attitude towards nutrition and body composition of adolescent swimmers training competitively in Trinidad and Tobago. The collected findings are to serve as an indication of the need to nutrition education among swimmers and possible other athletes. The study was composed of 122 male and 98 female swimmers (n = 220). The majority of the participants were of mixed decent, attending secondary school and were in the "15-17" age range. Over half of the participants have had nutrition class/course/seminar or seminar since beginning to swim. Further more than half of the participants indicated never attending a nutrition class/course/seminar at all.

Sources of Information – Swimmers in this study obtained information from a number of sources. The mean total number of sources used was 3.98 ± 2.404 (29.93 ± 18.490%). The top 2 sources of information were coaches and parents consistent with Hoogenboom et al. (2009). The least popular sources information were dietitians and those who indicated other sources such as DVD documentaries, the television and other family members.

Nutrition Knowledge – There were 5 statements dealing specifically with micronutrients. For the statement "protein is the main energy source for the muscle" only 20% of the respondents correctly answered as false. This was similar to the 31.7% of female cross-country runners who correctly answered this statement (Zawila et al., 2003). Whereas Ozdogan & Ozcelik (2011) found that 77.8% of the athletes in their study correctly

answered this statement. Carbohydrates, in the form of glucose and glycogen, are the main sources of energy for muscle; proteins are only used for energy when the body is deficient of carbohydrates (Whitney & Rolfes, 2011). For the statements "eating carbohydrates makes you fat" and "carbohydrates are stored in muscles in the form of glycogen" were 56.8% of swimmers answered correctly as false and 46.4% as true respectively. Eating carbohydrates does not make you fat however, eating carbohydrate in excess of energy needs or what the body can store will be stored as fat (Groves, 2007). Further, the amount of carbohydrates consumed affects the amount of glycogen stored; if glycogen stores are low performance can be negatively affected (Whitney & Rolfes, 2011). This reflected a lack of knowledge about the roles of protein and characteristics of carbohydrates in the body.

It is recommended that 30% of an athlete's caloric intake be from fat sources (Pramuková, Szabadosová, & Šoltésová, 2011). Fats have many roles in the body such as being an energy source, providing insulation in opposition to temperature extremes, protection against shock, and for maintenance and formation of cellular membranes. However, saturated fats have been linked to heart disease because if its role in increasing LDL cholesterol. So it is recommended that these fats be substituted for unsaturated fats (mono- and polyunsaturated fats) in the diet, which decrease the risk of heart disease. For questions dealing with fat, 75% of the swimmers correctly responded as true to the statement "fats have important roles in the body" and only 31.4% of them correctly answered false to the statement "saturated and unsaturated oils both have an equal effect on the health". This showed that participants were fairly knowledgeable about the

importance of fat in the diet but were not very knowledge able about the types of fat as reported by Davar (2012) and Dunn et al. (2007).

Eight (8) out of the 21 questions dealt with micronutrients. Potassium is one of the most abundant intracellular cations in the body and is needed to maintain fluid and electrolyte balance and the integrity of the cell and also need to aid in muscle contractions (Whitney & Rolfes, 2011). The best sources of potassium are fresh food such as bananas, which may contain over 400mg (Whitney & Rolfes, 2011). Over 50% of the participants (79.1%) correctly responded, true, to the statement "bananas are good sources of potassium", this was better than the 66.8% correct responses reported by Ozdogan & Ozcelik (2011). Only 30% of the swimmers answered false to the statement "table salt is an essential part of a healthy diet", which was similar to the 37.6% in Ozdogan & Ozcelik (2011). Sodium is the major extracellular cation and is needed for nerve impulses and muscle contractions, maintenance of cellular volume as well as acid base balance (Whitney & Rolfes, 2011). It is naturally found in vegetables and cereals and consuming these items can provide the recommended amount of sodium making it unnecessary to have additional salt added to food, additionally salt (sodium chloride) has been linked to high blood pressure and edema so excess should be avoided (Ozdogan & Ozcelik, 2011).

The statements "iron-deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood" was not answered well by the participants with only 38.2% correctly choosing true. In contrast, a similar question, "iron deficiency anemia results in decreased activity and performance", was answered well by participants in Davar (2012). Less than 40% of swimmers (37.7%) correctly chose false for the statement "iron in meat is absorbed at the same rate as iron in a plant food". This showed

a lack of knowledge about sources of iron, also seen in Davar (2012). Iron is needed for creation of hemoglobin and myoglobin, which accepts transports and releases oxygen around the body; it also serves as a cofactor for many enzymes needed for metabolism (Whitney &Rolfes, 2011). Absorption of iron is partially dependent on its source; animal sources of iron contain heme, which is easily absorbed, and plant sources contain non-hemeiron, which is not absorbed as well (animal sources also contain non-heme iron) (Whitney &Rolfes, 2011). A deficiency in iron is one of the most common nutrient deficiencies, and is observed in many athletes and non-athletes, especially in females (Ozdogan & Ozcelik, 2011).

Calcium is needed for proper bone development and is needed to maintain calcium levels body fluid (American College of Sports Medicine, American Dietetic Association & Dieticians of Canada, 2000). Insufficient calcium intake may cause a decrease in bone density and increases the risk of stress fractures (American College of Sports Medicine, American Dietetic Association & Dieticians of Canada, 2000). The majority of participants (84.1%) correctly choose true to the statement "milk and milk products are the best sources of calcium". This was similar to the results seen in Zawila et al. (2003) where all of the participants agreed with the statement "milk is a good supplier of calcium for all ages". Fortified food and the production of vitamin D by ultraviolet conversion in the skin are the primary sources of vitamin D (American College of Sports Medicine, American Dietetic Association & Dieticians of Canada, 2000). For the statement "The body can make vitamin D upon exposure to the sun" a fair amount of swimmers (68.6%) correctly chose true. These results were consistent with Ozdogan & Ozcelik (2011) where 67.6% of athletes correctly responded to the same statement.

Only 10.5% of the participants correctly chose false to the statements "vitamin supplements are recommended for all physically active people" which was the case in Zawila et al. (2003) where only 10.0% of the participant correctly responded to the statement. In contrast, 67.9% of the participants in Ozdogan & Ozcelik (2011) correctly answered the same question. For the statement "vitamins are good sources of energy" only 13.2% of the participants correctly identified false was the answer. This was lower than the 31.6% and 64.1% found in other studies (Ozdogan & Ozcelik, 2011; Zawila et al., 2003). Nutrient supplementation does not benefit the performance of well-nourished athletes so it can be said once a balanced diet is eaten which meets caloric needs additional vitamin supplements are not required (Whitney & Rolfes, 2011). Vitamins also do not produce energy however they are needed in the processes required for energy production (Whitney & Rolfes, 2011). The results for these questions showed that although the swimmers were knowledgeable about some of the sources of the above mentioned micronutrients, overall these swimmers lack knowledge about vitamins and mineral especially iron.

There were 2 statements that dealt with hydration on the questionnaire. Only 20.5% of swimmers correctly selected false to the statement "during physical activity, feeling thirsty is enough to indicate the need for liquid" In the study performed by Ozdogan & Ozcelik (2011), the rate of people being knowledge able about this was more than half the rate seen in the present study. While 85.9% of swimmers correctly indicated true as the response to "dehydration decreases performance" which was also the case in Davar (2012) where it was reported that female hockey players were seemingly knowledgeable about this. In normal circumstances thirst may be enough to stimulate fluid intake

however in vigorous training situations and demanding environments thirst may be an inadequate indicator (Department of Sport Nutrition, Australia Institute of Sport, n.d.). When an athlete is well hydrated before, during and after exercise performance is optimal however, if dehydrated performance decreases and there is an increased risk of potentially life-threatening heat related injury (American College of Sports Medicine, American Dietetic Association & Dieticians of Canada, 2000). The swimmers in this study need to be educated about the importance of staying hydrated pre-, during and post-exercise.

The 6 remaining statements on the questionnaire focused on diet practices. Participants correctly selecting false for the statement "skipping meals is justifiable if you need to lose weight quickly" came up to 84.5%, which was encouraging as only 12.8% 0f participants in another student responded correctly to this question (Ozdogan & Ozcelik, 2011). If calorie restriction is too strict then the individual may not receive sufficient nutrients and may suffer lose of lean tissue which can hamper performance significantly (Whitney & Rolfes, 2011). For the statement "alcohol consumption can affect absorption and utilization of nutrients", 64.1% of the participants correctly selected true which was comparable to the 67.1% of participants that answered correctly in (Ozdogan & Ozcelik, 2011). Alcohol dehydrates muscles which affects performance, stunts growth by interfering with absorption of nutrients, impairs psychological well being and it fattening (Thomas, 2012) so it is advisable that athletes avoid the consumption of alcohol. A majority of the participants (75.0%) correctly indicated false as the answer to "males and females of the same age group spend equal amounts of calories during the same exercise" which was higher than the 14.9% of participants in Ozdogan & Ozcelik (2011). Energy

requirements per day depend on age, sex, and activity level (National Institute of Health, n.d.).

A little over 50% of the participant (56.8%) correctly responded to the statement "The last meal before a competition should be eaten 3-4 hours before the competition" as true where was in Ozdogan & Ozcelik (2011) 81.6% of the partipant responded appropriately. It is suggest that endurance performance can be improved by consuming 200-300g of low glycemic index carbohydrates 2-4 hours before exercise, this allows for ingested carbohydrates to contribute to glycogen stores and this practice may also reduce gastrointestinal discomfort (Department of Sport Nutrition, Australia Institute of Sport, n.d.). For the statement "foods like chocolate, biscuits and chips are the most appropriate foods to be consumed soon after training" 76.4% of the participants indicated that the correct answer was false where as in Ozdogan & Ozcelik (2011) only 25.1% of the participants answered correctly. Davar (2012) also reported that 60% their participant agreed with this statement. Foods like fruit smoothies, low-fat milk or yogurt, or a lean meat/cheese/chicken sandwich with a piece of fruit are examples of appropriate post exercise meals (Department of Sport Nutrition, Australia Institute of Sport, n.d.). Chocolate, biscuits and chip contain a lot of fat which delays gastric emptying so that nutrients are not made available to the body (Stacher, et al., 1990). The statement "basic sugars like brown or granulated sugar, jam and honey are the most suitable energy sources for sportsmen" was correctly answered by 43.2% of the participants which was lower than the 72.3% of athletes that correctly answered in Ozdogan & Ozcelik (2011). Foods like basic sugars, jam and honey are high glycemic index foods, which enter the blood stream quickly and are carried away by insulin to the muscles; they cannot be used

to maintain blood glucose levels over a long period of time and may cause fatigue (Mills-Gray, n.d.). Athletes should consume moderate to low glycemic index food, which are broken down over time and so gives a constant supply of glucose in the blood over a period of time (Mills-Gray, n.d.). Athletes in this study should also be educated about pre-, during and post- exercise nutritional practices.

In this study, the nutrition knowledge of adolescent swimmers was found to be poor. Out of a possible score of 21, the highest score was 20 (95.24%) and the lowest score was 2 (9.52%). The mean knowledge score for the general sample was 10.97 ± 2.897 (52.25 ± 13.795%); this was lower than the mean score of 12.247 ± 3.525 found in Ozdogan & Ozcelik (2011) study where the same knowledge statements were used. The mean score for male respondents was higher than that for female participants, but there was no significant difference found when the means were compared, also seen in Ozdogan & Ozcelik (2011). The means knowledge score increase as the age range increased however no significant difference was found between means. The means for highest reported level of education, and number of nutrition classes were also compared (means not shown in results). This comparison was insignificant for highest reported level of education but was significant for number of nutrition classes taken ($p=0.039$). The significance between the means for number of nutrition classes taken indicates the more nutrition classes taken the higher the score, which suggests that nutrition education may be beneficial to athletes. The areas of nutrition knowledge that seemed to be deficient in this sample were the role of protein in the body, the characteristics of carbohydrates, the role of micronutrients in the body, types of fats and proper energy sources from food.

Relationship between Nutrition Knowledge and Sources of Nutrition Information – There was a positive significant correlation ($p=0.005$) between nutrition knowledge and sources of nutrition information, which meant that as nutrition knowledge increased so did the number of sources used. Barr (1986) also found a positive but weak correlation between nutrition knowledge sources and nutrition knowledge while Zawila et al. (2003) found no statistically significant relationship. The sources used by these swimmers seemed to be unreliable as seen by the low scores obtained in the nutrition knowledge section of the questionnaire. As such, with reference to these low scores, it was found that this study supported the statement made by Zawila et al. (2003) that the quality of nutrition sources should be more important than the quantity.

Attitudes towards Nutrition – In the results for the attitude section there were overall positive responses for 7 out of the 11 questions. The mean score of 41.69 ± 6.215 ($75.79 \pm 11.300\%$) reflected an overall positive attitude toward nutrition. When the means for sex, age range, highest reported level of education and number of nutrition classes taken since starting to swim were compared, no significant difference was found between any of the means for the groups. Whereas, in another study it was reported that female athletes had a significantly higher attitude score than male athletes and also those enrolled in physical activity majors had a higher score than other majors (Azizi et al.).

For the statement "learning facts about nutrition is the best way to achieve favorable changes in food habits" 79.5% of participants either strong agreed or agreed with the statement which was slightly less than in Zawila et al. (2003) and Davar (2012) where 91.7% and 93.3% of athletes respectively strongly agreed or agreed with the same statement. There was a low acceptance (16.3%) of the statement "learning about nutrition

is not important for athletes because they eat so much food they always get the nutrients their bodies need" and a high acceptance of the statement "the relationship between good eating habits and good health should be stressed to the athlete" by the swimmers. The results to these statements showed that the athletes may be receptive to nutrition education; the same conclusion was made by Zawila et al. (2003) and Davar (2012).

Relationship between Nutrition Knowledge and Attitudes toward Nutrition – It was found that there was a significantly positive correlation between nutrition knowledge and attitudes ($p=0.027$), as nutrition knowledge increased so did the attitudes toward nutrition. Many other studies have found the same relationship to be true (Perron & Endres, 1985; Hornstrom et al., 2011; Azizi et al., 2011). Therefore it may be said that nutrition education may not only increase nutrition knowledge but also have a positive effect on attitudes.

Body Composition – In order to identify the cutoffs for BMI the World Health Organization (2007) BMI-for-age tables for girls and boys aged 5 to 19 years were used. For the participants aged 20 and 21 were WHO classifications for adults (World Health Organization, 2006). The mean BMI of the sample was 21.25 ± 4.259 and it was observed that the vast majority of the participant fell into the category of "normal weight" (between the 3^{rd} and 85^{th} percentile for their age), this may have a positive effect on performance, these results were also seen in Juzwiak et al. (2008) where their participants also fell within normal ranges and Gibson et al. (2011) where is was reported that participants we not underweight or overweight. When means for BMI were compared there was no significant difference between means for sex or ethnicity. However, there

was a significant difference between the means for actual age (p=0.000), participants age 18 and 20 had higher BMI's than participants of other ages.

To identify the cutoff points for waist circumference developed by Fernández, Redden, Pietrobelli, Allison (2004) were used as seen in William (2005). Almost all of the participant were classified as low risk by these standards, so these athletes were considered not at risk for developing obesity and its co-morbidities such as metabolic syndrome, type-2 diabetes, and cardiovascular diseases. For waist circumference there was no significant difference between means for ethnicity however, there was a significant difference between the means for sex and actual age (p=0.035 and 0.001 respectively). Participants aged 18 and 20 had a higher waist circumference than participants of other ages and male had a higher waist circumference than females which were expected.

Body fat percentage cutoffs were identified using the International Obesity Task Force (IOTF) cutoffs were applied to the data collected in this study as seen in McCarthy, Cole, Fry, Jebb & Prentice (2006). Those who fell at or below the 2^{nd} percentile cutoff were considered under fat, between the 2^{nd} and 85^{th} percentile were considered to have normal fat, between the 85^{th} and 95^{th} percentile were considered over fat and those who fell at or about the 95^{th} percentile were considered obese (McCarthy, Cole, Fry, Jebb, & Prentice, 2006). Body fat values were obtained for 198 out of the 220 participants; the equipment used was not able to measure this variable to the remaining 22 participants because their body composition values were outside the measurement range (Omron Heathcare, 2008). Over half of the participant (55.05%) fell within the "normal fat" category, which may have a positive effect on performance. Juzwiak et al. (2008) also reported that participant

in their study fell within the recommended body fat range. Using body fat percentage it was found that there was no significant difference between means for ethnicity and actual age but there was a significant difference between means for sex (p=0.000). Females had a higher body fat percentage when compared to males which was expected because females usually have a higher body fat percentage than males (USA Swimming & The US Ski and Snowboard Association, 2006). Also body fat percentge plays a more important role in differentiating between healthy and obese individuals, as it has a greater ability to differentiate between lean mass and fat mass compared to BMI (Goonasegaran, Mat Nawi, & Abdul Wahab, 2012).

For visceral fat and skeletal muscle mass percentage the classifications seen in the Omron Heathcare (2008) instruction manual were used. Both visceral fat and skeletal muscle mass percentage were only able to be measured for the 30 participants in the "18-21" age range because the machine was only able to risterger values for the younger age ranges. The results for visceral fat classification showed that 96.67% of the participant were concidered to have normal virseral fat and not at risk for high levels of high cholestrol, heart disease or type-2 diabetes (Omron Heathcare, 2008). The results for skeletal muscle mass percentage showed that 30% of the participants fell within the normal range and 50% of the participant had high level of skeletal muscle mass. There was no significant difference between means for visceral fat for any other the demographic variables. Skeletal muscle mass was not significant difference in means for ethnicity and actual age but showed a significant difference in means for sex (p=0.00), males had a higher muscle mass than females which was expected based on the article by the USA Swimming & The US Ski and Snowboard Association (2006). Overall the swimmers in this study were

found to have a healthy body composition and at low risk for disease based on the comparison made above.

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

Conclusion

Swimmers training competitively in Trinidad and Tobago were found to lack nutrition knowledge. There were no significant differences in the nutrition knowledge between male and female participants or between age groups. Participants were also found to have a positive attitude towards nutrition but there was no significance between males and females or age groups. The swimmers were also found to be at low nutritional risk and had possessed an overall good body composition.

Limitation

- Some of the younger participant did not understand the statements on the questionnaire so this may have affected how they responded.
- It was difficult to arrange times to visit the clubs for data collection because of their respective training schedules.

Recommendation

- Qualified nutrition personnel should be made available to these swimmers so that accurate information is given and misconceptions are rectified.
- Coaches should enhance their knowledge about nutrition because they were a major source of information for these athletes.
- Further research can include the dietary practices of this population and the nutrition knowledge, attitudes and body composition of other sporting disciplines.

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APPENDIX A

Copy of Consent Form

THE UNIVERSITY OF THE WEST INDIES
Faculty of Food and Agriculture
Department of Agricultural Economics and Extension
St. Augustine Campus, Trinidad, West Indies

Agricultural Economics *Agricultural Extension* *Human Ecology*

October 5, 2012

Consent Form

For Investigative Procedures

Please permit me to introduce Ms. Safiya Beckford, who is a final year undergraduate student in the Human Nutrition and Dietetics programme. Ms. Beckford is required to conduct a mandatory research project as a partial fulfillment of her B.Sc. degree.

In that regard, Ms. Beckford has selected the topic "***Nutrition knowledge, attitudes and body composition of adolescent competitive swimmers in Trinidad and Tobago***." You will be asked to complete one (1) questionnaire, which require approximately 20-30 minutes to complete. This questionnaire(s) will be administered at your Club. We anticipate minimal psychological risks, and personal time inconvenience.

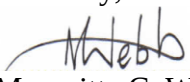
The results of this research will be useful in terms of health policy and practices. You may withdraw from this study at any time without jeopardizing your relationship with the University of the West Indies or the Department of Agricultural Economics and Extension.

We also wish to assure you that all information collected will be held in strict confidence and will only be used by researcher. Please complete the attached consent form.

Should you have further questions, Ms. Beckford will be happy to meet with you to discuss any concerns that you may have. I can be contacted at 1- 868-662-2002, Ext 82094 (work) or via e-mail marquitta.webb@sta.uwi.edu.

On behalf of the student, I wish to thank you for your time and assistance.

Sincerely,



Marquitta C. Webb (Dr.)
Lecturer

Human Nutrition and Dietetics

CONSENT FORM

I understand that if I agree to participate in this study, this means the following:

I understand that the participation in this study is entirely voluntary and I can choose to not answer any question or even to withdraw at any time from the study.

Participant / Guardian Date

If you have any questions regarding this study, you may contact Dr. Marquitta Webb, Department of Agricultural Economics and Extension at work: 662-2002 ext. 82094 or via email: marquitta.webb@sta.uwi.edu.

Appendix B

Copy of Questionnaire used

Nutrition Knowledge, Attitudes and Body Composition Questionnaire

Personal Questions

1. Sex: [ ] Female [ ] Male

2. Ethnic group: [ ] African [ ] Indian [ ] Caucasian [ ] Asian
   [ ] Mixed

3. Age range: [ ] 11-12 [ ] 13-14 [ ] 15-17 [ ] 18-21

4. What is your current level of education?
   [ ] Primary [ ] Secondary [ ] Tertiary

5. How many nutrition class/seminar/course have you attended since you started swimming?
   _____

6. When was the last time you attended a nutrition class/seminar/course?
   _____

7. From which sources have you obtained nutrition information?
   [ ] Books [ ] Magazines [ ] Newspapers
   [ ] Teachers [ ] Coaches [ ] Athletic Trainers
   [ ] Doctor [ ] Dietitian [ ] Parents
   [ ] Friends [ ] Teammates [ ] Internet
   [ ] other (please state) _____

Nutrition Knowledge

For each of the following questions, tick the response that best answers the question.

1. Protein is the main energy source for the muscle.
   [ ] True [ ] False [ ] Not Sure

2. Fats have important roles in the body.
   [ ] True [ ] False [ ] Not Sure

3. Iron-deficiency anemia results in a decrease in the amount of oxygen that can be carried in the blood.
   [ ] True [ ] False [ ] Not Sure

4. Iron in meat is absorbed at the same rate as iron in a plant food.
   [ ] True [ ] False [ ] Not Sure

5. The body can make vitamin D upon exposure to the sun.
   [ ] True [ ] False [ ] Not Sure

6. Vitamin supplements are recommended for all physically active people.
   [ ] True [ ] False [ ] Not Sure

7. During physical activity, feeling thirsty is enough to indicate the need for liquid.
   [ ] True [ ] False [ ] Not Sure

8. Skipping meals is justifiable if you need to lose weight quickly.
   [ ] True [ ] False [ ] Not Sure

9. Foods like chocolate, biscuits and chips are the most appropriate foods to be consumed soon after training.
   [ ] True [ ] False [ ] Not Sure

10. Vitamins are good sources of energy.
    [ ] True [ ] False [ ] Not Sure

11. Alcohol consumption can affect absorption and utilization of nutrients.
    [ ] True [ ] False [ ] Not Sure

12. Saturated and unsaturated oils both have an equal effect on the health.
    [ ] True [ ] False [ ] Not Sure

13. Eating carbohydrates makes you fat.
    [ ] True [ ] False [ ] Not Sure

14. Dehydration decreases performance.
    [ ] True [ ] False [ ] Not Sure

15. The last meal before a competition should be eaten 3-4 hours before the competition.
    [ ] True [ ] False [ ] Not Sure

16. Males and females of the same age group spend equal amounts of calories during the same exercise.
    [ ] True [ ] False [ ] Not Sure

17. Bananas are good sources of potassium.
    [ ] True [ ] False [ ] Not Sure

18. Table salt is an essential part of a healthy diet.
    [ ] True [ ] False [ ] Not Sure

19. Milk and milk products are the best sources of calcium.
    [ ] True [ ] False [ ] Not Sure

20. Basic sugars like brown or granulated sugar, jam and honey are the most suitable energy sources for sportsmen.
    [ ] True [ ] False [ ] Not Sure

21. Carbohydrates are stored in muscles in the form of glycogen.
    [ ] True [ ] False [ ] Not Sure

Attitudes toward nutrition

For each of the following questions, circle the number that best describes your answer.

1. Strongly agree
2. Agree
3. Undecided
4. Disagree
5. Strongly Disagree

1. The relationship between good eating habits and good health should be stressed to the athlete.	1	2	3	4	5
2. Coaches need to have good attitudes toward nutrition because of their close contact and influence upon athletes.	1	2	3	4	5
3. The type of food an athlete eats affects his/her physical performance.	1	2	3	4	5
4. What the athlete eats is only important if the athlete is trying to gain or lose weight.	1	2	3	4	5
5. Nutrition is more important during the competitive season than during the off-season for the athlete.	1	2	3	4	5
6. Food advertisements are a very reliable source of nutritional information.	1	2	3	4	5
7. It is the coach's responsibility to stress good nutritional practices.	1	2	3	4	5
8. The athlete should schedule his/her activities so he/she has time to eat.	1	2	3	4	5
9. Learning about nutrition is not important for athletes because they eat so much food they always get the nutrients their bodies need.	1	2	3	4	5
10. Learning facts about nutrition is the best way to achieve favorable changes in food habits.	1	2	3	4	5
11. Nutritional counseling would be important to the athlete who is trying to change his/her weight.	1	2	3	4	5

Anthropometric Measurements

Age: _____ Ethnicity: _____

Club: _____

Measurement	Value	Classification based on cut-off points (where applicable)
Height (feet & inches)		
Weight (lbs.)		
BMI		
Waist circumference (inches)		
Hip circumference (inches)		
Waist-to-hip ratio		
Body fat %		
Visceral fat %		
Skeletal muscle mass %		