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Original Research Article

Socioeconomic Standards, Nutritional Knowledge and Dietary Habits of Ghanaian Athletes: A Study of Three Major Sporting Regions in Ghana

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Abstract

Nutrition is essential in ensuring athletes' optimum sports performance and good health. This study's objective was to assess the socioeconomic (SE) standards, the nutritional knowledge, and the dietary habits of athletes across three (3) sporting regions in Ghana. Further, this study aimed to examine the relationship between the socioeconomic (SE) standards, the nutritional knowledge, and the dietary habits of athletes. The sample drew from football, hockey and basketball players. Data collection relied on an adapted Dietary Habits and Nutritional Knowledge Questionnaire by Paugh, 2005, while examination of the relationships was done using chi-square tests of association, at 0.050 level of significance. The results showed that athletes had reasonably good nutritional knowledge and dietary habits, this highlighted by mean percentage scores of 69.42% and 66.26%, respectively. Assessment of athletes' socioeconomic standards indicated that 80% lived on GHS1000 or less, per month. There were statistically significant relationships between sex and dietary habits, p=0.001; between sex and nutritional knowledge, p<0.001; between sporting disciplines and dietary habits, p=0.005; and between sporting disciplines and nutritional knowledge, p=0.021. Tests also revealed a statistically significant relationship between socioeconomic (SE) standard and nutritional knowledge, p=0.016. There was no significant relationship between athletes' level of nutritional knowledge and their dietary habits, p=0.620. Neither did the study establish any relationship between SE standard and dietary habits, p=0.292. This suggests a need for more in-depth exploration of the relationship between the socioeconomic (SE) standards, nutritional knowledge, and dietary habits of athletes.

Keywords: Socioeconomic indicators, Sports Performance, Dietary Habits, Optimum nutrition, Athletes, Nutritional Health.

INTRODUCTION

Nutritional and dietary habits have been of great interest in sports. They represent a focus area that is invaluable to athletes' training and performance. There is also a great deal of consensus that a person's socioeconomic (SE) factors influence his or her nutrition and dietary intake. However, despite the number of studies that have attempted to explore the determinants of dietary habits, a full understanding of the contribution of socioeconomic (SE) factors and nutritional knowledge to good dietary choices and practises of athletes still eludes many researchers. This is because, individually, there is still no clear evidence sustaining strong associations to dietary habits for any one of these factors (Spronk *et al*., 2014; Trakman *et al*., 2016; Vázquez-Espino *et al*., 2020). Still, the persistent assertion is that there should be an underlying link among these variables.

This assertion relies on the knowledge that sports usually involve intense physical activity in a competitive setting. This requires athletes to be in optimum physical condition in order to achieve any degree of success and, for this purpose, nutritional health is very important. Poor nutrition can result in a number of health problems that may be especially severe among athletes operating in highly competitive environments (Shifflett *et al.*, 2002). Unfortunately, athletes do not always make healthy food choices nor

do they always have the necessary nutritional knowledge to support their nutritional and physical goals, especially during competitions (Paugh, 2005; Burke *et al*., 2019). Thus, it is natural to expect that, with better understanding of nutritional information and guidelines, athletes would be able to make the right nutritional choices to achieve optimum physical performance and positive health outcomes.

Additionally, socioeconomic factors such as income, occupational status, place of residence, and educational level may play a considerable role in athletes' dietary habits and consequently affect their sports performance (Chandrasekaran *et al*., 2011; Burke *et al*., 2019; Kim & Kim, 2020; Vázquez-Espino et al., 2020). The case for Ghana reflects this scenario, as revealed by Mr. Baah-Nuako, former official of Kumasi Asante Kotoko, a Ghanaian Premier League club. In a television interview, he stated that Ghanaian players have lower earnings on the average than their African counterparts, with earnings as low as around $60.00 per month (JoyNews, 2020). The additional need to care for dependents means these low earning athletes find themselves compelled to take up other jobs and this likely affects their sports performance. Similarly, athletes' educational level is another important socioeconomic factor that impacts dietary habits, especially in these times when many professional athletes begin their careers as teenagers (Beck *et al*., 2015; Vázquez-Espino *et al*., 2020).

Undoubtedly, many factors affect athletes in elite competitions, where performance gains occur in small increments (Devlin & Belski, 2015). Nutritional adjustments to individual athletes' diet can alter body composition and this can enhance or limit sports performance (Broad & Cox, 2008; Heaney *et al*., 2011; Devlin & Belski, 2015). However, provision of accurate sports nutrition education remains a challenge in Ghana. This challenge in Ghana appears to have persisted because attempts to reform sports nutritional strategies have neglected studies on the impact of nutrition on athletes' performance. Further, reviews of the various sports documents in Ghana have evidenced these clear gaps in guidelines for sports nutrition (Baba, 2010; Nwafor, 2018; Charway & Houlihan, 2020). Ghana's National Sports Policy of 1994 remains the only extant sport policy document despite the passage of various legislation on sports (including recently in 2016) and plans to launch a new policy document (Baba, 2010; Nwafor, 2018; Charway & Houlihan, 2020).

Therefore, the aim of this study is to assess the level and quality of athletes' nutritional knowledge, socioeconomic standards and their dietary habits, and to address the limited data on interactions between same on Ghanaian athletes.

METHODS

Study Design

The study relied on a quantitative and qualitative questionnaire survey of athletes. The purpose was to investigate the socioeconomic standards, nutritional knowledge and dietary habits of athletes in Ghana.

Study Population

The population for the study is all Ghana-based athletes registered with the National Sports Authority that play in hockey, basketball, and football teams in Greater Accra Region, Central Region, and Ashanti Region.

Sample and Sampling Techniques

This study employed the purposive sampling approach. The sampling frame comprised a list of teams formulated through interactions with the Regional Football Associations (RFAs) in the Greater Accra, Ashanti and Central Regions; Ghana Hockey Association (GHA); and the Ghana Basketball Association (GBBA). Sampling generated one hundred and eighty-eight (188) valid athletes to be included in the study. This sample size was guided by the sample size calculation method as adapted from Oladunni & Sanusi (2013). The determination of minimum sample size was by means of the formula:

$$n=16\times 2p\times \frac{(100-p)}{W^2}$$

with an expected precision of 5% at a 95% confidence interval.

Where,
n = minimum sample size
p = proportion of athletes (5%)
W = width of confidence interval = 10%
n= 16x10x95/ 100 = 152 subjects.

Procedure for Data Collection

This research employed an adapted form of the Dietary Habits and Nutritional Knowledge Questionnaire, in Paugh (2005). The questionnaire had three sections: Socio-demographics, Dietary Habits, and Nutritional Knowledge.

The Socio-demographic section required the participants to provide responses about sex, age, type of sports and league played, height and weight, education, level of income, ethnicity, place and type of residence.

The Dietary Habits section included 18 numbered items, which required participants to indicate how often they ate a particular food item. The arrangement of responses was in increasing order of frequency of the target behaviour: "Never", "Sometimes", "Often", and "Always". Item numbers 2-4, 8-9, 14-15, and 17 were reverse phrased. The plan for

reverse phrased items was for them to receive reversed scores during analysis.

The Nutritional Knowledge section included 29 numbered items, which tested the extent of athletes' knowledge about nutrition. Available for each item were a set of responses, ordered according to increasing degrees of agreement with the given statements. The responses, in order, were "Strongly Disagree", "Disagree", "Agree" and "Strongly Agree". Item numbers 2, 20, and 29 were reverse phrased.

Scoring for items in both the Dietary Habits and the Nutritional Knowledge sections ranged from a minimum score of one (1) to a maximum score of four (4). The maximum score of 4 was assigned to the most desirable or acceptable responses in either section ("Always"/ "Strongly Agree"), with decrements of 1 point down to the minimum score of 1, which was assigned to the least desirable or acceptable responses in either section (("Never"/ "Strongly disagree"). The reverse phrased items received reversed scores in order to be consistent with this scoring scheme.

Statistical Analysis

The cleaning, verification and analyses of the data was completed using IBM SPSS (Statistical Package for Social Sciences) version 26.0 for Windows.

Post-data collection analysis led to the elimination of four problematic items from the Dietary Habits section. Consequently, the maximum score possible in this section was 56. For the Nutritional Knowledge section, the maximum score possible was 116. Athletes' received percentage scores for each section by having their scores for each section expressed as percentages of the maximum scores possible that section. This made it possible to include mean percentage scores for dietary habits and nutritional knowledge together with other descriptive statistics.

Athletes then received grades for each section, namely, "Poor", "Fair", "Good", and "Excellent", based on the classification of their percentage scores for that section. Furthermore, athletes' responses for "number of dependents", "educational level" and "type of residence", all received numerical weights. This made it possible to estimate the composite measure of socioeconomic factors, SE Standard (Socioeconomic Standard), as an expression of these numerical weights and athletes' reported monthly income. Athletes were then categorised as being at either "GHS1000 SE Standard or Less" or at "More than GHS1000 SE standard".

The results of the above steps served as basis for further analysis. Inferential techniques included chi-square tests of associations, to test hypotheses at a 0.050 level of significance. Further testing involved measuring the effect sizes using Cramer's V and odds-ratio.

Ethical Considerations

The principal researcher received ethical clearance from the Research and Ethics Committee of the University of Health and Allied Sciences, Ho, Ghana. The Pan African University Life and Earth Sciences Institute provided other permissions and approvals. The directors of the various institutions and the managers of the regional teams in Ghana provided permission for the participation of their athletes in the study. This study included only athletes who formally consented by filling an informed consent form. The research team handled all the data obtained from participants with utmost confidentiality, using such data only for the purpose of research. Participation in this study did not subject the participants to undue stress or trauma.

RESULTS AND DISCUSSION

General Characteristics of Data and Participants

The study sought to assess the socioeconomic standards, nutritional knowledge and dietary habits of athletes in Ghana. The instrument assessed socioeconomic variables as well as data about frequency of foods consumed from the "Food Guide Pyramid"; consumption of beverages; vitamin and mineral supplements; food intake, dieting and skipping meals; and frequency of fast-food consumption.

The results and discussions that follow draw from data analyses of 188 valid questionnaires received from athletes from three regions of Ghana, across three different sporting disciplines. Valid athletes were defined as those respondents aged 17 to 45 years and active as professional athletes in a particular sporting discipline, fulfilling the criteria proposed by Araújo & Scharhag (2016).

Sex Distribution

Out of the 188 athletes, 60% (n=112) were males and 40% (n=76) were females.

Table 1: Demographic characteristics of athletes

Demographic data	Number of athletes (n) (N=188)	Percentage (%)
Sex		
Male	112	59.6
Female	76	40.4
Home Region of Team		
Ashanti Region	65	34.6
Central Region	80	42.6
Greater Accra Region	43	22.9
Age Groups (years)		
17 - 22	120	63.8
23 - 28	53	28.2
29 - 34	10	5.3
35 - 40	3	1.6
41 - 46	2	1.1

Age Distribution

As seen in Table 1, less than 5% of the athletes were older than 32 years. About 40% (n=75) were aged 17 to 20 years, another 41% (n=77) were aged 21 to 24 years and a further 11% (n=21) aged 25 to 28 years, altogether accounting for 92% of the athletes sampled. The mean age in years was 22.4 years. The youngest athletes were aged 17 years, one male and 3 females, and the eldest athlete sampled was male, aged 45 years. One other notable fact was that athletes 29 years or older were predominantly male: only three (3) of these 15 were female (all aged 30 years).

Type of Sports

There was a nearly even distribution of athletes across the three (3) sporting disciplines: 31% (n=59) footballers, 35% (n=65) basketball players and 34% (n=64) hockey players. The sampled athletes represented more than 47 sporting clubs or academies.

Educational Status, Type of residence, and Number of Dependents

About 73% (n=137) of the athletes sampled reported having university education at undergraduate level or higher. A further 20% (n=37) had senior high school education and 5 more (3%) reported basic or junior high school education. In sum, this means that as much as 95% of the athletes had at least some form of education.

Table 2: Educational Status, Type of residence, and Number of Dependents

Category	Number of athletes (n) (N=188)	Percentage (%)
Educational Status		
None	1	0.5
Basic/Junior High	5	2.7
Senior High School	37	19.7
Undergraduate/Professional or Higher	137	72.9
Type of Residence		
Rural	39	20.7
Suburban	35	18.6
Urban	104	55.3
Number of dependents		
No Dependents	53	28.2
1 Dependent	11	5.9
2 Dependents	41	21.8
3 Dependents	30	16.0
4 Dependents	30	16.0
5 Dependents	9	4.8
6 or More Dependents	1	0.5

More than 55% of the athletes lived in urban dwellings. Among the rest, there were nearly equal numbers (about 20% each) dwelling in suburban (n=35) and rural dwellings (n=39).

Though some 7% of athletes did not provide data on their dependents, more than 28% (n=53) of the athletes reported having no dependents. Only one athlete reported having more than five (5) dependents. The remaining athletes reported having 1 to 5 dependents as shown in the table above.

Income Level

Some 38% of the athletes reported having monthly income of less than GHS100.00 per month ($16.41; quoted from www.xe.com, 22 January 2022) and a further 29% reported incomes from GHS100.00 to just under GHS1000.00. The remaining athletes who reported income data reported having incomes of GHS1000.00 or more.

Socioeconomic (SE) Standard

Weighting the income data by athletes' educational level and adjusting for the number of dependents and the type of residence produced a composite measure for athletes' socioeconomic data in terms of Ghana Cedis, the Socioeconomic (SE) Standard, to categorise the athletes (as explained in the methods section). More than 65% (n=123) of the 188 athletes were categorised as being at SE Standard GHS1000 or Less. In addition, some 16% of these athletes were categorised as being at the More than GHS1000 SE Standard. There was no data on the SE Standard of the remaining 18% of the athletes because of issues of incomplete data.

Table 3: Distribution of the Socioeconomic (SE) standard of Athletes

SE Standard	Frequency	Percentage (%)
GHS1000.00 or Less	123	65.4
More than GHS 1000.00	30	16.0
No Data	35	18.6
Total	188	100.0

Summary of Athletes' Demographic and Socioeconomic Data and Characteristics

As noted earlier, this study considered athletes from three (3) sporting disciplines, drawn in similar proportions and representing some 47 sporting clubs or academies. While the numbers of males and females were similar (a male to female ratio of 6:4), the athletes were mostly youthful, with 92% of them (173 athletes) being younger than 29 years. Interestingly, there were no females older than 30 years among the athletes sampled.

With the above background, it is perhaps natural to see that 73% (137) of the athletes reported having university education at undergraduate level or higher, with more than 55% (104) of athletes living in urban dwellings. Another notable thing about these athletes' is that more than 37% (71 athletes) reported monthly earnings of less than GHS100.00 ($17.00). Furthermore, the data reveals that just about two (2) out of every three (3) of the athletes (66.5%) reported monthly earnings of less than GHS1000.00 ($170.00). Details on the number of athletes' dependents provide further context about the socioeconomic conditions of these athletes. Fully a third of the athletes, or 1 in 3 athletes, had either only one dependent or none at all (28.2% have no dependents and 5.9% have just one dependent).

Combining the data on income, educational level, number of dependents and type of residence produced the composite measure, SE Standard, to reassess and categorise the athletes' socioeconomic data. This done, the data still showed that roughly two (2) out of every three (3) athletes, or 65.4% of the athletes, were living on a GHS1000 Standard or less.

However, not all of the athletes provided a full set of socioeconomic data. This means the above statistics becomes even more remarkable when we totally exclude athletes having some missing data.

Sources of Nutritional Information

As seen in Figure 1, coaches and management (33%) were the most popular source of nutrition information, followed by television (24%). Notably, only 7% of the athletes reported receiving primary nutrition information from a dietitian or nutritionist while the rest used magazines, the internet, or social media.

Furthermore, only 21% of the athletes had ever taken part in a nutrition course prior to this study.

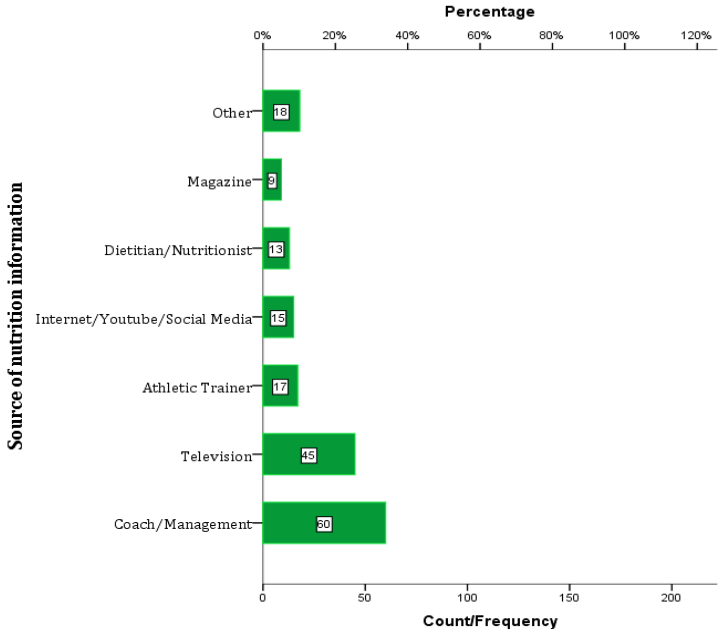

Figure 1: Pareto Chart showing the Distribution of Sources of nutritional information

Nutritional Knowledge

Figure 2 shows the results of the assessment of athletes' nutritional knowledge. More than 55% of the athletes sampled obtained scores indicating good or excellent nutritional knowledge. A further 27.5% demonstrated fair levels of nutritional knowledge.

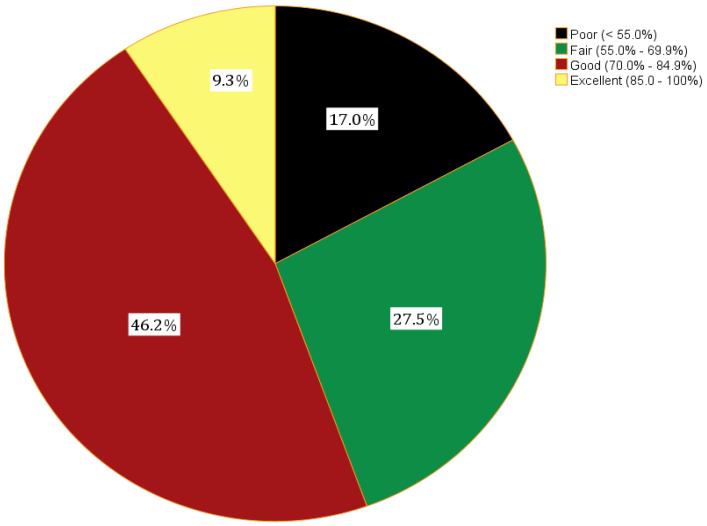

Figure 2: Distribution of Nutrition Knowledge Percentage Scores

Further, athletes' mean percentage score on nutritional knowledge was 69.4%. These results together show that the athletes demonstrated above average levels of nutritional knowledge.

Table 4: Summary of Dietary Habits and Nutrition Knowledge Scores

Variable	Mean score	Percentage Mean Score (%)
Dietary Habits	37.11	66.26%
Nutritional Knowledge	80.52	69.42%

Dietary Habits

Figure 3 shows the results of the assessment of athletes' dietary habits. Only three (3) athletes, representing just 1.6% reported "Excellent" dietary habits. A further 27% (n=21) reported "Good" dietary habits, a still reasonably high level of dietary practise. Then again, very few, 7% (n=13), reported poor dietary habits. This means that, nearly two (2) out of every three (3) athletes (64%) received assessments indicating passably fair dietary habits. The mean percentage score of 66.3% further underlines this observation.

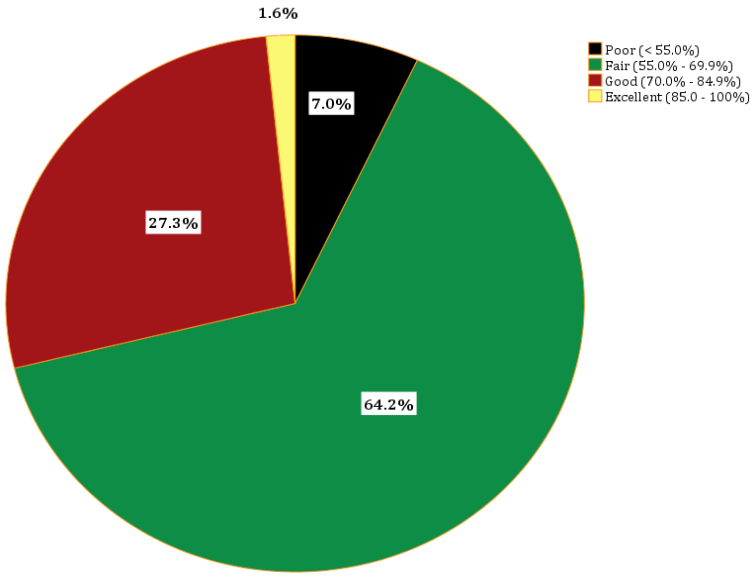

Figure 3: Distribution of Dietary Habits Percentage Scores

Summary: The Contexts of Nutritional Knowledge and Dietary Habits

The observations in this study point, conspicuously, to the fact that coaches and management were the most popular primary source of nutrition information (33% of athletes reported this), contrasting sharply with the 7% of athletes that indicated their dietitian or nutritionist. It is also noteworthy that television was the second most popular source of nutrition information (24% of athletes reported this). This may not be too unexpected, seeing as only about 21% of the athletes had ever taken a nutrition course as of the time of this study.

In all, the main sources of nutrition information for athletes in this study agreed with previous studies (Trakman *et al*., 2016; Brooks, 2018; Jacob *et al*., 2019; Jenner *et al*., 2019), which also cited coaches as the main source of information while nutritional information from dietitian/nutritionist remained among the less popular sources.

The results also indicate that a majority of the athletes had a very high level of nutritional knowledge (55.5%), with another sizable group of athletes (27.5%) demonstrating passably average levels of nutritional knowledge. However, the athletes' high levels of knowledge did not appear to translate fully into similarly high levels of dietary practise. Instead, less than 30% reported high levels of dietary practise whiles most of them (more than 64%) demonstrated rather average dietary habits. It is also interesting to note, however, that while 17% of the athletes demonstrated poor nutritional knowledge, only a much smaller 7% of them reported patently poor dietary habits.

Relationship between Dietary Habits and Nutritional Knowledge

There was no significant association between Dietary Habits and Nutritional Knowledge, n = 182, $\chi 2$ = 2.713, *df* = 4, and *p* = 0.620. Thus, we fail to reject the null hypothesis that there is no association between dietary habits and nutritional knowledge. The clustered bar chart below appears to confirm this result and the earlier observations that athletes demonstrated nutritional knowledge do not seem to reflect in their reported dietary habits.

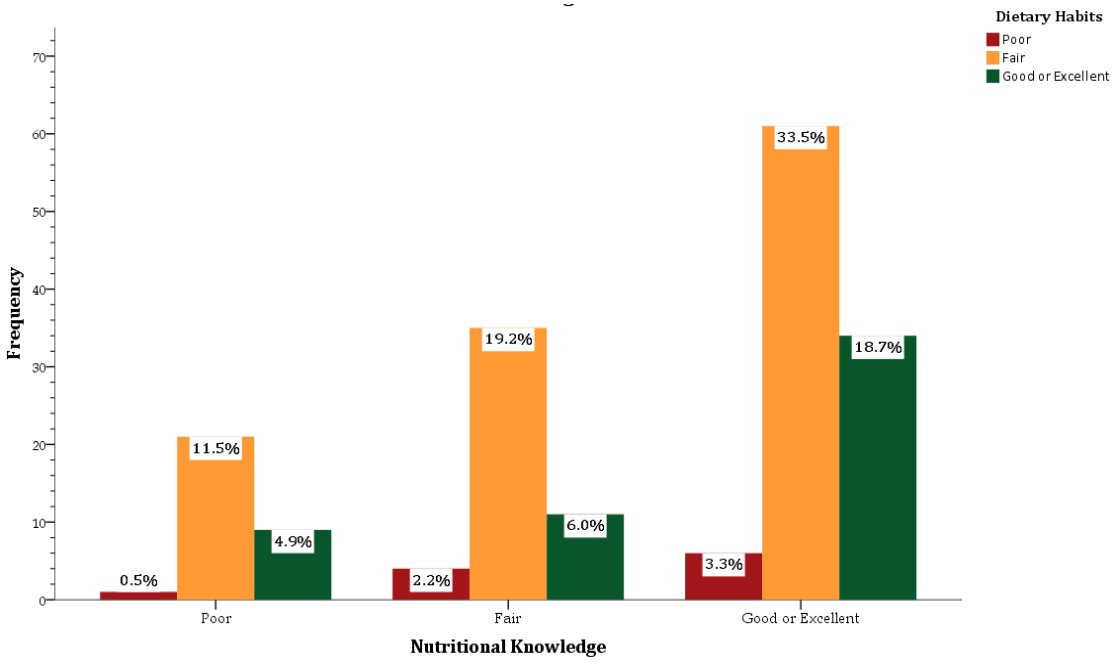

Figure 4: Distribution of Athletes by Nutritional Knowledge and Dietary Habits

These findings stand in contrast to other studies and reviews that have reported high levels of nutrition knowledge to be significantly associated with positive dietary habits (Spronk *et al*., 2014; Folasire *et al*., 2015; Rosi *et al*., 2020).

Further, interpreting these results together with a deeper item-by-item analysis of the athletes' dietary habits and nutritional knowledge provided some intriguing and unexpected insights into the information presented above.

First, at 66.26%, the mean percentage scores for dietary habits section in this study was higher than that reported by Sedek &Yih (2014). It was, however, at par with the findings of Giroux (2015) although Giroux studied only female athletes. Just as was the case in the two studies, deeper analysis showed athletes in this study exhibiting some crucial gaps in nutritional knowledge and reporting some alarming dietary practises.

One such scenario is the high intake of carbonated beverages reported in this study, where almost half (49.4%) of the athletes reported regularly consuming carbonated beverages. In another instance, about 60% of the athletes reported skipping breakfast at least four (4) times even though about 70% of them agreed with nutrition knowledge item 1– "Skipping breakfast can negatively affect athletic performance" – while about 62% agreed with item 3 – "Nutrition affects mental performance".

These findings are consistent with the outcomes of other studies including Folasire et al. (2015) and Loncarica (2016), which while reporting marginal scores on the dietary and knowledge scales also discovered some erroneous concepts and alarming gaps in specific knowledge the athletes possessed about nutrition that in the long run could greatly affect their performance outcomes. Since Worsley (2002) defined nutritional knowledge (NK) as the ability to understand healthy nutrition concepts, these misconceptions could be due to a lack of proper and targeted nutritional education among the athletes.

These notable gaps may also relate to the finding that only 7% of athletes receive their nutritional information from dietitians/nutritionists (see Figure 1). Their coaches, management, and television were the main sources of nutritional information and this may suggest a gap in the knowledge that is available from these sources.

Relationships: Socioeconomic (SE) Standard, Nutritional Knowledge, and Dietary Habits

There was a significant association between Socioeconomic (SE) Standard and Nutritional Knowledge, n = 150, $\chi 2 = 8.265$, $df = 2$, $p = 0.016$. Cramer's V measure of the strength of this relationship is 0.235 out of the possible maximum value (1), p = 0.016. This statistically significant effect size indicates a weak association between SE Standard and Nutritional Knowledge.

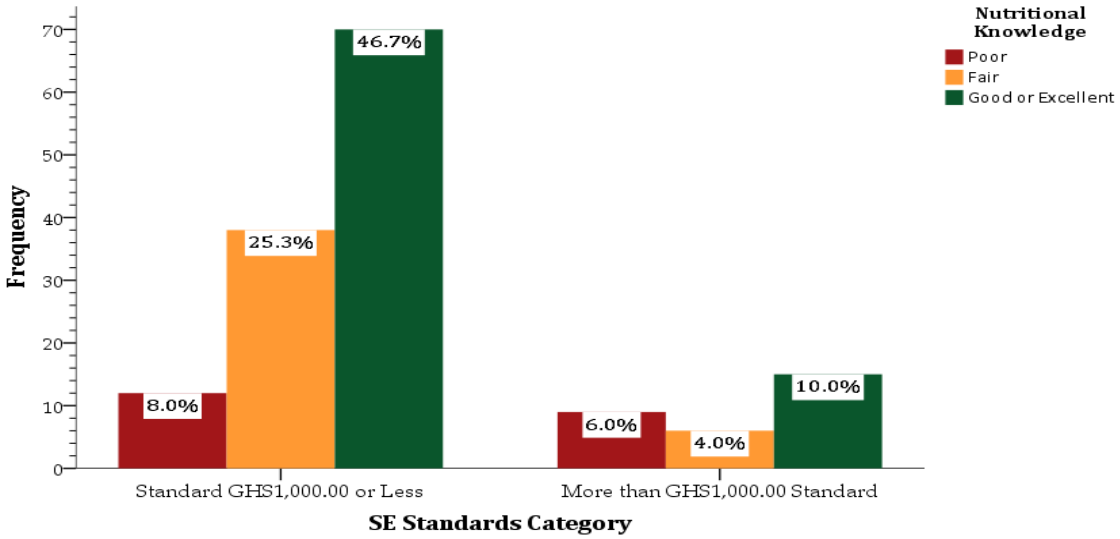

Figure 5: Distribution of Athletes by Nutritional Knowledge and Socioeconomic (SE) Standard

Considering the clustered bar chart, Figure 5, a few things are observable about athletes categorised at GHS1000 Standard or Less. First, this group accounts for 80% of the athletes considered. Further, the greater part of this cohort (46.7% overall) had good or excellent nutritional knowledge. In fact, only one (1) in ten (10) athletes in this group (8% overall) demonstrated poor nutritional knowledge. The observation of athletes categorised at GHS1000 Standard or Less stands sharply distinct from athletes categorised at Above GHS1000 Standard. The athletes categorised at Above GHS1000 Standard made up 20% of those considered. Exactly half of this cohort (10%) had good or excellent nutritional knowledge. However, those categorised as having a fair level of nutritional knowledge formed the smallest proportion, accounting for every 1 in 5 athletes in this socioeconomic group. Furthermore, a proportionally higher three (3) out of every ten (10) athletes in this socioeconomic group showed demonstrably poor nutritional knowledge. In addition, the odds of athletes having poor dietary habits were 3.86 times higher if they were at the More than GHS1000 Standard than if they assessed as being at GHS1000 Standard or Less. Contrarily, the odds of athletes having fair dietary habits were 1.85 times higher if they were at GHS1000 Standard or Less than if they were at the More than GHS1000 Standard. In a similar manner, the odds of athletes having good or excellent dietary habits were 1.40 times higher if they were at GHS1000 Standard or Less than if they were at the More than GHS1000 Standard.

There was no significant association between SE Standard and Dietary Habits, n = 153, $\chi 2 = 2.750$, $df = 2$, $p = 0.292$. Therefore, we fail to reject the null hypothesis that there was no association between SE

Standard and Dietary Habits. This is apparent from the clustered bar chart below. Irrespective of their SE Standard, more than half of the athletes reported fair dietary habits with all or close to all of the rest reporting good or excellent dietary habits. In addition, it may not be entirely unexpected that those reporting poor dietary habits were overwhelmingly all at GHS1000 Standard or Less.

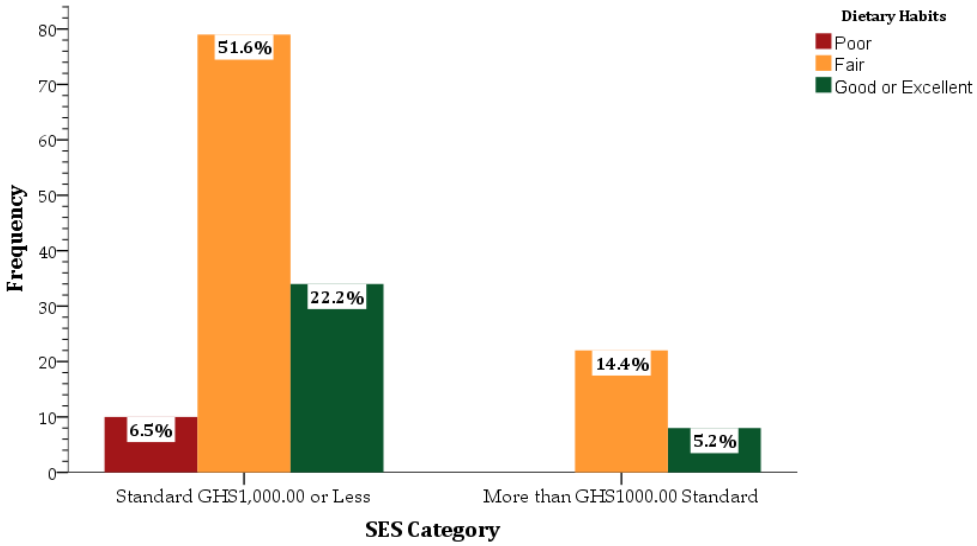

Figure 6: Distribution of Athletes by Dietary Habits and Socioeconomic (SE) Standard

Some aspects of these results appear to align with the reports of Spronk *et al*., (2014), and Vázquez-Espino *et al*., (2020), who in their studies reported greater levels of nutrition knowledge among athletes with higher socioeconomic status (SES), which is also a composite measure of social and economic standing.

Other aspects of this result, however, suggest that this situation is neither so clear-cut nor as simply stated. This result did not appear to agree with the findings of Spronk *et al*., (2014), who reported that higher education and socioeconomic status had positive influences on dietary intake and habits. The findings also appeared to disagree with the results reported by Norman & Conner (2017) that younger, wealthier, better-educated individuals under low levels of stress with high levels of social support are more likely to practise health enhancing-behaviours.

However, the contexts of this particular study may provide further insight into this: these athletes, while predominantly young and generally well educated, also reported rather low incomes (and consequently, had lower SE Standard). Specifically, whiles it is true that fully half of those at the More than GHS1000.00 Standard demonstrated good or excellent nutritional knowledge, the picture is even better for those athletes at GHS1000.00 Standard or Less, where the proportion is closer to 60%. Similarly, while fully two (2) in ten (10) athletes at the More than GHS1000.00 Standard demonstrated fair nutritional knowledge, the proportion for those at GHS1000.00 Standard or Less was more than three (3) out of every ten (10) athletes. What is even more intriguing is that, the findings clearly indicate that the odds of an athlete having poor dietary habits is almost 4 times higher if he is at the More than GHS1000 Standard than if he assesses at GHS1000 Standard or Less.

All these, when taken together with the trends in dietary habits, may suggest that the wealthier athletes are likely focussing less on acquiring individual nutritional knowledge but relying more on their support systems to make their dietary choices. This particular idea certainly invites further investigation.

Relationships: Athletes' Sex, Nutritional Knowledge, and Dietary Habits

There was a significant association between athletes' sex and nutritional knowledge, n = 182, $\chi 2$ = 15.254, *df* = 2, p < 0.001. Cramer's V measure of the effect size of this relationship is 0.278 out of the possible maximum value (1), p < 0.001. This statistically significant effect size points to a weak strength to the association between athletes' sex and Nutritional Knowledge.

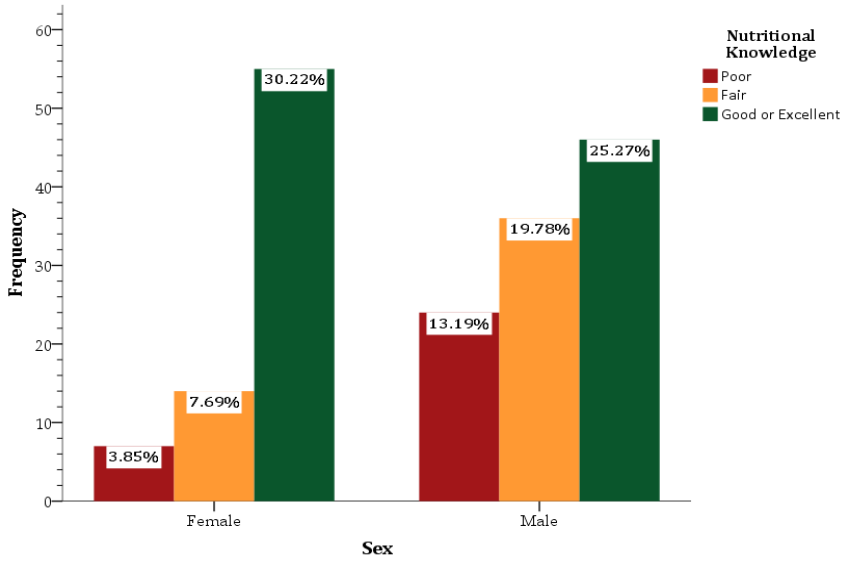

Figure 7: Distribution of Athletes by Nutritional Knowledge and Sex

Figure 7 illustrates this and suggests that the driver of this relationship appears to be female athletes. The effect sizes, based on odds ratios, provide a numerical interpretation of this result. The odds of athletes having poor nutritional knowledge were 2.89 times higher if they were male than if they were female. However, on the other end of the spectrum, the odds of athletes having good or excellent nutritional knowledge is 3.42 higher if they are female than if they are male. This is a particularly significant result (standard residual score, z, is 2.0 > 1.96).

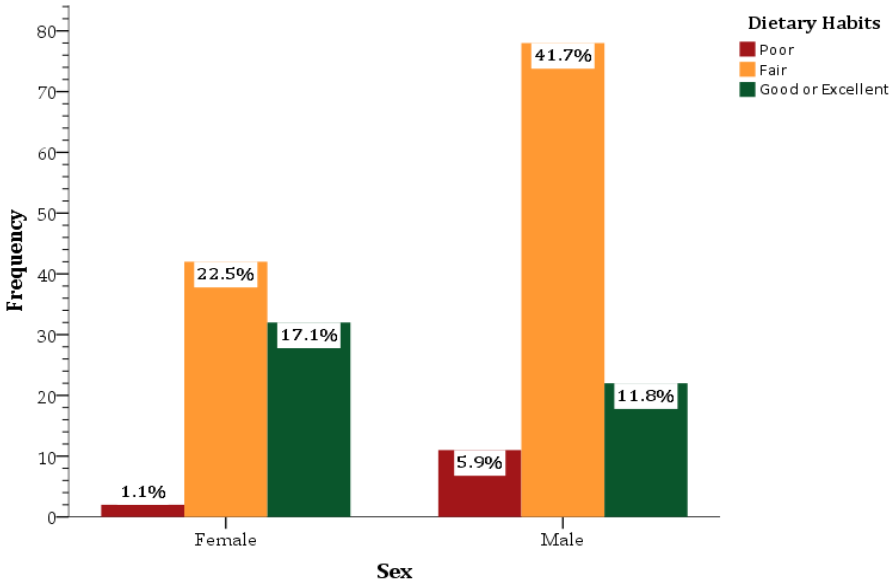

Figure 8: Distribution of Athletes by Dietary Habits and Sex

There was also a significant association between athletes' sex and dietary habits, n = 187, χ^2 = 12.779, *df* = 2, *p* = 0.001. Cramer's V measure of effect size was 0.261 out of the possible maximum value (1), p = 0.001. This statistically significant effect size points to a weak strength to the association between athletes' sex and dietary habits.

Male athletes appeared to be the main drivers of this particular relationship as shown by the clustered bar chart above and the odds ratios. The odds of athletes having poor dietary habits were 4.07 times higher if they were male than if they were female. Similarly, but to a lesser extent, the odds of athletes having fair dietary habits were 1.91 times higher if they were male than if they were female. However, when it comes reporting good or excellent dietary habits, the trend of relationships sees a reversal. Here, the odds of athletes having good or excellent dietary habits were 2.94 times higher if they were female than if they were male.

It is perhaps predictable that athletes showed a significant sex-based association with both nutritional knowledge and dietary habits. This was albeit an inverse relationship, with males tending towards the lower points of knowledge and habits and females tending towards the higher levels of nutritional knowledge and better dietary habits. These findings agree with those of Hendrie *et al*., (2008); Parmenter *et al*., (2000); Spendlove *et al*., (2012); and Spronk *et al*., (2014), who found that females tended to score better on assessments of nutritional knowledge and dietary habits.

Relationships: Athletes' Sporting Discipline, Nutritional Knowledge, Dietary Habits

There was a significant association between athletes' sporting discipline and nutritional knowledge, n = 182, χ^2 = 11.530, *df* = 4, *p* = 0.021. Cramer's V measure of effect size was 0.178 out of the possible maximum value (1), p = 0.021. This statistically significant effect size indicates a weak strength to the association between sporting discipline and nutritional knowledge.

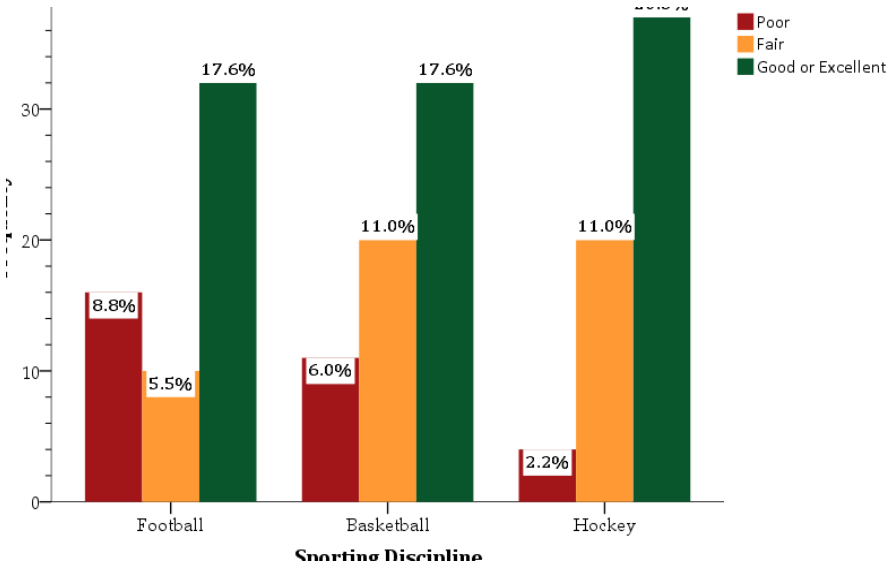

Figure 9: Distribution of Athletes by Nutritional Knowledge and Sporting Discipline

The clustered bar chart suggests that footballers and hockey players have particular effects on different aspects of this relationship. First, footballers represent more than half the athletes with poor nutritional knowledge (8.8% overall) whiles they also form the least proportion of athletes with fair nutritional knowledge (5.5%overall). In fact, among footballers, those with fair levels of nutritional knowledge are the fewest as compared to either footballers who have poor habits or footballers who have good or excellent habits, a situation contrary to that of both hockey and basketball players. It is also noticeable that hockey players represent the smallest group of athletes with poor nutritional knowledge (2.2% overall) while also representing the biggest group of athletes with good or excellent nutritional knowledge (20.3% overall).

There was a significant association between Athletes' Sporting Discipline and Dietary Habits, n = 187, χ^2 = 14.720, *df* = 4, *p* = 0.005. Cramer's V measure of effect size was 0.198 out of the possible maximum value (1), p = 0.005. This statistically significant effect size indicates a weak strength to the association between Sporting Discipline and Dietary Habits.

The clustered bar chart in Figure 10 suggests that footballers and basketball players drive the relationship in different ways. First, footballers represent close to half of the athletes with good or excellent dietary habits (13.9% overall), almost the same proportion have fair dietary habits (15.0% overall). Curiously, this means that, footballers also represent the smallest proportion of athletes with fair dietary habits. Basketball players present a different picture, representing the smallest proportion of athletes with good or excellent dietary habits (5.3% overall) and then the largest proportion of athletes with fair dietary habits (27.8% overall). Even more importantly, basketball players with fair dietary habits represent over 5 times the proportion of basketball players who report good or excellent dietary habits. Notably, whiles the proportions of athletes reporting poor dietary habits are quite similar across the three sporting disciplines, basketball players represent the smallest proportion (1.6% overall).

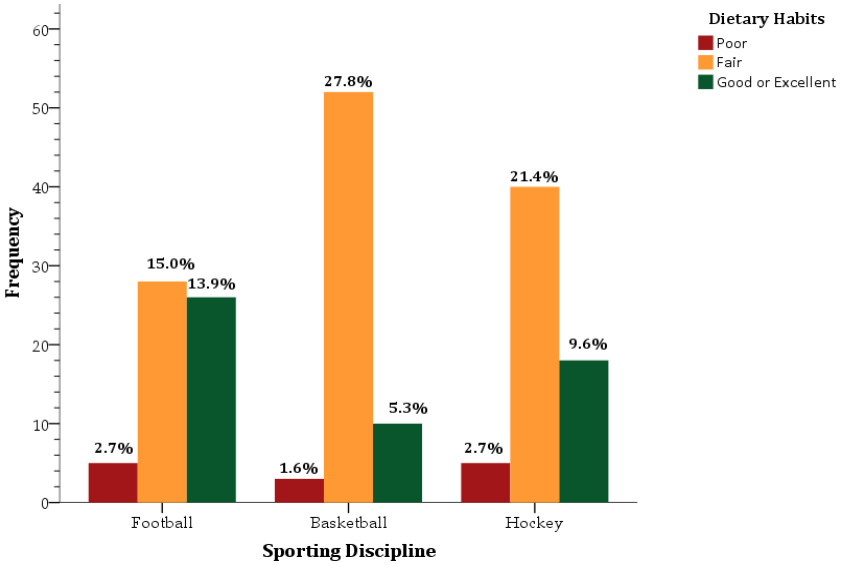

Figure 10: Distribution of Athletes by Dietary Habits and Sporting Discipline

In summary, basketball athletes are notable for their overwhelmingly average dietary habits; football athletes are notable for their relatively more positive dietary habits; and hockey athletes reflect the rather average dietary behaviour of basketball athletes but to a lesser extent. By contrast, football athletes are overrepresented among athletes with poor nutritional knowledge and yet the majority of them demonstrate extensive nutritional knowledge. Hockey athletes are notable for having the largest group of athletes with good or excellent nutritional knowledge whiles also having the smallest group of athletes with poor nutritional knowledge. These observations may reflect the variations in the cultural aspects and physical demands of the different types of sports as suggested by Jacob *et al*., (2019). However, Trakman *et al*., (2016) reported no significant differences in nutrition knowledge scores based on sport played.

The contrasting circumstances of football athletes (who exhibit the least knowledge but demonstrate the best habits) may suggest that they receive greater support, possibly from coaches and management, in making better dietary choices.

CONCLUSIONS

The essential thrust of this study is that the high nutritional knowledge of the sampled athletes did not appear to translate fully into similarly high levels of dietary practise. This reflects the results from other similar studies though with some distinct differences. A remarkable thing to note is that, for this study, relatively greater numbers of athletes exhibited poor nutritional knowledge in comparison to those that reported poor dietary habits. Not only that, the findings revealed that there is a statistically significant association between athletes' sports discipline and their nutritional knowledge. This may however be mediated by support, possibly from coaches and management, in translating this into better dietary choices. Predictably, athletes showed a significant sex-based association with both nutritional knowledge and dietary habits. The findings indicated that, compared to their male counterparts, female athletes were more likely to show good or excellent dietary habits.

Altogether, these lend support to the consensus that the specific contribution of nutrition knowledge to the overall quality of food intake is still bafflingly complex. That is, it relies on the influences and interactions of many demographic and environmental factors, which still invite further exploration. A major strength of this study is that it involved the survey of athletes from more than one sports region. Some deficits do however exist in this body of data and that ought to stimulate wider exploration and deeper examination of the factors influencing athletes' dietary choices, and the motivations for adopting and practising good dietary habits. Such exploration and examination would invariably push the boundaries of understanding about why adequate nutritional knowledge may not always result in better nutrition practises. It would also help to improve the dietary habits of athletes based in Ghana. In addition, further research may benefit from utilising a modified version of the Nutrition for Sport Knowledge Questionnaire (ANSKQ) to help overcome some of the limitations with this current instrument.

As a final point, this study has shown coaches and management to be a major source of information and influence for athletes regarding food and supplement choices, as well as nutritional behaviours. Thus, further development and availability of effective and practical sports nutrition tools for coaches would only serve to promote not only athletic performance but also healthy dietary habits in the sports environment while eliminating any potential gaps in their knowledge.

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APPENDIX

DIETARY HABITS: SUB-SCALE 1

Item	Responses	Frequency	(%) Total Athletes	(%) Valid Responses
How often do you eat breakfast in the morning?	Never: Does not occur at all	26	13.8	14.0
	Sometimes: 1-2 days per week	62	33.0	33.3
	Often: 3-4 days per week	42	22.3	22.6
	Always: 5-7 days per week	56	29.8	30.1
	Missing: No Response	2	1.1	
	Total	**188**	**100.0**	**100.0**
How often do you record what you eat?	Never: Does not occur at all	80	42.6	43.7
	Sometimes: 1-2 days per week	38	20.2	20.8
	Often: 3-4 days per week	34	18.1	18.6
	Always: 5-7 days per week	31	16.5	16.9
	Missing: No Response	5	2.7	
	Total	**188**	**100.0**	**100.0**
How often do you eat three base meals/day?	Never: Does not occur at all	21	11.2	11.4
	Sometimes: 1-2 days per week	64	34.0	34.6
	Often: 3-4 days per week	64	34.0	34.6
	Always: 5-7 days per week	36	19.1	19.5
	Missing: No Response	3	1.6	
	Total	**188**	**100.0**	**100.0**
How often do you eat breads, cereals, pasta, potatoes or rice?	Never: Does not occur at all	14	7.4	7.6
	Sometimes: 1-2 days per week	33	17.6	17.9
	Often: 3-4 days per week	53	28.2	28.8
	Always: 5-7 days per week	84	44.7	45.7
	Missing: No Response	4	2.1	

	Total	**188**	**100.0**	**100.0**
How often do you eat fruits i.e. apples, bananas or oranges?	Never: Does not occur at all	14	7.4	7.6
	Sometimes: 1-2 days per week	58	30.9	31.4
	Often: 3-4 days per week	51	27.1	27.6
	Always: 5-7 days per week	62	33.0	33.5
	Missing: No Response	3	1.6	
	Total	**188**	**100.0**	**100.0**
How often do you eat vegs, i.e. broccoli, tomatoes, carrots/salads?	Never: Does not occur at all	18	9.6	9.7
	Sometimes: 1-2 days per week	65	34.6	35.1
	Often: 3-4 days per week	51	27.1	27.6
	Always: 5-7 days per week	51	27.1	27.6
	Missing: No Response	3	1.6	
	Total	**188**	**100.0**	**100.0**
How often do you eat dairy products, i.e. milk, yoghurt/cheese?	Never: Does not occur at all	14	7.4	7.5
	Sometimes: 1-2 days per week	63	33.5	33.7
	Often: 3-4 days per week	55	29.3	29.4
	Always: 5-7 days per week	55	29.3	29.4
	Missing: No Response	1	0.5	
	Total	**188**	**100.0**	**100.0**

DIETARY HABITS: SUB-SCALE 2

Item	**Responses**	**Frequency**	**(%) Total Athletes**	**(%) Valid Responses**
How often do you avoid carbonated drinks? (Item: 8)	Never: Does not occur at all	39	20.7	21.2
	Sometimes: 1-2 days per week	52	27.7	28.3
	Often: 3-4 days per week	71	37.8	38.6
	Always: 5-7 days per week	22	11.7	12.0
	No Response	4	2.1	0.0
	Total	**188**	**100.0**	**100.0**
How often do you avoid berry jams, cookies, candies or other sweets? (Item: 14)	Never: Does not occur at all	24	12.8	12.9
	Sometimes: 1-2 days per week	26	13.8	14.0
	Often: 3-4 days per week	69	36.7	37.1
	Always: 5-7 days per week	67	35.6	36.0
	No Response	2	1.1	0.0
	Total	**188**	**100.0**	**100.0**
How often do you avoid snacking on foods like potato chips, cakes, candies, donuts or soda? (Item: 15)	Never: Does not occur at all	18	9.6	9.7
	Sometimes: 1-2 days per week	39	20.7	21.0
	Often: 3-4 days per week	92	48.9	49.5
	Always: 5-7 days per week	37	19.7	19.9
	No Response	2	1.1	0.0
	Total	**188**	**100.0**	**100.0**
How often do you avoid fast foods? (Item: 17)	Never: Does not occur at all	35	18.6	19.1
	Sometimes: 1-2 days per week	60	31.9	32.8
	Often: 3-4 days per week	60	31.9	32.8
	Always: 5-7 days per week	28	14.9	15.3
	No Response	5	2.7	0.0
	Total	**188**	**100.0**	**100.0**
How often do you follow your meal times? (Item: 2)	Never: Does not occur at all	32	17.0	17.5
	Sometimes: 1-2 days per week	44	23.4	24.0
	Often: 3-4 days per week	77	41.0	42.1
	Always: 5-7 days per week	30	16.0	16.4
	No Response	5	2.7	0.0
	Total	**188**	**100.0**	**100.0**

DIETARY HABITS: SUB-SCALE 3

Item	Responses	Frequency	(%) Total Athletes	(%) Valid Responses
How often do you function without vitamin supplements? (Item: 3)	Never: Does not occur at all	23	12.2	12.6
	Sometimes: 1-2 days per week	52	27.7	28.6
	Often: 3-4 days per week	51	27.1	28.0
	Always: 5-7 days per week	56	29.8	30.8
	Missing: No Response	6	3.2	
	Total	**188**	**100.0**	**100.0**
How often do you function without mineral supplements? (Item: 4)	Never: Does not occur at all	28	14.9	15.4
	Sometimes: 1-2 days per week	46	24.5	25.3
	Often: 3-4 days per week	53	28.2	29.1
	Always: 5-7 days per week	55	29.3	30.2
	Missing: No Response	6	3.2	
	Total	**188**	**100.0**	**100.0**

NUTRITIONAL KNOWLEDGE

Item	Responses	Frequency	(%) Total Athletes	(%) Valid Responses
Skipping breakfast can negatively affect athletic performance	Strongly Disagree	27	14.4	14.9
	Disagree Somewhat	26	13.8	14.4
	Agree Somewhat	50	26.6	27.6
	Strongly Agree	78	41.5	43.1
	No Response	7	3.7	
	Total	**188**	**100.0**	**100.0**
Proteins are not the best and most efficient source of energy (Item: 2)	Strongly Disagree	84	44.7	47.5
	Disagree Somewhat	55	29.3	31.1
	Agree Somewhat	25	13.3	14.1
	Strongly Agree	13	6.9	7.3
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
Nutrition affects mental performance	Strongly Disagree	39	20.7	22.0
	Disagree Somewhat	28	14.9	15.8
	Agree Somewhat	52	27.7	29.4
	Strongly Agree	58	30.9	32.8
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
The pre-event meal should be eaten 3-4 hours prior to competition	Strongly Disagree	23	12.2	13.6
	Disagree Somewhat	32	17.0	18.9
	Agree Somewhat	59	31.4	34.9
	Strongly Agree	55	29.3	32.5
	No Response	19	10.1	
	Total	**188**	**100.0**	**100.0**
Calcium excretion from the body increases with alcohol consumption	Strongly Disagree	25	13.3	14.2
	Disagree Somewhat	72	38.3	40.9
	Agree Somewhat	50	26.6	28.4
	Strongly Agree	29	15.4	16.5
	No Response	12	6.4	
	Total	**188**	**100.0**	**100.0**
According to the Food Guide pyramid: one should consume 6-11 servings from the bread, cereal, rice & pasta group	Strongly Disagree	20	10.6	11.3
	Disagree Somewhat	48	25.5	27.1
	Agree Somewhat	75	39.9	42.4
	Strongly Agree	34	18.1	19.2
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
According to the Food Guide pyramid: one should consume 2-4 servings from the fruit group	Strongly Disagree	11	5.9	6.2
	Disagree Somewhat	40	21.3	22.6
	Agree Somewhat	63	33.5	35.6

	Strongly Agree	63	33.5	35.6
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
According to the Food Guide pyramid, one should consume 2-3 servings from the dairy group	Strongly Disagree	20	10.6	11.2
	Disagree Somewhat	35	18.6	19.6
	Agree Somewhat	80	42.6	44.7
	Strongly Agree	44	23.4	24.6
	No Response	9	4.8	
	Total	**188**	**100.0**	**100.0**
According to the Food Guide pyramid, one should consume 2-3 servings from the meat group	Strongly Disagree	13	6.9	7.4
	Disagree Somewhat	44	23.4	25.0
	Agree Somewhat	64	34.0	36.4
	Strongly Agree	55	29.3	31.3
	No Response	12	6.4	
	Total	**188**	**100.0**	**100.0**
Eating breakfast can improve concentration	Strongly Disagree	14	7.4	8.0
	Disagree Somewhat	22	11.7	12.5
	Agree Somewhat	45	23.9	25.6
	Strongly Agree	95	50.5	54.0
	No Response	12	6.4	
	Total	**188**	**100.0**	**100.0**
Carbohydrates are less fattening than fatty foods	Strongly Disagree	15	8.0	8.5
	Disagree Somewhat	39	20.7	22.0
	Agree Somewhat	49	26.1	27.7
	Strongly Agree	74	39.4	41.8
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
60% of total calories should come from carbohydrates	Strongly Disagree	15	8.0	8.5
	Disagree Somewhat	51	27.1	28.8
	Agree Somewhat	62	33.0	35.0
	Strongly Agree	49	26.1	27.7
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
Carbohydrates are easier to digest than fats or proteins	Strongly Disagree	30	16.0	16.9
	Disagree Somewhat	32	17.0	18.0
	Agree Somewhat	48	25.5	27.0
	Strongly Agree	68	36.2	38.2
	No Response	10	5.3	
	Total	**188**	**100.0**	**100.0**
Excess vitamin consumption can be toxic	Strongly Disagree	24	12.8	13.5
	Disagree Somewhat	48	25.5	27.0
	Agree Somewhat	61	32.4	34.3
	Strongly Agree	45	23.9	25.3
	No Response	10	5.3	
	Total	**188**	**100.0**	**100.0**
Anaemia is a deficiency in iron	Strongly Disagree	17	9.0	9.9
	Disagree Somewhat	28	14.9	16.3
	Agree Somewhat	55	29.3	32.0
	Strongly Agree	72	38.3	41.9
	No Response	16	8.5	
	Total	**188**	**100.0**	**100.0**
Average percentage of body fat in females is 20-25%	Strongly Disagree	16	8.5	9.0
	Disagree Somewhat	38	20.2	21.5
	Agree Somewhat	64	34.0	36.2
	Strongly Agree	59	31.4	33.3
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**

Cereal, bread, bagels and pasta are good sources of carbohydrates	Strongly Disagree	17	9.0	9.5
	Disagree Somewhat	25	13.3	14.0
	Agree Somewhat	40	21.3	22.3
	Strongly Agree	97	51.6	54.2
	No Response	9	4.8	
	Total	**188**	**100.0**	**100.0**
Nuts and beans are good sources of protein	Strongly Disagree	15	8.0	8.4
	Disagree Somewhat	11	5.9	6.1
	Agree Somewhat	33	17.6	18.4
	Strongly Agree	120	63.8	67.0
	No Response	9	4.8	
	Total	**188**	**100.0**	**100.0**
Athletes tend to consume twice as much protein as recommended	Strongly Disagree	15	8.0	8.5
	Disagree Somewhat	26	13.8	14.7
	Agree Somewhat	74	39.4	41.8
	Strongly Agree	62	33.0	35.0
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
Balanced consumption of protein is beneficial for athletes (Item: 20)	Strongly Disagree	42	22.3	23.7
	Disagree Somewhat	61	32.4	34.5
	Agree Somewhat	51	27.1	28.8
	Strongly Agree	23	12.2	13.0
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**
The best sources of iron come from animal products and fish	Strongly Disagree	18	9.6	10.5
	Disagree Somewhat	37	19.7	21.5
	Agree Somewhat	61	32.4	35.5
	Strongly Agree	56	29.8	32.6
	No Response	16	8.5	
	Total	**188**	**100.0**	**100.0**
Eating cereals/breads enriched with iron should be eaten with a source of Vitamin C to enhance iron absorption	Strongly Disagree	14	7.4	8.0
	Disagree Somewhat	36	19.1	20.6
	Agree Somewhat	73	38.8	41.7
	Strongly Agree	52	27.7	29.7
	No Response	13	6.9	
	Total	**188**	**100.0**	**100.0**
Proteins act to repair and build muscle tissue and make hormones to boost the immune system	Strongly Disagree	11	5.9	6.3
	Disagree Somewhat	23	12.2	13.1
	Agree Somewhat	47	25.0	26.9
	Strongly Agree	94	50.0	53.7
	No Response	13	6.9	
	Total	**188**	**100.0**	**100.0**
Fats are essential in all diets	Strongly Disagree	18	9.6	10.3
	Disagree Somewhat	53	28.2	30.5
	Agree Somewhat	58	30.9	33.3
	Strongly Agree	45	23.9	25.9
	No Response	14	7.4	
	Total	**188**	**100.0**	**100.0**
If a diet is lacking in carbohydrates, proteins are then used for energy	Strongly Disagree	20	10.6	11.6
	Disagree Somewhat	22	11.7	12.7
	Agree Somewhat	77	41.0	44.5
	Strongly Agree	54	28.7	31.2
	No Response	15	8.0	
	Total	**188**	**100.0**	**100.0**
Oatmeal, legumes and fruits are sources of soluble fibre	Strongly Disagree	16	8.5	9.3
	Disagree Somewhat	23	12.2	13.4
	Agree Somewhat	61	32.4	35.5

	Strongly Agree	72	38.3	41.9
	No Response	16	8.5	
	Total	**188**	**100.0**	**100.0**
The recommended amount of fibre is 25 grams per day	Strongly Disagree	9	4.8	5.2
	Disagree Somewhat	39	20.7	22.7
	Agree Somewhat	80	42.6	46.5
	Strongly Agree	44	23.4	25.6
	No Response	16	8.5	
	Total	**188**	**100.0**	**100.0**
Vitamin C is also known as ascorbic acid	Strongly Disagree	11	5.9	6.5
	Disagree Somewhat	27	14.4	16.0
	Agree Somewhat	44	23.4	26.0
	Strongly Agree	87	46.3	51.5
	No Response	19	10.1	
	Total	**188**	**100.0**	**100.0**
You can be dehydrated even when you do not feel thirsty (Item: 29)	Strongly Disagree	46	24.5	26.0
	Disagree Somewhat	54	28.7	30.5
	Agree Somewhat	39	20.7	22.0
	Strongly Agree	38	20.2	21.5
	No Response	11	5.9	
	Total	**188**	**100.0**	**100.0**