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Prediction of Athletic Performance through Nutrition Knowledge and Practice: A Cross-Sectional Study among Young Team Athletes

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Abstract

The present study was conducted to assess the nutrition knowledge, practice, and status and to identify the nutritional and body composition factors predicting athletes' performance. Young team athletes including 40 footballers and 50 hockey players were recruited in this study (age 16.48±1.5) to assess the nutrition knowledge (NK), nutrition practice (NP), and 24-hour dietary recall using a semi-structured questionnaire. Physical characteristics, including height, weight and body mass index (BMI), along with static strength- handgrip and relative back strength, were recorded. Fat mass (FM), fat-free mass (FFM), muscle mass (MM), basal metabolic rate (BMR) and glycogen store was determined using a bioelectrical impedance analyser. Aerobic capacity (VO_2max) was measured with a beep test. The majority of the athletes with good NK scores were found to have good NP scores as well and vice versa ($\chi 2$=23.861, p=0.000). Their mean recorded scores for NK and NP were found to be 11.13±3.6 and 7.30±2.0 out of a total of 20 and 12, respectively. Daily consumption of protein (β=0.336; p value=0.004), sodium (β=0.273; p value=0.006) and dietary fibre (β=0.220; p value=0.002) were found to be the best predictors for nutritional practice. Nutrition knowledge and practice had significant positive correlation with BMR (0.314***; 0.419***), calcium intake (0.248*; 0.482***), iron intake (0.303***; 0.221*) and VO_2max (0.331***; 0.428***), respectively. Daily calorie consumption (β=0.144, p=0.029), BMR (β=0.304, p<0.001***), MM (β=0.213, p=0.020), calcium (β=0.275, p=0.001) and iron intake (β=0.240, p=.001) were the significant predictors of athletic performance. Therefore, good nutrition knowledge may improve the nutritional habits and dietary pattern of athletes. Body composition and nutrient intake can predict athletic performance. Intervention studies should emphasize nutrition education aiming for improved athletic performance.

Key words: *basal metabolic rate, bioelectrical impedance analysis, body composition, dietary pattern, aerobic capacity*

Introduction

Optimal fuelling is an essential requisite for athletes to excel to their best ability (Maughan & Burke, 2011; Kerksick et al., 2008). Apart from nutrition playing an influential role in enhancing on-field performance; it also promotes muscle growth, prevents injury, accelerates recovery, and supports rehabilitation (Mahan & Stump, 1998). Undoubtedly, athletes' daily diet and fluid intake affect their health, body composition, and substrate availability during exercise as well as recovery time (American Dietetic Association, 2009). Adequate nutrition, which can be reached through sufficient nutrition knowledge (NK), is an integral part of a training programme

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as it helps in optimizing intake of both macronutrients and micronutrients; and modulating the body composition of athletes (Rosenbloom, Jonnalagadda, & Skinner, 2002)

However, it must be noted that many athletes are still not able to interpret the knowledge of adequate nutrition into suitable dietary alternatives (Sakamaki, Toyama, Amamoto, Liu, & Shinfuku; 2005; Cupisti, Alessandro, Castrogiovanni, Barale, & Morell, 2002). As reported by Sakamaki et al. (2005), only a few athletes reflect the concept of satisfactory dietary choices when selecting from a food menu. They remain poorly educated about healthy nutritional practice (NP) and are inexperienced in making apt daily nutritional preferences (Hornstrom, Friesen, Ellery, & Pike, 2011). A weak positive correlation between nutrition knowledge and dietary intake of athletes was reported in a systematic review (Sakamaki et al., 2005; Cupisti et al., 2002; Hornstrom et al., 2011; Heaney, O'Connor, Michael, Gifford, & Naughton, 2011). Furthermore, another study confirmed an insignificant correlation between nutrition knowledge and practice (Supriya, 2013). In contrast, increased nutrition knowledge with considerable increases in total energy, carbohydrates, and protein intakes was reported in other studies (Heaney et al., 2011; Supriya, 2013).

Appropriate nutrient consumption corresponds to peak athletic performance, whereas nutrient paucity may lead to decreased performance (Hornstrom et al., 2011; Valliant, Emplaincourt, & Wenzel, 2012). While working at the highest intensities that can be supported by oxidative phosphorylation, carbohydrate has an advantage over fat as a substrate thereby improving gross exercise efficiency (Cole, Coleman, Hopker, & Wiles, 2014). There exists an evidential interaction of dietary protein with exercise, which further provides both a trigger and a substrate for the synthesis of contractile and metabolic proteins (Phillips & Van Loon, 2011; Phillips, 2012). Physical activity and training are vital for maintaining appropriate body weight and fat mass, which are further dependent on the nutritional status of sportspersons (Rodriguez, Di Marco, & Langley, 2009; Burd, West, & Moore, 2011). Positive energy balance alone has an essential anabolic effect (Forbes, Brown, Welle, & Lipinski, 1986), whereas restriction of energy intake and loss of muscle and fat mass negatively affects athletes' performance (American Dietetic Association, 2009).

Research investigating the direct relationship between NK and performance has been sparse to date. Team athletes are always looking to expand their competitive edge over their opponents. Nevertheless, it has been frequently reported that athletes have poor NK (Heaney et al., 2011). So, if a relationship is proven to exist between NK and performance, nutritional education intervention could accordingly be designed to enhance athletic performance. The present study was conducted to assess the NK, NP and athletic performance; and to identify the nutritional and physiological factors predicting athletes' performance.

Methods

Subjects

The present cross-sectional study involved 90 randomly selected male athletes from the Sports Authority of India (age16.48±1.5) exclusively participating in team sports: football (n=40) and hockey (n=50). The inclusion criteria required the athletes to be at least state-level performers with a minimum of 3-4 years of formal training history. The study protocol was executed in accordance with the ethical guidelines of the Declaration of Helsinki, 1975. Prior to the initial testing, a complete explanation of the procedures, potential risks and benefits of the tests were explained to all the subjects and informed consents were obtained from them.

Physical Characteristics & Body Composition Measurements

Physical characteristics of the subjects, including height and weight, were measured using anthropometric rod and digital scale following standard procedure, and the body mass index (BMI) was calculated (Sodhi, 1991; WHO, 1995). Body composition including fat mass (FM), fat-free mass (FFM), muscle mass (MM), basal metabolic rate (BMR) and glycogen content were assessed using Bioelectrical Impedance Analysis (BIA) (Maltron Bioscan 920- 2, UK). Measurements were taken following the standard testing manual of Maltron International (Sarkar, Debnath, Chatterjee, & Dey, 2018).

Assessment of Static Strength and Aerobic Capacity

Handgrip strength and Relative Back strength (RBS) was measured using digital handgrip dynamometer and back dynamometer (SENOH, Japan), respectively, following standard procedures (Sarkar et al., 2018). Maximal Oxygen Consumption or aerobic capacity (VO2max) was gauged through an indirect method of a multistage physical fitness test (Beep test) from which VO2max was predicted (Leger & Lambert, 1982).

Assessment for NK and Daily Dietary Intake

Information regarding participants' 24-hour diet recall was recorded by means of a self-administered, semi-structured questionnaire. The cooked food items were converted to raw amounts, and the nutrients were calculated accordingly. Food models were used to assist the team athletes in approximating portion sizes. All measurements were performed twice, and the average values were recorded. Three consecutive dietary recalls were repeated to reduce the imprecision in nutrient intakes. The nutrients were calculated using Dietsoft software (version 1.1.6) developed by the Department of Dietetics, All India Institute of Medical Sciences (AIIMS), New Delhi. The nutrients in the software are based on the values published in the "Nutritive value of Indian Foods" by ICMR, 2017 (Singh, Gupta, Ghosh, Lock, & Suparna, 2015). Questionnaire constituting of 20 and 12 questions were structured using previous studies and those referenced by Supriya (2013) and Zawila, Steib, and Hoogenboom, (2003), respectively.

Data Analysis

The Statistical Package for the Social Sciences (SPSS, IL version 20.0) was used to execute all the statistical analyses. Mean NK and NP scores calculated based on the responses of the participants were found to be 1.13±3.6 and 7.30±2.0 respectively. The participants scored "1" for every correct answer and "zero" for every wrong answer as well as for those who chose the "not sure" option; their scores were summed up accordingly. Those who scored less than the mean score were classified as having poor NK and NP while those who scored more than the mean score were classified as having good NK and NP. The categorical variables NK and NP scores were compared using the chi-square test. Inferential statistical test was done using Pearson correlation product-moment and simple linear regression analysis.

Results

Table 1 represents the mean and SD of the anthropometric, nutritional, and physiological profile of the team athletes. Their mean height, weight, and BMI were 168.83±6.6 cm, 56.04±6.3kg, and 19.80±1.4 kg/m2, respectively. Their fat mass and fat-free mass were 11.04±4.8% and 88.96±4.8%, respectively, along with a mean glycogen store of 451.99±80.8 gm. Mean values for muscle mass and BMR were found to be 24.02±3.2 gm and 1756.91±125.9 Kcal, respectively. Their reported values for static strength and aerobic capacity parameters are displayed in Table 1.

Table 1. Anthropometric, Nutritional and Physiological Profile of the Team Athletes

Variables	Mean(SD)	Minimum	Maximum
Age (yrs)	16.5±1.5	14.3	19.8
Height (cm)	168.8±6.6	157.4	186.5
Weight (kg)	56.0±6.3	46.4	73.7
BMI (kg/m2)	19.8±1.4	16.2	22.9
Fat mass (%)	11.0±4.8	4.8	25.3
Fat free mass (%)	88.9±4.8	74.7	95.1
Muscle mass (kg)	24.0±3.2	19.6	33.0
BMR (Kcal)	1756.9±125.9	1492.0	1997.0
Glycogen (gm)	451.9±80.8	193.0	621.0
RBS (kg/Kg body wt.)	1.8±0.2	1.4	2.4
Right-hand grip strength(kg)	37.9±6.2	26.0	52.0
Left-hand grip strength(kg)	36.9±6.4	24.0	56.0
VO2max (ml/min/kg)	54.5±4.8	43.9	65.2

Legend: BMI: Body Mass Index; BMR: Basal Metabolic Rate; RBS: Relative Back Strength

Table 2 depicts the responses of the team athletes to the NK and NP questionnaire. Forty-two athletes scored above the mean NK score and therefore had good NK, whereas the rest scored poorly (Table 3). The majority of athletes answered the following questions correctly: increasing protein in the diet is necessary in order to increase muscle mass of the body (63%); consuming fruits and vegetables every day is important in order to get necessary vitamins and minerals (61%); during exercise, mass ingestion of large amounts of fluid is preferred over frequent ingestion of small amounts (65%); a sound NP for athletes is to eat a wide variety of different food types from day to day (77%); skipping meals is justifiable if you need to lose weight quickly (83%); a high-fat meal, which is slowly digested, should be avoided before athletic events (68%) and the pre-event meal should be eaten about 3-4 hours before competition (60%).

The least correctly answered questions were the following: carbohydrates are not as easily and rapidly digested as protein and fat (42%); vitamin supplementation is recommended for all physically active persons (48%); vitamins are a good source of energy (42%); fibre in the diet may help to decrease constipation, decrease blood cholesterol levels, and prevent cancers (48%); and lack of iron in the diet can result in fatigue, injury, and illness (37%).

Thirty-two athletes were found to have good NP scores. The majority of the athletes believed that nutritious diet would help them improve their athletic performance (80%) and having a nutritionist would be helpful to them as an athlete (88%). Seventy-eight per cent of them had breakfast daily, and majorities were also found to have daily intake of milk and milk products (72%). Only 43% of athletes were aware of the number of calories they should consume every day in accordance with their sports discipline.

Table 2. Responses of Team Athletes (Percent) to the Nutrition Knowledge and Nutrition Practice Questionnaire

Nutrition Knowledge			
S/N	Questions	Correct n (%)	Incorrect n (%)
01	Carbohydrates are not as easily and rapidly digested as protein and fat	38 (42)	52 (58)
02	Eggs and legumes are examples of protein sources other than meats	38 (42)	52 (58)
03	Protein is the primary source of muscular energy for the athletes	51 (57)	39 (43)
04	Increasing protein in the diet is necessary in order to increase muscle mass of the body	57 (63)	33 (37)
05	Consuming fruits and vegetables every day is important in order to get necessary vitamins and minerals.	55 (61)	35(39)
06	Vitamin supplementation is recommended for all physically active persons	43 (48)	47 (52)
07	Vitamins are a good source of energy	38 (42)	52 (58)
08	Fibre in the diet may help to decrease constipation, decrease blood cholesterol levels, and prevent cancers	43 (48)	47 (52)
09	Dehydration can impair physical performance	54 (60)	36 (40)

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Nutrition Knowledge			
S/N	**Questions**	**Correct n (%)**	**Incorrect n (%)**
10	During exercise, mass ingestion of large amounts of fluid is preferred over frequent ingestion of small amounts	59 (65)	31 (35)
11	A 200-pound person uses about twice as many calories to run a mile as a 100-pound person	44 (49)	46 (51)
12	A person with a higher percentage of body fat may weigh less than a person of the same size with a greater muscle mass	45 (50)	45 (50)
13	A sound nutritional practice for athletes is to eat a wide variety of different food types from day to day	69 (77)	21 (33)
14	Skipping meals is justifiable if you need to lose weight quickly	75 (83)	15 (17)
15	When trying to lose weight, acidic foods such as grapefruit are of special value because they burn fat	31 (34)	59 (66)
16	If trying to lose weight, carbohydrates should come from fruits and vegetables rather than from breads and pastas	52 (58)	34 (38)
17	Nutrition is more important during the competitive season than during the off-season for the athlete	41 (46)	49 (54)
18	A high-fat meal, which is slowly digested, should be avoided before athletic events	61 (68)	29 (32)
19	The pre-event meal should be eaten about 3-4 hours before competition	54 (60)	36 (40)
20	A lack of iron in the diet can result in fatigue, injury, and illness	33 (37)	57 (63)
Nutrition Practice			
S/N	**Questions**	**Yes n (%)**	**No n (%)**
01	Do you have access to nutrition counselling?	35 (39)	55 (61)
02	Do you actively seek out or read nutrition information?	26 (29)	64 (71)
03	Do you read the nutrition facts label when selecting a food item to eat?	51 (57)	29 (43)
04	Having a nutritious diet will improve my athletic performance.	72 (80)	18 (20)
05	I change my pattern of eating at the time of a competition	48 (53)	42 (47)
06	Having a Sports Nutritionist would be helpful to me as an athlete.	79 (88)	11 (22)
07	I am aware of how many calories I need to consume every day to promote my best athletic performance.	39 (43)	51 (57)
08	I always eat at least one hour before training/competition	51 (57)	39 (43)
09	I consume lots of water during and after training/competition	59 (66)	31 (34)
10	I always take my breakfast daily	70 (78)	20 (32)
11	Do you use supplements like multivitamin as an athlete?	42 (47)	48 (53)
12	I consume milk and milk products daily	65 (72)	25 (27)

Table 3 demonstrates the status and relationship of NK of team athletes with their NP. Majority of the athletes with good NK scores were found to have good NP scores and vice versa ($\chi2$=23.861, p=0.000). Their mean recorded scores for NK and NP were found to be 11.13±3.6 and 7.30±2.0 out of a total of 20 and 12 respectively.

Table 3. Status and Relationship of Nutrition Knowledge with Nutrition Practice of Team Athletes

Nutrition Knowledge Scores (11.13±3.6)					
	Status	Poor	Good	$\chi2$	P
Nutrition Practice Scores (7.30±2.0)	Poor	42	16		
	Good	6	26	23.8	<0.001
	Total	48	42		

Legend: $\chi2$ - Chi-square test

Table 4 shows that team athletes had much lower daily calorie consumption (2756.90±622.0 kcal) as their carbohydrate (465.58±129.6 gm), protein (110.03±26.0 gm) and fat (74.19±12.9 gm) intakes were found to be lower than the RDA. Protein (β=.336; p=0.004), sodium (β=0.273; p=0.006) and dietary fibre (β=0.220; p=0.002) intake were found to be the significant predictors for nutritional practice. Although inversely proportional, carbohydrate was also found to be significantly predictive (β=-0.227; p=0.035) NP. About 66% of the variance in the NP can be explained by the model represented in Table 4.

Table 4. Daily Nutrient Consumption of Team Athletes and Its Prediction on their Nutritional Practice

Nutrients	RDA	Daily consumption	β	t	Sig.
Energy (Kcal)	4500	2756.9±622.0	.006	.091	.93
Carbohydrate (gm)	675	465.6±129.6	-.227	-2.145	.04*
Protein (gm)	164	110.0±26.0	.336	2.949	.004**
Fat (gm)	125	74.2±12.9	.145	1.626	.12
Calcium (mg)	1200	1081.7±326.6	.130	1.730	.08
Phosphorus (mg)	2400	2280.9±619.6	.201	1.869	.07
Iron (mg)	28	22.9±8.7	.009	.122	.90
Sodium (mg)	<2300	1277.5±126.1	.273	2.818	.006**
Potassium (mg)	4700	2893.3±580.4	.087	.819	.42
Dietary fibre (gm)	28	21.6±5.3	.220	3.145	.002**

Legend: RDA- ;*-p<0.05; **-p<0.01; Predictors: (Constant) Energy, carbohydrate, protein, fat, calcium, hosphorus, iron, sodium, potassium, dietary fibre

Dependent variable: nutrition practice; Adjusted R2=0.665, Std. Error=1.190, F=18.66, p=.000

Table 5 depicts the Pearson correlation coefficient of the nutritional and physiological status of team athletes. NK and NP have significantly positive correlation (0.407***). Furthermore, both the parameters showed significantly positive correlation with BMR (0.314***; 0.419***), calcium intake, (0.248*; 0.482***) iron intake (0.303***; 0.221*), and aerobic capacity (0.331***; 0.428***), respectively. NP also showed significantly positive correlation with calorie intake (0.282**).

Table 5. Pearson Correlation Coefficient of Nutritional Parameters and Physiological Status of Team Athletes

	GLY	VO_2	HGS	CalI	CaI	FeI	NK	NP
HT	.286**	.374***	.553***	.079	.275**	.391***	.042	.117
WT	.324***	.208*	.499***	-.141	-.034	.115	.011	.100
BMI	.424***	.157	.354***	-.021	.008	.238**	.146	.129
MM	.616***	.476***	.399***	.212*	.191*	.277**	.190	.197*
GLY		.320***	.286**	.186	.148	.026	.015	.171
BMR		.718***	.007	.363***	.578***	.375***	.314***	.419***
VO2			.149	.442**	.642***	.541***	.331***	.428***
HGS				-.046	-.015	.195*	-.016	.067
CalI					.221*	.175	.054	.282**
CaI						.298**	.248*	.482***
FeI							.303***	.211*
NK								.407***

Legend: ***-p<0.001; HT-height, WT-weight; BMI-body mass index; FM-percentage body fat; FFM-percentage of fat free mass; MM-muscle mass; BMR-basal metabolic rate; GLY-glycogen store; HGR-right hand grip strength; HGL-left hand grip strength; VO_2max-aerobic capacity; CalI-calorie intake, CaI-Calcium intake, FeI-Iron intake, NK-nutrition knowledge; NP-nutrition practice

Muscle mass showed positive correlation with glycogen store (0.616***), handgrip strength (0.399**), and VO_2max (0.476***). Glycogen store was found to have a positive Pearson correlation value with VO_2max (0.320***) and handgrip strength (0.286**). Total calorie (0.442**), calcium (0.642***) and iron (0.541***) intake were found to have significantly positive correlation with VO_2max. Also, VO_2max showed significant positive correlation with height (0.374***) and weight (0.208*).

Table 6. Prediction of Aerobic Capacity of Team Athletes with Reference to their Nutrition Score, Anthropometric Status and Body Composition Profile

Variable	β	T	Sig
Height	.013	.144	.88
Weight	-.102	-1.184	.24
BMI	.009	.093	.93
Fat mass	.060	.830	.41
Muscle mass	.213	2.373	.02*
Glycogen	.092	1.109	.27
BMR	.304	3.862	<0.001***
CalI	.144	2.225	.03*
CaI	.275	3.617	<0.001***
FeI	.240	3.299	.001**
NK score	.025	.372	.71
NP score	.003	.043	.96

Legend: Dependent Variable - VO2max; Adjusted R2=0.716, Std. Error=2.537, F=19.71, p=.000

Table 6 shows the prediction of aerobic capacity of team athletes with reference to their nutrition scores, anthropometric status, and body composition profile. The highly significant predictor of aerobic capacity or VO_2max was BMR (β=0.304, p<0.001***). Muscle mass (β=0.213, p=0.020), daily calorie consumption (β =0.144, p=0.029); calcium (β =0.275, p=0.001) and iron intake (β=0.240, p=0.001) were also found to significantly predict VO_2max. About 72% of the variance in maximal oxygen consumption (VO_2max) can be explained by this model.

Discussion

It is said that athletes who comprehend the vital function of an optimal diet and reflect the knowledge in their dietary behaviour tend to flourish more in their sports life (Ozdogan & Ozcelik, 2011; Frederick & Hawkins, 1992). The present study revealed significant correlation between NK and NP scores of team athletes, which are in agreement with the previous findings (Hornstrom et al., 2011; Oluyemisi, Abiola, & Rasaki, 2015) although Supriya (2013) reported contradicting results stating no significant correlation between knowledge and practice. The NK and NP scores recorded in this study ranged from a low of 15% and 16% to a high of 85% and 91% respectively. The mean scores were equivalent to answering only 55% of NK (11.13±3.6) and 67% of NP (7.30±2.0) questions correctly. Hornstrom et al. (2011) also reported similar mean NK scores attempted by the athletes. In contrast, Abood, Black, and Birnbaum (2004) reported comparatively higher NK scores and also demonstrated the ability to increase both NK and positive dietary changes during an eight-week intervention programme. Other studies showed even lower NK scores among athletes. Barr (1986) reported an average nutrition score of 34%, whereas Batson, Sease, Stanek, and Leski (2004) found 99% of athletes surveyed to have poor NK. It was observed in the present study that 62% of the study population who had good NK score, also scored well for NP.

Furthermore, in agreement with Heaney et al. (2011), a positive correlation between NP score and energy consumption was observed. Team games (i.e., football and hockey) categorized under Group-IV demand an average daily calorie consumption of 4500 Kcal with an energy bifurcation of 60%, 15% and 25% to be obtained from carbohydrate, protein and fat respectively (Panandiker, Satyanarayana, Ramana, & Sinha, 2007). On an average, only 61% of the total daily calorie requirement was met by the subjects; and carbohydrate, protein and fat intake was met up to 69%, 67%, and 56% of the daily recommendation respectively (Table 4). Team athletes were recorded with lower consumption of grains (76%) and milk & dairy products (51%), which are among the primary sources of carbohydrate and protein, respectively, which may be a cause for their macronutrient deficits, as also discussed by Hoogenboom et al. (2009).

In contrast, Saris, van Er-Baart, Brouns, Westererp, and ten Hoor (1989) reported intake of a hefty amount of carbohydrate-rich fluids and supplements by athletes and also affirmed the intake of CHO-rich liquids to be suitable for maintaining energy and fluid balance. A large number of respondents of this study did not meet the RDA for micronutrients including calcium, iron, sodium and potassium, as also observed in other studies (Cupisti et al., 2002; Heaney et al., 2011; Nazni & Vimala, 2010). Low energy availability and low dietary calcium aggravates the risk of low bone-mineral density and stress fractures, whereas iron deficiency, with or without the prevalence of anaemia may impair muscle function and also limit work capacity (Nickols-Richardson, Beiseigel, & Gwazdauskas, 2006; Nattiv, Loucks, & Manore, 2007; Haymes, Driskell, & Wolinsky, 2006).

Food groups that were maximally consumed by the team athletes of the present study in accordance to the standard food composition pattern were meat, poultry, fish, pulses and fruits, whereas vegetable intake was much lesser than their standard RDA. Oladunmi and Sanusi (2013) reported similar results, which also found athletes to consume milk and legumes less frequently.

The present study illustrated that although team athletes had noteworthy nutritional deficits, daily intake of protein, sodium and dietary fibre were the best predictors of NP. Team athletes consumed an average of 2gm/kg body weight/day of protein, although they are recommended to have 2.4gm/kg body weight/day. In such intermittent games, long distances are covered by the players that eventually results in substantial sweat loss and electrolyte imbalance than observed in non-athletes (Bangsbo, Mohr, & Krustrup, 2006). However, sweat rates influencing sodium loss can differ broadly among individuals. Hence, considering each athlete's unique physiological needs, guidelines for sodium intake should be established (Abbey, Wright, Christina, & Kirkpatrick, 2017). A research finding suggested that dietary fibre enhances athletic performance, reduces physical stress, and augments the normal diurnal changes in cortisol levels (Sugiyama, Yamaguchi, Hu, A. Kobayashi, & H. Kobayashi, 2017). Micronutrient intake is considerably lowered by poor energy consumption, which may further impair athletic performance (Hornstrom et al., 2011).The inadequacy in players' energy intake may have occurred due to their unhealthy eating habit and suboptimal intake pattern of various food groups. Although 88% of the study population believed that having a sports nutritionist would be helpful only 39% had access to nutrition counselling, which might have resulted in negligence leading to infrequent consumption of common healthy staples and inadequate energy intake in majority of the athletes (Panandiker et al., 2007; Torres-Mcgehee et al., 2012).

Furthermore, NK and NP both showed significant correlation with aerobic capacity and hence may have translated to athlete's performance. The present study corroborated the findings produced by Ozdogan and Ozcelik (2011), who reported suboptimal athletic performance to be associated with poor knowledge of nutrition and athletes' lack of awareness about additional nutrient needs. This study revealed strong positive correlation between calorie intake and VO_2max, thus validating the necessity for sufficient energy intake for optimal athletic performance (American Dietetic Association and American College of Sports Medicine, 2000; American Dietetic Association, 2009). Athletes' performance expressed as VO_2max was best predicted by BMR, an essential factor of the energy requisite that elucidates the indirect role played by NK and practice. BMR is also positively correlated with energy and calcium intake, which also emerged as one of the best predictors of VO_2max. Another predictor of athletic performance was muscle mass (American Dietetic Association and American College of Sports Medicine, 2000; American Dietetic Association, 2009). It has strong positive correlation with glycogen store, resting metabolism, calorie, iron and calcium intake. Hence, combining an energy-rich diet that includes

adequate carbohydrate consumption with strategically timed protein intake with a well-designed strength and resistance training programme may prove beneficial for athletes (American Dietetic Association, 2009; Tipton and Wolfe, 2004).

Although NK and NP were not strong predictors for athletes' performance, present baseline data confirmed directly proportional relationship of NK and NP with VO_2max. Basal metabolic rate and iron intake were affirmed as the strongest predictors of VO_2max. However, muscle mass, daily calorie consumption and iron intake also notably predicted VO_2max. Therefore, NP and dietary habits, if channeled to meet optimal energy requirements ascertaining favourable muscle mass and body weight, may improve athletic performance. Athletes need to have a strong fuelling regimen so as to maintain their on-field excellence. Therefore, they should be self-sufficient with the basic knowledge of sports nutrition, avoid skipping meals and follow healthy diet pattern in accordance to their nutritional and metabolic demands.

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Conflict of Interest
The authors declare that there are no conflicts of interest.

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