ABSTRACT

Cricket is an intermittent sport that is dominantly endurance based, and requires speed, flexibility, agility, strength, coordination and occasional bouts of power demands. The International Society for Sports Nutrition (ISSN), the International Olympic Committee (IOC), and the American Council of Sports Medicine (ACSM) all provide nutrient requirements for athletes. These guidelines are not sport-specific and are based on the kind, intensity, and duration of physical exercise. The International Life Sciences Institute (ILSI), National Institute of Nutrition (NIN), and Sports Authority of India (SAI) produce nutrition standards for excellence in sports performance based on the nature of the activity; however, cricket is not one of them. The Sports Authority of India, the country's governing organisation for sports, does not govern cricket, hence there are no nutritional guidelines for cricketers developed by SAI. Additionally, the national cricket regulatory body in India, the Board of Cricket Control in India (BCCI), has not yet developed any such guidelines. Despite being one of the most popular sports in the nation, little research has been done on the nutritional requirements of cricket players or dietary recommendations that are tailored to them. As a result, the formulation of the same is urgently needed, which calls for extensive research in this area.

Based on the literature review, a few gaps were identified. Firstly, there is a paucity of data on the nutritional status, body composition, energy expenditure, fitness level, morbidity-injury profile and nutrition awareness of Elite Indian cricketers. Secondly, there is unavailability of recovery drinks in the market. The present study was therefore formulated to bridge these gaps. The broad objective of the study was to assess the nutritional status, fitness level, energy expenditure and nutrition awareness among elite cricketers of Urban Vadodara and study the impact of a cocoa flavanol rich drink on post-event muscle recovery.

In phase 1, all the sports associations located in Vadodara involved with cricket were visited and Elite cricketers (n=96) from these associations were identified. All of them play through the Baroda Cricket Association. Anthropometry was conducted using standard methods, and body composition using the bioelectrical impedance method. Dietary intake was assessed using a 3-day 24 hour dietary recall and a semi-structured food frequency questionnaire. Energy expenditure was assessed using a fitness tracker, and haemoglobin by Sodium lauryl sulphate method. For fitness, various cricket-specific tests were conducted to assess several components like speed, agility, muscular endurance and power. The morbidity

injury profile was assessed using a pretested questionnaire. The participants (N=96) belonged to the Ranji boys' squad consisting of 29 participants, U-23 boys had 38 participants, Senior women were 14 and U-19 women had 15 participants. The prevalence of overweight and obesity as measured by body mass index (BMI) was highest in U-23 boys (44.7%), followed by Ranji boys (35.7%), Senior women (28.6%), and U-19 women (least) (20 percent). Highest central obesity rates were reported in senior women (WHtR- 64.3 percent, WHR-64.3 percent, and WC-35.7 percent). Only 29-54 % of the participants had normal percent body fat. The mean energy intake of the Ranji boys' squad was only 94% of the EAR, U-23 boys met 97 % of the EAR, senior women met 82% of the EAR and U-19 women met 85% of the EAR (ICMR, 2020 requirements for moderate worker). When compared to the recommendations for endurance athletes, the energy from macronutrients revealed lower percentages of calories coming from carbohydrates (47-50 percent against 55-60 percent) and proteins (12-14 percent versus 15-20 percent), and greater percentages of calories coming from fats (36-37 percent versus 20-25 percent). Similar trends were observed across all the squads. The mean Calcium intake of only the Under-23 squad met the RDA; for Iron intake, none of the squads met the RDA and for ascorbic acid, all the squads fulfilled the RDA by ICMR-NIN, 2020 for a moderate worker. Mild anemia was present in 23% of the Senior women squad, 20% of the Under-19 women, 13% in the Under-23 boys' squad and 5% in the Ranji boys squad. Moderate anemia was found only in Women, Senior Women (7.7%) and Under-19 women squad (6.7%). To sum up, the cricketers did not have adequate nutritional status as assessed by anthropometry, body composition and dietary intake. The iron status in the participants was also not adequate as assessed by the haemoglobin levels. Moreover, the participants displayed poor fitness scores in terms of cardio-vascular endurance, speed, agility and power. Thus, despite the fact that the cricketers were from elite category and competed at national and international level they did not have expected or desired nutritional status, haemoglobin levels and fitness levels.

In phase 2 A, a market survey of commercially available protein supplements and sports drinks was conducted. In all, 60 protein supplements were surveyed from 15 different brands and were in the form of Powder (83%), Bar (14%), and Beverage (4%). Ninety-two percent of the products met the IOC guideline of 20-50 g protein per serving. Whey protein concentrate (58%) and whey protein isolate (50%) were the most commonly used sources of protein in the supplements. The mean cost per gram of protein of the protein supplements was INR 5.5±2.6 however; the range was INR 1.7 to 13.9. Products containing isolate form of protein sources were the most expensive. Ninety percent of the protein supplements had the presence of sweeteners, 72% had sugar and 60% had both sweetener and sugar. Amongst those products that contained sweeteners, 87% had Sucralose, 43% had Acesulfame Potassium and 15% had

Stevia. On 20% of the products, usage instructions were missing. Thus, leaving supplement usage up to the discretion of the consumer, which may result in suboptimal supplement effectiveness.

Phase 2 A also dealt with studying the composition of sports drinks in terms of carbohydrate and electrolyte content, ingredients used and cost. Fifty-eight percent of the sports drinks were in the form of powder, 28% in the form of tablets and 28% ready-to-drink formula. The majority of the products i.e. 67% fell in the ideal carbohydrate content range of 4-8g/100ml. The most commonly added carbohydrates to the sports drinks were Maltodextrin (56%) and Glucose (48%), and Maltodextrin plus Fructose (in 18% of products) was the most common combination which is also the most desirable combination in the ratio of 2:1 due to its oxidation rate, osmolality and palatability. Twenty-six percent of the products contained sweeteners, 54% of which had added sucralose. Approximately 74% of items fell within the recommended sodium range of 23-69 mg/100 ml. Nutritional information was presented 'Per Serving' on the labels making it easy for the consumers to assess their intakes. Twelve percent of the products did not specify the sodium content, even though salt was present. This could be considered a violation of product labelling regulations. Only a few products carried instructions for reconstitution of the products in powder or tablet form. The absence of such instructions can result in incorrect preparation and lead to gastrointestinal discomfort and impaired performance. The average cost of sports drinks per serving was INR 66.5 (n=41) and varied widely from INR 9.3 to 186. Ten percent of the products had caffeine which is no longer banned by The World Anti-Doping Agency. To summarize phase 2 (A), 92% of the protein supplements met the IOC recommendation of 20 to 50 g of protein per serving. However, just 40% of the sports drinks satisfied the standards for sodium and carbohydrate content, despite the fact that both are crucial. In both the supplement categories, there were violations of the rules governing product labelling, including omission of directions for use and reconstitution and failure to disclose the amount of sodium in sports drinks.

In phase 2 B, a kitchen-based muscle recovery drink was developed, standardized, and supplemented to study the impact by measuring the change in serum CK levels. Based on the Sensory evaluation, the placebo drink composition per serving of 250 ml was Milk-250 ml, sugar- 15g and milk powder- 5.6g. The experimental drink composition per serving of 250 ml was Milk-250 ml; Hershey’s unsweetened Cocoa powder- 10g and Sugar- 20g. The calculated flavanol content of the placebo drink, which included no cocoa powder, was zero, while the experimental beverage contained 350 mg of cocoa flavanols. The pre-intervention and post-intervention CK values were compared to assess the impact of the intervention with cocoa flavanol rich drink on the muscle recovery of the participants. The CK levels dropped from

326.71 ± 195.37 U/L (Pre-intervention) to 211.00 ± 96.028 U/L (Post-intervention) in Ranji boys' squad placebo group; the reduction being non-significant (p=0.08). The rise was observed in the CK levels of the Ranji boys' squad experimental group from 329.17 ±182.74 U/L (Pre-intervention) to 376.83±281.73U/L (Post-intervention); the rise being non-significant (p=0.44). In the women squad placebo group, a reduction in the CK levels was observed from 203.17 ± 121.72 U/L (Pre-intervention) to 133.58 ± 74.99 U/L (Post-intervention); the reduction being statistically non-significant (p=0.108). The women's squad experimental group, recorded a reduction in the CK levels from 147.92 ±96.06 U/L (Pre-intervention) to 128.92 ± 68.92 U/L (Post-intervention); the same being statistically non-significant (p=0.605). Thus, the findings indicate that the intervention with cocoa flavanol rich drink did not show an impact on muscle recovery post eccentric workout as assessed by change in CK levels.

In phase 3, a semi-structured questionnaire was used to evaluate the athletes' current attitudes, behaviours, and knowledge on sports nutrition. Based on the knowledge gaps, a booklet was developed as a nutrition education intervention tool. The intervention involved distribution of the booklet to the participants and daily reinforcement of the key messages for 21 days. At the baseline over 89.3% of the respondents indicated that nutrition support is critical in their sport and over 86.7% believed that a nutritionist should be a member of the sports professionals' team. Only about 21% of the participants consumed solid foods within the recommended period of 30 minutes after the match, which is the window of recovery. In all the squads the post-intervention knowledge scores improved compared to the baseline pre-intervention scores (p=0.000). Scores on basic understanding of ergogenic aids improved by 110%, those on nutrients that aid Iron absorption by 69%, nutrients that help in Calcium absorption by 44%, sources of Iron by 39%, and important source of energy during exercise by 33%. All the participants consumed some or the other form of supplements; Sports drinks were consumed by 96% of the participants, protein by 44% and BCAA by 3% of the players. The key knowledge deficit areas of the cricketers at the baseline showed significant improvement post-intervention across all the 3 squads thus emphasising the need and benefit of nutrition education for athletes.

The recommendations that emerge from the present study for the Baroda Cricket Association include the employment of a sports nutritionist who can give personal nutrition advice and conduct nutrition seminars on regular basis for the players. Regular monitoring of body composition and iron status of the cricketers should be done. Appropriate nutrition counseling and support to achieve and maintain the desired body composition and iron status needs to be given to improve fitness and performance of the players. The

cricketers should be taught how to read and interpret product labels as they were using supplements in some form. The cricketers also need to be educated on preparation of simple low-cost kitchen-based sports drinks like lemonade, which they can carry instead of expensive commercial products that did not meet the IOC guidelines at times. With respect to Future research recommendations, mapping energy expenditure using newer technologies like Geolocation to develop guidelines for energy requirements is the need of the hour. Moreover, it is necessary to explore other flavanol rich foods to develop kitchen-based drinks for muscle recovery. Research involving multiple sensitive biomarkers other than creatine kinase to assess muscle recovery should also be conducted.