CHAPTER 1: INTRODUCTION

There are numerous sports being played in the world and cricket is one of them. Cricket is the second most popular international sport and the most popular on domestic front with millions of dollars being spent and earned on competitive events(https://sportsshow.net/top-10-most-popular-sports-in-the-world/, https://sportzwiki.com/cricket/10-reasons-why-cricket-is-the-most-famous-sport-in-india,Mandrekar et al, 2017) Cricket originated in England and is played in several countries around the globe. Also, it is the most commercialized and highly sought after sport in Indian subcontinent which to a large extent can be attributed to its lucrative side. Along with recreational cricket being enjoyed by the mass, elite/professional cricket has also been quite big in India with several State teams and Ranji squads in addition to the National team. Baroda Ranji team has had the glorious winning history and is considered as one of the prominent teams in the country.

Cricket is an intermittent sport which is dominantly endurance based, and also requires speed, flexibility, agility, strength, coordination and occasional bouts of power demands. (Bhide and Mandalika, 2018) Factors that contribute to success in sports include talent, training, motivation and nutrition. Nutrition is an essential element of any professional sport training programme due to its numerous merits like improving athletic performance, speeding up the post event recovery and maintaining optimum nutritional status. Diet affects performance and the foods which are part of the training and competition phase affect how the athlete trains and competes. Optimum nutrition supports intensive training while reducing the risk of illness and injury (International Olympics Committee, 2012). Sports nutrition is critically essential as long before deficiency symptoms start appearing, physical performance declines. (Panandiker, 2007) Nutrition is thus increasingly recognized as a key component for optimal sporting performance. (Beck et al, 2015)

'It is the position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine that the performance of, and recovery from, sporting activities are enhanced by well-chosen nutrition strategies (The Academy of Nutrition and Dietetics, American College of Sports Medicine and Dieticians of Canada, 2016). Sports demand increased nutrient requirement owing to the raised physical activity. The physical demands of each sport vary and so the nutrient requirements differ too. The International Olympic Committee states that "The amount, composition and timing of food intake can profoundly affect sports performance. Good nutritional practice will help athletes train hard,

recover quickly and adapt more effectively with less risk of illness and injury."(Bhide and Mandalika, 2018)

Nutrient requirements for athletes are given by International Society for Sports Nutrition (ISSN), International Olympic Committee (IOC) and American Council of Sports Medicine (ACSM). However, these guidelines are generic and not sport specific. They are developed based on the type, intensity and duration of physical activity. (Potgieter, 2013) Nutrition guidelines for excellence in sports performance by International Life Sciences Institute (ILSI), National Institute of Nutrition (NIN) and Sports Authority of India (SAI) are developed for different categories of sports based on the nature of the activity but cricket doesn't feature in that. (Panandiker, 2007) Cricket does not fall under the Sports Authority of India which is the national body for sports so there are no nutritional guidelines from the same for cricketers. Also, Board of Cricket control in India (BCCI) which is the national cricket governing body has yet not come up with any such guidelines. Despite being one of the top sports of the country, there has not been much research on nutritional requirements of cricket players and nutritional guidelines specifically targeted to them. Thus, there is a dire need for formulation of the same and that requires extensive work in this area.

The review of latest guidelines for exercise and sports nutrition from ACSM, IOC and ISSN clearly indicates that no single consensus provides all the required guidelines and recommendations needed to develop a nutrition plan for an athlete. Therefore, a combination of these and other guidelines should be used to individualize the nutritional management of athletes. (Potgieter, 2013) Energy demands of athletes depend on the periodised training load and competition program and it varies across the season. A diet providing adequate energy from a wide range of commonly available foods can meet the macro and micronutrient requirements of training and competition. (Maughan and Burke, 2012) According to both ISSN and ACSM, a normal nutrient rich diet that contains a variety of food groups should provide sufficient amounts of micronutrients in most cases. (Potgieter, 2013) Many athletes do not meet their nutrition goals due to reasons like poor knowledge of foods, poor or outdated knowledge of sports nutrition, lack of access to sports professionals, inadequate finances, and busy life leading to inadequate time to obtain or consume appropriate foods, poor availability of good food choices, frequent travel and choosing the wrong supplements. (Maughan and Burke, 2012)

The importance of hydration in sports is well established. Pre, during and post competitive event or workout hydration is essential for an athlete. Current hydration consensus recommends:

1. Beginning exercise in state of Euhydration
2. Preventing excessive hypo-hydration during exercise and
3. Replacing remaining losses following exercise prior to the next workout session.

These practices attenuate the adverse effects of acute dehydration. However, it is recommended that fluid needs are individualized and rely on factors such as personal sweat rate, type, intensity and duration of exercise and environmental conditions. (Belval et al, 2019) It is not a good decision to drink only when thirsty as by the time a person is thirsty a signification water loss has already happened. Also, the rules and opportunities to drink fluids in various sports may not coincide with the time that thirst hits. (Maughan and Burke, 2012) During exercise lasting longer than an hour and which results in fatigue, in addition to water it is advisable to consume a source of carbohydrate that is rapidly converted to blood glucose.

Early morning pre match hydration status in 27 odd cricket showed that 7.4% of the players were very dehydrated, 74.1% were dehydrated and only 18.5% were euhydrated. (McDonald, 2018) Imparting hydration education resulted in significant improvement in hydration knowledge as well as the hydration status in 120 college athletes. (Sobana and Many, 2014) As there are limited studies which have explored hydration status of athletes and cricketers specifically, in-depth research needs to be conducted on this aspect.

Training periodization i.e. dividing the annual athletic training plan into units which helps athletes to ensure peak performance at major competitions is required to enhance the training programme in any sport. Nutrition periodization works along with training periodization as the athlete's nutritional needs change based on the training schedule and adjusting the nutrient intake accordingly becomes very important. (Bhide and Mandalika, 2018) Also, in any sport, the pre, during and post competition nutrition is important and needs to be thoroughly planned and implemented. In cricket, on the match day or the day of competition, the dietary strategies differ for players of various departments of the sport. For instance, during the batting spell, the batsman may get out even on first ball or may go on to play majority of the overs. So in case of extended presence at the crease, regular consumption of beverages containing water, carbohydrate and sodium may become essential. Also, tail-enders are unsure when they will have to go to bat so during that largely long waiting duration they may snack or sip on unhealthy options if they don't have well-structured nutrition guidance. While the duration a batsman plays depends on how long he/she

survives at the crease, a wicketkeeper is active almost during the entire innings. Due to this player to player variation, individualization of nutrition guidance is of paramount importance in Cricket.

Energy expenditure is usually higher during the training phase compared to the pre-season and the match season. In Cricket, during the matches, the energy expenditure varies across different positions e.g. the energy expended by a wicketkeeper is different from that by a batsman or a pacer. Tracking energy expenditure for the various departments of Cricket is therefore essential. Cricketers generally rely on aerobic energy supply, and the rates of energy expenditure in cricket are relatively low, except for fast bowlers during a bowling spell and fielders sprinting after the ball. Thus there is an element of both aerobic and anaerobic energy systems involved in the game. (Dana et al, 2014) But as data on energy expenditure in cricketers is lacking, this area needs to be considered for Research.

Like in non-athletic population, even in athletes all the macro and micro nutrients are certainly vital for the general health. Due to the increased demands posed by sports, certain nutrients like Iron, Calcium, and Sodium become all the more important. Adequate Iron is very crucial for athletes and more so for females and a balanced diet can easily help meet this iron requirement. Iron is a functional component of oxygen transport and energy production in humans and therefore has a big role in sport and exercise performance (Alaunyte, Stojceska and Plunkett, 2015). Iron deficiency even without anemia can hamper muscle activity, and limit work capacity leading to compromised training adaptation and athletic performance. (The Academy of Nutrition and Dietetics, American College of Sports Medicine and Dieticians of Canada, 2016) Therefore, it is crucial to regularly monitor iron status of athletes and correct it if needed. Athletes who restrict energy intake or diet diversity are those who have higher chances of developing Iron or any micronutrient deficiency. Athletes who undertake altitude training also need to have iron status monitored to ensure they have sufficient iron stores to allow adaptations to their specialized training demands. (Maughan and Burke, 2012)

Calcium is another mineral, a micronutrient which becomes significant in athletes. Conditions like prolonged intensive training, low calorie intake, calcium deficiency, excessive loss of calcium in sweat, amenorrhoea disturbs the calcium homeostasis. This makes the athletes more susceptible to fatigue, osteoporosis and stress fractures. In such a situation, calcium supplementation can be considered to correct deficiency and improve bone health. (Krieder et al, 2010 and Bhide and Mandalika, 2018) Sodium

is an electrolyte which is important to athletes as it is the prominent one that gets lost through sweat during physical activity. Prolonged exercise occasionally leads to hyponatremia (low sodium levels) in athletes due to increased loss of sodium in sweat, limited capacity of kidneys to excrete water and excessive intake of fluid. (Hoffman et al, 2016) When blood sodium levels fall rapidly the consequences are severe and life threatening. This can be avoided by preventing consuming excessive water and replacing sodium lost in sweat by the intake of sodium containing beverages. (Bhide and Mandalika, 2018)

Dietary supplements are used by athletes worldwide. (Garthe & Maughan, 2018) Athletes across various sports rely on nutritional supplements for many benefits including promoting adaptation to training, accelerating recovery, enhancing competitive performance and providing convenient source of nutrients. (Knapik et al, 2016) With the supplement market being what it is today, supplements are readily available to athletes and are accepted more within the athletic culture (McDowall, 2007). Various forms in which sports foods are available in the market include sports drinks, sports gels, liquid meals and sports bars (International Olympics Committee, 2012). Utilization of supplements is commonplace among athletes and it is found to range from 13% to 50% across the nations. The commonly consumed supplements are carbohydrate supplements, energy drinks, vitamin and mineral supplements, fish oils, whey Protein and creatine. Most often multiple supplements (more than 3) are taken concurrently.(Nabuco et al, 2017; Tawfik et al, 2016; Graham-Paulson et al, 2015; Aljaloud and Ibrahim, 2013; Muwonge et al, 2017)

In Cricket, Protein supplements and Sports drinks are widely consumed. Protein supplements are used to meet increased protein requirements during intense training, recovery from injury etc. Protein supplements including high protein bars and amino acid preparations are among the biggest selling sports nutrition products. (Maughan and Burke, 2012) Sports drinks are consumed during ongoing training or matches to replenish lost water and electrolytes and get optimum amount of carbohydrates. They are also utilized post intense physical activity for rehydration. Sports drinks typically contain 4-8% carbohydrate and 23-69 mg sodium per 100ml of the solution. (IOC Sports Medicine Manual, 2000) Carbohydrates in the sports drinks help to replenish sugar stores and electrolytes accelerate rehydration. (ACSM, 2011)

However, as a word of caution, the American College of Sports Medicine has suggested that athletes should be counseled regarding the appropriate use of supplements and should consider taking them after careful evaluation (Potgieter, 2013). Thus, the short cut approach through supplementation should be

discouraged and emphasis should be laid on good eating habits as a foundation to optimal nutrition (International Olympics Committee Sports Medicine Manual, 2000). Certain supplements may help athletes to meet sports nutrition goals, train hard, and stay healthy and injury-free and can directly enhance competition performance. However, a well-informed sports nutritionist can help identify which products are appropriate, how to integrate them into the athlete's sports programme and how to ensure that the benefits outweigh the possible adverse effects (Maughan et al, 2018) As there are enough studies exploring the supplement use in various sports but the data on Cricketers is lacking, so there is a need to carry out Research in this area and determine the trends.

Body composition and weight are two of the several factors that help an athlete to perform at the highest potential. (Panandiker, 2007) Body composition is the relative amounts of muscle, fat and bone in the body and is considered to be a predictor of athletic performance (Bhide and Mandalika, 2018). High strength to weight ratio is important to excel for majority of the athletes. Studies at National Institute of Nutrition on athletes show that the body composition is an important component in training induced adaptations and may influence physiological parameters like VO_2 max resulting in improved maximal work performance. (Panandiker, 2007) Periodical assessment of body composition of athletes can be helpful to determine the nutritional status, to assess the effect of sports specific training on body composition, to study the growth status in young athletes and to explore the suitability of an athlete to the chosen sport.

Low body fat and higher muscle mass are linked to optimal performance in many sports. As body fat adds to weight without adding to strength, less body fat percentages are emphasized for improved performance. However, body muscle content is influenced by factors like genetic predisposition, nutrition, physical activity, age, gender and body type. An inverse relation has been observed between body fat and athletic performance in activities requiring translocation of body mass either vertically as in jumping or horizontally as in running. Bone mass has not been closely associated with performance especially in non-weight bearing endurance activities like swimming and cycling but it is helpful in weight bearing sports such as running which require optimum skeletal mass to withstand the stress of repetitive motions. Strength and power athletes such as jumpers are benefitted by higher body fat along with high bone mass as it enables them endure heavy load and impact forces. (Bhide and Mandalika, 2018)

Data on body composition of cricketers is scarce however, available evidence shows greater lean mass in cricketers (61.4 ±6.0 kg versus 56.8 ± 7.1 kg, p=0.010), as compared to their physically active age-

matched controls. (Micklesfield et al 2002 as cited in Payne, 2017) Fast bowlers are reported to have significantly greater lean mass (67 ± 5.8 kg versus 56.5 ± 3.8 kg, p=0.001) and lower fat mass 17.4 ±2.9% versus 20.5 ±5.0%) than the non-athletic controls. (Lees et al, 2016 as cited in Payne, 2017) However, there is a need to carry out more research on assessing the body composition of cricketers and its association with performance and recovery.

Like in any other sport, physical fitness has a big role in the performance of a cricketer. Fitness assessment is an important aspect of an athlete's program. The fitness levels of an athlete have impact on the competitive performance and therefore fitness training is given lot of attention. In cricket, fitness components like endurance, speed, strength, power, agility and flexibility are very important to excel (Mandrekar, 2017). Traditionally cricket was not strongly associated with physical fitness and there were overweight players seen in Elite teams. But since last two decades, the importance of fitness in Cricket has risen as there are more stringent fitness tests to clear to be part of the squad. Although research in the field of sports science has evolved considerably over time, not many studies have been conducted on the ideal anthropometry and physical fitness of cricketers, especially as they relate to the 'specialist' disciplines within the sport. Since cricket consists of different disciplines, it is likely that players will display different physiques and different levels of physical fitness. (Dana et al, 2014)

Available evidence indicates superior anthropometry and fitness in players engaged in more intense level of competition in a sport than their age matched counterparts.(Nazeer et al, 2018) The game of cricket has the unique distinction of "specialists" within the discipline. It has been observed that the standing height, arm length, leg length and body composition measurements were significantly higher in fast bowlers than spin bowlers. The mean standing height in fast bowlers was 167.4 ± 4.3 cm while that in spinners was 163.8 ± 4.2 cm. (Lamani et al, 2016) Thus it is evident that the anthropometric parameters vary between spin bowlers and pacers.

The pre-season training too plays an important role in enhancing specific skills namely, the running speed, agility and strength endurance in experimental group compared to the controls. (Ravikumar, 2019; Bhat and Sreedhar, 2018) Thus the merits of sport specific fitness and well structured training programme are quite evident. But there are no studies revealing the impact of nutritional status on fitness levels and this gap needs to be addressed.

In cricket, as in any other sport, exercise induced muscle damage (EIMD) is very common in response to training or workout or intense physical activity. EIMD further results in delayed onset muscle soreness (DOMS) (Pritchett et al, 2011). Speedier muscle recovery from DOMS is crucial for the next athletic performance and therefore athletes and their support staff are constantly searching for the optimal recovery drink. Although the impact of Antioxidants on free radical activity is well known, the efficacy of antioxidant supplementation on indices of muscle recovery is still not well established.

There are studies demonstrating positive impact of anthocyanin rich antioxidant juice, blueberry consumption whey protein hydrosylates soy protein isolate supplement curcumin and piperine supplementation and taurine supplementation on recovery from Exercise induced muscle damage. (Lima et al, 2019, Mcleay et al, 2012, Brown et al, 2017, Shenoy et al 2016, Delecroix et al, 2017 and McLeay et al, 2017) Cocoa flavanols are also hypothesized to show positive impact on muscle recovery but there are limited studies on the same. Creatine Kinase is one of the few biomarkers used to assess muscle recovery (Brancaccio et al, 2007). Administration of 350 mg of cocoa flavanol containing drink twice post exercise for a single day proved to be ineffective in reducing the Creatine Kinase level. Therefore, it was suggested to assess the long-term impact of cocoa flavanol supplementation on muscle recovery. (Peschek et al, 2014) . Also, there are not adequate number of conclusive studies showcasing acceleration of muscle recovery by food based interventions. Development, standardization and impact evaluation of food based interventions on muscle recovery from EIMD is therefore need of the hour. Therefore, a drink which is easy to prepare, highly palatable and acceptable and convenient to consume post event can be explored and if found impactful can serve the purpose.

Basic sport specific nutrition knowledge of an athlete can result in better nutrition-based choices. Nutrition education programs improve nutrition knowledge which eventually leads to better diet quality. (Trakman et al, 2017) Therefore, it is important to discover the existing knowledge, practices and attitude of athletes towards Sports Nutrition. This will give an insight into whether an intervention is required in the same and if so then which aspects to focus on. The availability of nutrition information for athletes varies. Younger/recreational athletes are more likely to receive generalised nutrition information from mainly their coaches and trainers. Whereas, elite athletes are more likely to have access to specialised sports nutrition input from qualified professionals (Beck et al, 2015). Based on the systematic review of 36 studies conducted on Nutrition knowledge of Coaches and athletes, it was concluded that areas like energy density, the need of supplementation and role of protein are the ones which require education as

the proper knowledge around these is lacking. (Trackman et al, 2016) As the data on knowledge of athletes and their support staff is inadequate, this area needs to be studied further.

The above described introduction lead to framing of the Rationale of the Research which is as follows.

Rationale

The study was formulated with the following rationale

- There is paucity of data on the nutritional status, body composition, energy expenditure, fitness level, morbidity-injury profile and nutrition awareness in Elite Indian cricketers. The present study was therefore formulated to bridge this gap and assess the above-mentioned aspects. Post exercise recovery is very crucial for the next athletic performance. Therefore, a cocoa flavanol rich drink was developed and standardized in the laboratory and its impact on the post event muscle recovery was evaluated.

Broad Objective

- To assess the nutritional status, fitness level and nutrition awareness among elite cricketers of Urban Vadodara and study the impact of supplementation on the post event muscle recovery.

Specific Objectives

1. To assess the socio-economic status of elite cricketers from Urban Vadodara.
2. To assess the body composition and fitness level of the participants.
3. To assess the nutrient intake (diet + supplement) of the participants.
4. To assess haemoglobin levels in the participants
5. To assess the energy expenditure of elite cricketers from various departments of the sport.
6. To record the injuries and morbidities reported by the participants.
7. To survey the composition of commercially available Protein supplements and Sports drinks, examine their nutritional quality and utility.
8. To standardize a cocoa flavanol rich drink and study its impact on the muscle recovery in elite cricketers.
9. To assess nutrition awareness among participants and study the impact of Nutrition Health Education.