CHAPTER 5: SUMMARY AND CONCLUSIONS

Cricket is the second most popular international sport and the most popular on the 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, 2017). India has several State teams and Ranji squads in addition to the National team. Baroda Ranji team has had a glorious winning history and is considered 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) Nutrition is an essential element of any professional sports training programme due to its numerous merits like improving athletic performance, speeding up the post event recovery, and maintaining optimum nutritional status reducing the risk of illness and injury. (International Olympics Committee, 2012)

Nutrient requirements for athletes are given by the International Society for Sports Nutrition (ISSN), the International Olympic Committee (IOC) and the 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 the 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. (ILSI, NIN, SAI, 2007) Cricket does not fall under the SAI which is the national body for sports so there are no nutritional guidelines from the same for cricketers. Also, the 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 in the country, there has not been much research on the 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 above described introduction lead to the framing of the Rationale of the Research which is as follows.

RATIONALE

Based on the literature review, the following gaps were identified

1. There is a paucity of data on the nutritional status, body composition, energy expenditure, fitness level, morbidity-injury profile, and nutrition awareness in Elite Indian cricketers.

2. Unavailability of recovery drinks in the market for athletes/sports person.

The present study was therefore formulated to bridge these gaps.

BROAD OBJECTIVE

- 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 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 elite cricketers from Urban Vadodara.
3. To assess the nutrient intake (diet + supplement) of the elite cricketers from Urban Vadodara.
4. To assess haemoglobin levels in the elite cricketers from Urban Vadodara.
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 elite cricketers from Urban Vadodara.
7. To survey the composition of commercially available Protein supplements and Sports drinks and examine their nutritional quality.
8. To standardize a cocoa flavanol rich drink and study its impact on muscle recovery in elite cricketers.
9. To assess nutrition awareness among participants and study the impact of Nutrition Health Education.

PHASE1-NUTRITIONAL STATUS ASSESSMENT, TRACKING ENERGY EXPENDITURE, HAEMOGLOBIN ESTIMATION, FITNESS ASSESSMENT AND MORBIDITY INJURY PROFILE

METHODOLOGY

All the sports associations located in Vadodara involved with cricket were visited. Elite cricketers from these associations were identified. The operational definition of elite male cricketers is those who train for a minimum of 5 hours for at least five days a week. The operational definition of elite female cricketers is those who train for a minimum of 4 hours for at least five days a week. The following inclusion criteria were used to enroll the participants in the study.

- Elite Male Cricketers 19 to 30 years of age.
- Elite Female Cricketers 14 to 30 years of age.
- Willing to participate.
- Cricketers who were not differently abled or who did not suffer from any disease.
- Non-pregnant and non-lactating females.
- Those who were not under any drug treatment.
- Those with normal Creatine Kinase levels at the baseline.

The following exclusion criteria were used

- Elite cricketers who were not residing in Vadodara.
- Elite cricketers who were not a part of any of the Baroda Cricket Association squads during enrolment.

- Purposive sampling of the participants was carried out based on the above-mentioned inclusion criteria.
- In all, 96 participants fulfilled these criteria. All of them play through the Baroda Cricket Association.
- After receiving well-informed, written consent, the participants were enrolled in the study.

Anthropometry was conducted using standard methods, and body composition using bioelectrical impedance method. Dietary intake was assessed using 3-day 24-hour dietary recall and a semi-structured food frequency questionnaire. Energy expenditure was assessed using a fitness tracker, and haemoglobin through the 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 pretested questionnaire.

RESULTS OF PHASE 1

- The participants (N=96) belonged to four squads, 2 boys' squads and 2 women's squads. The Ranji boys' squad consisted of 29 participants, U-23 boys had 38, Senior women were 14 and U-19 women 15.

- Based on body mass index (BMI) the prevalence of overweight and obesity combined was highest in U-23 boys (44.7%), followed by Ranji boys (35.7%), Senior women (28.6%) and least in U-19 women (20%). Underweight participants were seen in only women squads; Senior women (7.1%) and U-19 Women (13.3%).

- Central obesity was found to be highest in Senior women (WHtR- 64.3%, WHR-64.3%, WC-35.7%). WHtR was found to capture the highest number of abdominally obese participants (Senior women- 64.3%, Under-19 women- 53.3%, Under-23 boys' -31.6% and Ranji boys' -25%).

- The average body fat percentage of cricket players in all squads exceeded the cut-offs recommended by the American Council on Exercise (ACE) (2009) (6 and 13 percent for men and 14 and 20 percent for women athletes), Bhide and Mandalika (2018), and Jeukendrup (2010) (5 to 10 percent for men and 8 to 15 percent for women athletes). Ranji boys had higher body fat than U-23 boys, while Senior women had higher body fat than U-19 women. Thus the elder group had higher body fat than their younger counterparts.

- Only 29-54 % of the participants had normal percent body fat. Sixty-four percent of participants from the Senior women squad, 48% from Ranji boys, 47% from Under-19 women and 30% from Under-23 boys squad had higher than normal percent body fat.

- None of the cricketers across all the squads had higher than normal percent lean body mass. Percent lean body mass was low in 36% of Senior women, followed by 11% of Ranji boys and 7% of the Under-19 women squad.

- Average energy expended by the batsman (n=7) per hour was 83 kcal, fielders113 kcal, (n=2), Spinners82 kcal, (n=3), Pacers107 kcal, (n=3) and Wicketkeeper 61 kcal, (n=1). Similar data could not be captured in the boys' squad as due to the stringent Board of Cricket Control in India (BCCI) rules, they do not allow outsiders to be present on the ground during matches.

- The mean energy intake of the Ranji boys' squad was only 94% of the EAR, that of 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).

- The energy derived from macronutrients, when compared with the guidelines for endurance athletes, showed lower percent calories coming from carbohydrates (47-50% versus 55-60%) and proteins (12-14% versus 15-20%) and higher from fats (36-37% versus 20-25%). Similar trends were observed across all the squads.

- For Calcium, Iron and Ascorbic acid the RDA by ICMR-NIN, 2020 were used for comparison as there are no RDA by ISSN, ACSM and IOC for micronutrients. The mean Calcium intake of only the Under-23 squad met the RDA, for Iron none of the squads met the RDA and for ascorbic acid all the squads met the RDA.

- The top ten most frequently (daily, thrice a week, twice a week and weekly) consumed iron-rich foods across all the squads were Wheat flour (whole), Green gram dal, Black gram dal, Bengal gram(whole), Bengal gram, roasted, Lentil, Cowpea and Coconut, dry.

- The top ten most frequently (daily, thrice a week, twice a week and weekly) consumed Calcium-rich foods across all the squads were Curd, Green gram (whole), Black gram dal, Bengal gram (whole), Spinach, Milk (Buffalo), Dates(dried), Paneer, Fenugreek leaves and Coconut dry.

- Anemia was more prevalent in women (32.14%) than in men participants (8.33%). Mild anemia was present in 23% of the participants from Senior women squad, 20% of the Under-19 women, 13% in the Under-23 boys' squad and 5% in the Ranji boyssquad. Moderate anemia was found only in Women, Senior Women (7.7%) and Under-19 women squad (6.7%). None of the cricketers had severe anemia.

- The cardio-vascular fitness was assessed by Yo yo test, agility by run- a-three test, power by vertical jump test andspeed by 20-m sprint test. The participants from Ranji boys' squad had better fitness levels than the Under-23 boys. Fifty percent of the Ranji players demonstrated adequate cardio-vascular fitness, 73% had desired agility levels, 73% displayed adequate speed component and 73% had desirable power as assessed by criterion set by BCA.

- For the women's squad, there are no benchmarks set by BCA to make comparisons with. However, U-19 women demonstrated better scores compared to Senior women in terms of muscular endurance and cardio vascular endurance as assessed by the Prone hold and Repeated Sprintability test respectively.

- Around 46% of the participants did not experience any morbidity in the last 15 days from the date of the interview. The top 3 morbidities reported by the cricketers across all the squads were cough and cold (27.5%) followed by headache (20.9%) and loss of appetite (15.4%)

- Thirty-seven percent of the cricketers (N=91) experienced no major injuries in the last 2 years. The top 3 injuries reported consisted of Ankle twist (11%) followed by finger/thumb injury (8.8%) and finger fracture (6.6%).

CONCLUSIONS OF PHASE 1

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 played at national and international level they did not have expected or desired nutritional status, haemoglobin levels and fitness levels.

PHASE 2

2A- SURVEY ON COMPOSITION OF COMMERCIALLY AVAILABLE PROTEIN SUPPLEMENTS AND SPORTS DRINKS

Protein supplements and sports drinks are commonly consumed by cricketers in general. Due to this reason, a market survey of commercially available protein supplements and sports drinks was conducted

METHODOLOGY- PROTEIN SUPPLEMENTS

The composition of the protein supplements was studied in terms of protein content, source and cost. For this, all (three) sports supplement stores in the city of Vadodara, Gujarat were identified. All protein

supplements from the websites of these stores were listed. Further, the detailed composition of these products was accessed from the official websites of the respective brands. Products that did not provide Nutrition Facts Panel were excluded from the study. In all, sixty products were surveyed.

RESULTS OF PHASE 2(A) - PROTEIN SUPPLEMENTS

- The 60 surveyed products belonged to 15 different brands and were in the form of Powder (83%), Bar (14%), and Beverage (4%). The supplements available in powder form have to be reconstituted into a beverage by adding to milk or water. The bars are supposed to be consumed one at a time and those in beverage form are ready-to-drink formulas.

- Overall, 92 percent of the items had protein contents within the IOC's recommended range of 20 to 50g 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 all the protein supplements was 5.5±2.6 and ranged between INR 1.7 to 13.9. Hydrolyzed whey protein isolate, milk protein isolate, soy protein isolate, and whey protein isolate made up the four most expensive protein sources in the products surveyed.

- 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 twenty percent 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) SURVEY ON THE COMPOSITION OF COMMERCIALLY AVAILABLE SPORTS DRINKS

Sports drinks are designed to deliver a balanced amount of carbohydrate and fluid to allow an athlete to simultaneously rehydrate, refuel and replace sodium losses during physical activity. (Begum et al, 2015)

METHODOLOGY- SPORTS DRINKS

The composition of sports drinks was studied in terms of carbohydrate and electrolyte content, ingredients used and cost. Three sports supplement stores in the city of Vadodara, Gujarat were purposively selected. All sports drinks from the websites of these stores were listed. Further, the detailed composition of these products was accessed from the official websites of the respective brands. Products that did not provide Nutrition Facts Panel were excluded from the study. In all, fifty products were surveyed.

RESULTS OF PHASE 2(A) - SPORTS DRINKS

- 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 supplements available in powder and tablet form have to be reconstituted into a beverage by adding to water.

- The majority of the products i.e. 67% fell in the ideal carbohydrate content range of 4-8g/100ml (American College of Sports Medicine et al. 2007; American Dietetic Association et al. 2009). (Sawka et al., 2007)(Rodriguez et al, 2009).

- The most commonly added carbohydrates to the sports drinks were Maltodextrin (56%), Glucose (48%), Fructose (38%), and Sucrose (18%). 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.(Sawka et al., 2007)(American College of Sports Medicine et al. 2007; American Dietetic Association et al. 2009).

- Ten percent of the products had caffeine which is no longer banned by The World Anti-Doping Agency. ("Sports Drinks," 2009).

- The average cost of sports drinks per serving was INR 66.5 (n=41) and the range varied widely from INR 9.3 to 186.

- 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.

CONCLUSIONS OF PHASE 2(A)

Ninety two percent 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.

PHASE 2 (B) DEVELOPMENT, SUPPLEMENTATION AND IMPACT EVALUATION OF A COCOA FLAVANOL RICH DRINK ON MUSCLE RECOVERY

The survey of Protein supplements and Sports drinks revealed that there was no Muscle Recovery drink available in the market. A muscle recovery drink was developed, standardized, and supplemented to study the impact to address this gap.

METHODOLOGY

Inclusion Criteria for supplementation

- Those who are not intolerant or allergic to any food ingredient in the supplement.
- Those who did not have abnormally high baseline Creatine Kinase levels

Exclusion criteria for supplementation

- Those who did not find the chocolate flavour acceptable.
- Those who had any gastrointestinal issues or any acute morbidity on the day of supplementation.

- Creatine Kinase (CK) was assessed in blood to determine the recovery status. Creatine kinase was analysed using enzymatic kit method, CK MB through Fujifilm dri chemistry analyser and CK MM by formula method.
- The CK total and MB and MM levels were assessed on day 1 after a resting phase of 10 days to capture the actual baseline values. This was assessed to rule out any muscle or cardiac abnormality.
- On day 2, all the participants had to perform a strenuous workout consisting of eccentric exercises which would naturally result in elevated CK total levels.
- Twenty-four hours post this workout; the blood was again assessed for CK total levels to capture the elevated levels post-workout.
- The participants were randomly divided into 2 groups the supplementation group which received 250 ml of the experimental drink and the placebo which received 250 ml of the Placebo drink.
- The intervention was carried out for 21 days during which the participants were provided the drinks on the ground itself and had to consume it within 30 minutes post-training.
- At the end of 21 days, the participants again performed the exact same workout consisting eccentric exercises as on day 2 and 24 hours later their blood was assessed to capture the post intervention CK total levels.
- The participants were given a list of foods having cocoa powder and asked not to consume any of those foods during the intervention period of 21 days so that it does not interfere with the results.

RESULTS OF PHASE 2 (B)

- The quantity of cocoa powder in the muscle recovery drink was fixed i.e. 10g that has 350 mg cocoa flavanols which is the suggested quantity based on literature to see a positive impact on muscle recovery. The quantity of sugar to be incorporated was arrived at using sensorial methods.

- 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.

- As the placebo did not have any cocoa powder, the calculated flavanol content was nil in it whereas the experimental drink had about 350 mg of cocoa flavanols.

- In the Women's squad (n=24), the supplementation could be successfully carried out for 21 days. From the Ranji boys' squad (n=20) the supplementation could be carried out only for 10 days due to the unexpected announcement of their match schedule during the intervention period. There were 6 drop outs from the Ranji squad and none from the women squad. Supplementation could not be carried out in the Under-23 boys' squad due to their prolonged match season and invitation matches even during the off-season.

- The mean baseline CK total value was within the reference limits for participants from both Ranji boys' and women's squads as per the ideal range of 82-1083 U/L for boys and 47-513 U/L for women. (Mougios, 2007). The mean CK-MB values were also within the normal range for all the squads according to the ideal range of 5 to 25 IU/L for all; women and boys. (Tsung & Savory, 1986)

- The pre 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. Reduction in the CK levels was observed in the Ranji boys' squad placebo group from 326.71 ± 195.37 U/L (Pre-intervention) to 211.00 ± 96.028 U/L (Post-intervention); 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).

- The rise in the post intervention CK levels in the Ranji boys' instead of the reduction cannot be explained due to two limitations. The first limitation was the reduction in the supplementation period from21 days10 days due to the unexpected announcement of their match schedule during the intervention period. Secondly, the participants used to pick up the drink and proceed for the ice bath as per their protocol therefore, monitoring of the drink consumption was not possible in the Ranji boys' squad. (Monitoring was possible in the women's squad as they don't have the protocol of ice bath)

- 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); but the reduction was statistically non-significant (p=0.108). In the women's squad experimental group, a reduction in the CK levels was observed 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).

CONCLUSION OF PHASE 2 (B)

The intervention with cocoa flavanol rich drink did not show an impact on muscle recovery post eccentric workout as assessed by CK levels.

PHASE-3-ASSESSMENT OF NUTRITION KNOWLEDGE OF CRICKETERS AND IMPACT EVALUATION OF INTERVENTION WITH A NUTRITION EDUCATION TOOL

METHODOLOGY

- The existing knowledge, practices and attitudes of athletes towards Sports Nutrition were assessed using a semi-structured questionnaire.
- The gaps in knowledge identified formed the basis for the development of the tool in the form of a booklet for intervention.
- The intervention was carried-out by distributing the booklet to the participants.
- Also, there was daily reinforcement of the key messages for 15 days after distributing the booklet sent on what's app group through the coaches.
- The impact evaluation was carried out after a washout period of two months. The same questionnaire was used at the baseline and for collecting post Nutrition education tool intervention responses. The data at baseline and post-intervention were collected using the interview method.

RESULTS OF PHASE 3

- The knowledge scores at baseline revealed that majority of the players across all the squads were in the FAIR category i.e. 41-50% score.

- About 89 to 100% of respondents indicated that nutrition support is critical in their sport. The primary argument given was that it increases strength and stamina. For individuals who stated that nutrition support is not necessary for their sport, the most frequently given reasons were that a healthy diet is too expensive and that only coaching and exercise increase performance.

- About 87 to 100% believed that a nutritionist should be a member of the sports professionals' team. A sports nutritionist's most well-recognised job was that of a person who could construct customised diet plans to help athletes improve their performance. Some respondents claimed that eating a healthy diet is unreasonably expensive; this highlights the need of having a sports nutritionist who can debunk such myths.

- Over 21% of the participants consumed solid foods within the recommended period of 30 minutes after the match. However, most of them (over 46.2%) had solid food within 30 minutes to an hour following the contest. These findings indicate a lack of awareness among the participants regarding the timing of solid foods.

- All the participants across all four squads were consuming some kind of supplement. Sports drinks were the most widely used segment of supplements (by 96% of the cricketers), followed by protein supplements (consumed by 44% of the respondents) and BCAA (taken by 3% of the participants).

- The majority (83.3%) of the participants across all squads reported that supplements were useful to them in their sport. Over 58.3 percent of the participants stated that they used supplements to increase their strength, making it the most common reason given.

- Only sports drinks were provided as supplements by the sports association during the competitive events. The participants procured other supplements from the strength and conditioning coaches of the association and at times from the gym trainers.

- Majority of the participants sought advice on supplements from the strength and conditioning coaches and physiotherapists while a very small percentage of participants talked to the coaches. None of them consulted a Sports Nutritionist or a Nutritionist for the supplement advice.

- In all the squads the post-intervention knowledge scores improved over the baseline pre-intervention scores ($p=0.000$). The components in which the participants were poor at baseline showed improvement post intervention. 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%.

CONCLUSION OF PHASE 3

- The majority of the cricketers (79%) were not consuming solid meals within the window of recovery post-match or exercise which is very crucial for an athlete and can negatively affect the next performance.
- The association to which the cricketers belonged did not have a Sports nutritionist but as high as 87 to 100% of the participants across all the squads felt the need to have one.
- 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.

RECOMMENDATIONS

The recommendations that emerge from the present study are essentially of two types

1. Action points for the Baroda Cricket Association

- 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 counselling 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..

2. 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.