

Impact of Carbohydrate Supplementation on Physical and Field Performance of High School Female *Kho-kho* Players

Renuka Meti, Apparao G. Bujurke¹ and G. Saraswathi

*Department of Studies in Food Science and Nutrition, Manasagangotri,
University of Mysore, Mysore, Karnataka, India*

E-mail: renekabujurke@rediffmail.com; g_saraswati@yahoo.com

¹ *Department of Sports, SDM Engineering and Technology College, Dharwad,
Karnataka, India*

E-mail: g_saraswati@yahoo.com

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ABSTRACT The present study was undertaken to study the impact of carbohydrate supplementation on physical and field performance of female high school *Kho-kho* players of Dharwad city, Karnataka, India. Players were divided into two groups as control and experimental. Both the groups were assessed for physical measurements, physical performance, nutrient intake before and during the supplementation. Experimental group supplemented with carbohydrate rich snack (Carbohydrate -72gm) three days before the final match. On the day of competition, experimental group received a carbohydrate (6.75%) electrolyte beverage before, during and after the competition. The physical performance results revealed significant improvement in the selected fitness tests like strength by 9.6 cm, agility by 1.2 sec, and endurance by 338 mts. There was significant improvement in the game performance. From the research findings it is evident that carbohydrate supplementation can be beneficial to activities like intermittent high intensity exercise similar to that of team sports.

INTRODUCTION

Nutritional factors can conceivably influence performance at almost any stage during training or competition. The importance of dietary carbohydrate before exercise or during competition is well established. Total body carbohydrate stores are limited and often less than the carbohydrate requirements of athletic training and competition. The availability of carbohydrate as a substrate for muscle metabolism is a critical factor in the performance of high intensity, intermittent work (Burke 2001). Muscle and liver glycogen levels are relatively small and are reduced during training and competitions (Brouns 1993; Murray and Horswill 1998). At higher exercise intensities carbohydrate is the most important fuel source (Brouns 1993). Maintaining good dietary supply of carbohydrate becomes increasingly important to exercising athletes (Jae-KO et al. 2010). Research has shown that athletes who eat a generous supply of dietary carbohydrate are better able to maintain their carbohydrate stores and maintain strenuous physical activity (Keith et al. 1989).

Kho kho is a many century old game in India. The word *kho* originated from Sanskrit verb 'syu' means getup-go. The word *kho* can be connected to yoga. It is modified form of run and chase. The game requires neither a big play-

ground nor any expensive playing equipment. Due to its simple form and less expensive nature, this game is much popular among the school children. A team shall consist of 12 players and only 9 take the field initially. Every team has to chase and defend twice in a match that consists of 2 innings. Sprinting, dodging, diving are a few skills needed for successful exhibition of the game.

Objectives

Sports nutrition in India is an emerging field, limited studies are available on sports nutrition and its impact on the performance level. Information regarding nutrition, nutrient intake, and impact of supplementation in relation to specific team games is not available. Hence the present study was undertaken to assess the impact of carbohydrate supplementation on physical and field performance on the performance of high school female *kho-kho* players.

MATERIAL AND METHODS

Selection of Subjects

The girls studying in ninth and tenth standard (14-15 years) were selected from schools

of Dharwad City. Twenty-four players, who were participating in *kho-kho* matches at school, inter-school and district levels were selected from schools. The selected subjects were divided in to two groups namely control group (12) and experimental group (12). The study was conducted between 2004-2008.

Assessment of Physical Characteristics

Anthropometric Measurements and Hemoglobin Estimation

The subjects were measured for their standing height by using Anthropometric rod and body weight by weighing scale. Mid- arm and chest circumferences were measured using fiber tape. All the measurements were carried out as per the guidelines of Jellife and Jellife (1966). Skin- fold measurements were obtained from two sites of the body, that is, triceps, biceps with the help of the standard skin fold calipers (Lange-Cambridge scientific industries Cambridge, Maryland USA). Lean body mass and percent body mass was estimated by predicted formulae (Deurenberg et al. 1991; Bose 1999).

Physical Performance by AAHPERD (American Alliance for Health, Physical Education, Recreation and Dance) Tests

AAHPERD physical fitness tests which measures speed, agility, strength, flexibility and endurance were conducted for *kho-kho* players as recommended by Clarke and Clarke (1976). Speed was measured using 50-mt dash. Agility was measured using 20-mt shuttle run with the help of stopwatches. The time taken is measured in seconds. Time was measured to the nearest of $1/10^{\text{th}}$ of a second by a hand held stopwatch. Strength was measured using vertical jump, which was measured using fiber tape. Flexibility was measured using forward bend test, which was measured using fiber tape in centimetres. Endurance was measured by 7 minutes walk or run, and the distance covered by the subjects was noted down in metres. All the above-mentioned tests were conducted before and after the supplementation programme. Subjects were given two practices before the beginning of the test.

Development of Snack and a Sport Drink for Supplementation

For the purpose of supplementation, a snack (*laddu*- Indian sweet preparation) and a drink was developed using underutilized foodstuffs like *Rajkeera* (*Amaranthus paniculatus*) (15g), refined flour (*Triticum aestivum*) (15g), Gardencress seed (*Lepidium sativum*) (5g), groundnuts (10g), jaggery (50g) and cooking oil (10g). Each serving of two *laddus* (103g) contained 72g of carbohydrate. A drink was developed using *kokum* (*Garcenia indica*), rice flakes (*Oryza sativa*), sugar and electrolyte. A drink supplied 6.75% of carbohydrate-electrolyte. Acceptability trials were carried out for the developed products.

Assessment of Nutrient Intake

Diet survey was carried out for seven-day actual intake was recorded before the event to measure their dietary intake and was converted in to nutrient intake as per the guidelines (Indian standard reference) given by (Thimmamma and Parvathi 1996), using the Recommended Dietary Allowances (RDA) given by (Sathyanarayana et al. 1985).

Conducting the Study

Carbohydrate Supplementation

Supplementation trials were followed by the recommendation by Wright et al. (1988). Experimental group received two *laddus* (Indian sweet preparation) for three consecutive days. Whereas control group did not receive any supplementation. On the day of competition experimental group received 5ml/per kg body weight (app 220-250ml) of sport drink (6.75% carbohydrate) before, during and after the events. Total two trials were conducted with a gap of fifteen days.

Impact Evaluation

1. **Physical Performance:** Physical performance was evaluated by AAHPERD tests.
2. **Field Performance:** The field performance of *Kho-kho* players was evaluated by a set of three coaches' experts in *kho-kho* game. The experts were briefed about the evalua-

tion of each individual player during the game. The experts were unaware of the control and experimental group and they evaluated the game specific skills like offensive, defensive, pole dive general performance, number of fouls and game performance. Each attribute was given maximum of 10 score.

- 3. Self-evaluation by Subjects:** A checklist was given to experimental group to evaluate the supplementation programme.

RESULTS AND DISCUSSION

Physical Characteristic of *Kho-kho* Players

It is evident from the Table 1 (Anthropometric and hemoglobin measurements of female *kho-kho* players) that the physical characteristics given were similar in both control and experimental group except in triceps and lean body mass and percent body fat. The selection of subjects for the study was done with the help of the physical education teachers, so criteria for selection was carried out on the basis of those subjects who play the game. Therefore subjects were not matched essentially in all the physical attributes.

Table 1: Anthropometric and hemoglobin measurements of female *kho-kho* players

Physical characteristics	Control (no=12)1	Ex1 (no=12)2
<i>Anthropometric Measurement</i>		
Height (cms)	151 ±2.9	150 ±5.8
Weight (kg)	48.8±4	41.4 ±9.8
BMI	21.0±1.2	18.3 ±4.2
Mid arm circumferences (cm)	23.2±1.7	23.4 ±2.9
Chest circumferences (cm)	74.0±6.1	76.0 ±9.3
Biceps (mm)	5.5±0.7	4.65 ±1.4
Triceps (mm)	10.1±0.5	9.4 ±1.5
Hemoglobin (gm%)	10.3±2.1	9.8 ±1.8
<i>Body Composition</i>		
Percentage body fat (%)	20.1±1.2	16.2 ±3.4
Fat mass (kg)	9.8±2.0	8.1 ±5.0
Fat free mass (kg)	38.8±2.4	33.2 ±6.9

Physical Performance of *Kho-kho* Players

The mean speed performance of *kho-kho* players between two groups was 8.9±1.8 and 8.18±0.55 for experimental and control group respectively. Strength performance was 23.25±8.2, 23.5±8.2, for control and experimental group. Agility performance of *kho-kho* players between both the groups was 11.2±0.6 and

11.0±0.5 respectively. Flexibility of *kho-kho* players was 3.8±1.0, 4.2±2.0. Mean endurance performance of control and experimental group was 951±150, 937±216 (Table 2) (Physical performance female *kho-kho* players). Both the groups exhibited similar performance in all the components.

Table 2: Physical performance female *kho-kho* players

Motor components	Control (n=12)1	Ex1 (n=12)2
Speed (sec)	8.2± 0.5	8.9± 1.8
Strength(cms)	23.2± 8.2	23.5± 8.2
Flexibility(cms)	3.8± 1.0	4.2± 2.0
Agility(sec)	11.2± 0.6	11.0± 0.5
Endurance(mts)	951 ±150	937 ±216

Table 3 (Impact of supplementation on nutrient intake of *kho-kho* players) shows the seven-day dietary intake, when compared two groups, there was significant difference (P<0.01) in the intake of all the nutrients namely, calories, protein, fat, carbohydrate, iron, and calcium. This result indicates that nutrition supplementation has improved the overall intake of foodstuffs and nutrient intake. It is note worthy to mention here that when compared the diet sheets of control and experimental group, experimental group selected foods rich in carbohydrates like roots and tubers, sago, more of cereals servings and fruits.

Performance

1. Physical Performance

Table 4 depicts impact of carbohydrate supplementation on physical performance of *kho-kho* players. From the table it is evident that there is no significant improvement in all the parameters of performance in the control group, whereas in carbohydrate-supplemented group except speed and flexibility performance other parameters showed significant improvement. Carbohydrate supplementation did not show any impact on speed and flexibility performance. This may be attributed that release of glucose in a single speed may not show any significant impact on speed performance. Flexibility as component of physical fitness is the ability to move the body and its parts through a wide range of motion without undue strain to the muscle attachments. Muscle size apparently has very

Table 3: Impact of supplementation on nutrient intake of kho-kho players

Nutrients	Kho-kho (1, 2, 3 rd day)		Kho-kho (4,5,6,7 th day)	
	Control	Experimental	Control	Experimental
Calories (Kcal)	1456±156	1963±185*	1572±119	2281±112*
Protein (g)	55± 6	55± 48	60± 2	61± 3*
Fat (g)	48± 5	50± 2*	50± 3	48± 2*
Carbohydrate (g)	201± 22	323± 38*	221± 16	401± 25*
Iron (mg)	11± 4	30± 4*	12± 3.5	39± 3*
Calcium (mg)	365±160	546±111*	390±125	675± 60*

*Significant at P<0.01 level

little influence on flexibility (Jones 1977). Thereby carbohydrate supplementation did not improve the flexibility performance. The performance of repeated strength before carbohydrate supplement was 23.5±8.2. After carbohydrate supplementation, the strength performance was improved by 33.1±6.8. There is significant improvement (P≤0.001) in strength performance after carbohydrate supplementation. Strength is recognized as the most important factor in the physical performance. Strength is very much dependent on body weight and muscular force. Lighter person is stronger per body kg than the heavier person (Johnson and Nelson 1986). The agility performance of *kho-kho* players after carbohydrate supplementation significantly improved (P<0.01). The agility component is ability to mobilize one's energy effectively in making single or repeated movements requiring a maximum expenditure of force (Clarke and Clarke 1976). The endurance performance of players was 937±216 after carbohydrate supplementation endurance performance significantly (P<0.001) improved by 1275±214. Endurance is the ability of a muscle to repeat movements against sub maximal resistance or pressure or to maintain a certain degree of tension over time. Thereby carbohydrate supplementation had an impact on the endurance performance. Similar results are also stated by other authors (John et

al. 2003; Costas et al. 2002). This present study result indicates that carbohydrate supplementation improves selected physical performance of team game players. Similar results were obtained by Khanna and Manna (2005) where they have concluded that carbohydrate replacement during exercise enhance performance of sports activities. Another study by Winnick et al.(2005) concluded that carbohydrate feedings during intermittent high intensity exercise similar to that of team games improve performance. They found out that carbohydrate feedings resulted in faster repeated 20-mt sprints, higher average jumps.

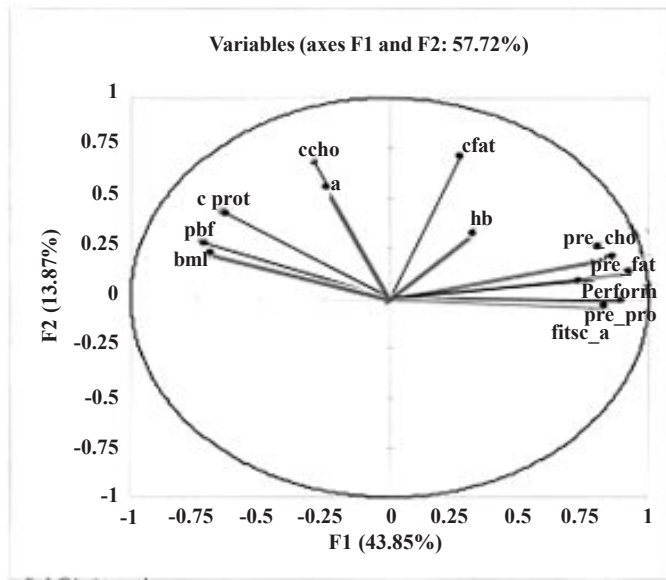
Field Performance

Table 5 depicts impact of carbohydrate supplementation on field performance of *kho-kho* players. Field performance was evaluated with the following game specific variables like, offensive, defensive, pole dive and number of fouls through out the game all these parameters was observed among control group than in experimental group. The experimental group scored better in all the game specific skills when compared to control group. Carbohydrate fed team won the match where in control team lost the game. The carbohydrate fed group significantly performed better than control group.

Table 4: Impact of carbohydrate supplementation on physical performance of kho-kho players

Variable	Control n=12			Experimental n=12		
	Before	After	T test	Before	After	T test
Speed (sec.)#	8.2± 0.5	8.7± 0.6	ns	8.9± 0.8	9.0± 0.8	Ns
Strength (cm)	23.2± 8.2	22 ± 8.1	ns	23.5± 8.2	33.1± 6.8	**
Flexibility (cm)	3.8± 1.0	3.7± 0.9	ns	4.2± 2.0	4.5± 1.8	Ns
Agility (sec.)#	11.2± 0.6	12.1± 0.4	ns	11.0± 0.5	9.8± 0.4	**
Endurance (mt)	951 ±150	951 ±200	ns	937 ±216	1275 ±214	**

#Lesser the value, better the performance ** significant at P<0.01 level



*xl Stat package

Fig. 1. Mapping of the variables in sports performance

1. Carbohydrate bi-carbohydrate intake before supplementation
2. Fitsc bi-physical fitness score before supplementation
3. Hb-hemoglobin before supplementation
4. Fat bi-fat intake before supplementation
5. Pro bi-protein intake before supplementation
6. pdf-percentage body fat
7. bmi-body mass index
8. per ai-performance after supplementation
9. precho ai-pre event carbohydrate intake after supplementation
10. prepro ai-pre event protein intake after supplementation
11. prefat ai-pre event fat intake after supplementation
12. fitsc ai-physical fitness score after supplementation

Table 5: Impact of carbohydrate supplementation on the field performance of kho-kho players

Variable	Control	Experimental	t test results
Offensive	4.5±1.4	6.3±1.0	**
Defensive	4.5±0.7	6.1±1.1	**
Pole dive	4.4±0.8	6.2±0.8	**
No. of fouls	13.0±2.0	6.0±1.2	**
Game performance	4.7±0.9	6.4±1.0	**

Note: Each attribute was given a maximum of 10 score. t test result = ** Significant at P<0.01 level.

Performance of Team Games: Associated Variables - Results of Discriminate Analysis (DA)

An attempt was made to understand the impact of various variables, which influenced the team games. Therefore the collected data points from experimental group (before and after supplementation) were entered in excel sheet (XL stat 2006 software) and analysis was carried out. The results of DA are presented in Figure 1 shows the loading of F₁ and F₂ (57.72%) variances. It is evident from the map, that the carbohydrate supplementation showed significant association on performance.

It is also interesting to note here that apart from carbohydrate, pre- competition protein, fat

intake and physical fitness status have also shown significant association on performance. Further studies have to be conducted to throw light upon on the impact of different variables on sports performance.

Self -Evaluation

Opinion from the participants Table 6 (opinion of the players regarding supplementation (%)) was collected to know the impact of supplementation program. And they also expressed that earlier; they never gave importance to food nutrients and their relation to performance. According to their view only training and practice are the two factors important for the sports. The present study suggests that the importance of principles of nutrition in sports should also be made to known to even high school athletes in order to improve their performance in future.

CONCLUSION

Based on the present study and its findings it is evident that the carbohydrate supplementation can be beneficial to activities like intermittent high intensity exercise similar to that of team sports. Carbohydrate supplementation helped the team game players to improve their

Table 6: Opinion of the players regarding supplementation (%)

Items	Kho-kho players
1. Performance was better	100
2. Grading	
1	47
2	33
3	20
3. Supplementation trials are good before the events	77
4. Beverage during competition improves performance	70
5. Good training	71

performance as revealed by their physical and field performance during the competition.

RECOMMENDATIONS

The study recommends to standardize techniques to evaluate sports performance in relation to nutrition and other environmental factors. The present study suggests that the importance of nutrition in sports should reach all sports personnel involved in team games and athletics in order to maximize their performance.

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