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PRE-EXERCISE ORS DRINK AND MUSCLE EFFICIENCY BY BICYCLE ERGOGRAPHY

Physiology

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ABSTRACT

Introduction: Dehydration, substrate and electrolyte depletion are the major problems seen during a prolonged bout of exercise. Administration of Oral Rehydration Solution (WHO) can be of great benefit to those involved in the exercise programs of longer duration as it contains water, carbohydrates and electrolytes which help to delay fatigue. Nutrition is found to play an important role that mediates skeletal muscle adaptations during exercise performance of an individual. Carbohydrates, electrolytes and water help to improve exercise performance. Aim of our study is to record the muscle efficiency parameters by performing exercise in bicycle ergometer till fatigue in male students by administering Oral Rehydration Solution (WHO) before the exercise session.

Materials And Methodology: This is a Cross Sectional study, performed in the research laboratory of the Department of Physiology, Coimbatore Medical College, Coimbatore. About 50 male adults performed cycling exercise in bicycle ergometer in seven sessions at 50,75 and 100-watts intensities, without and with ORS ingestion before the start of the cycling exercise. Parameters like energy expenditure, cycling duration and cycling distance and VO2max were recorded.

Results: The data collected from the selected subjects were recorded in a Master Chart. Using SPSS 22 version software, mean, standard deviations and 'p' values were calculated. Unpaired 't' test and ANOVA test was used for comparison of parameters. There was a significant relationship between the comparison of parameters without and with ORS ingestion before the onset of cycling exercise.

Conclusion: In the present study there is an increase in the muscle efficiency parameters, RPP, METs and VO2 max values following ORS ingestion and exercise by bicycle ergometry.

KEYWORDS

Muscle Efficiency, Calories, Exercise.

INTRODUCTION

Exercise can be defined as a planned, structural and repetitive physical activity. The final or the intermediate objective of doing exercise is to improve or maintain physical fitness.[1] Aerobic power is the maximum capacity of an individual's body to use oxygen while doing incremental exercise. This reflects the physical fitness of an individual. VO2max is considered as the single best indicator of cardiovascular fitness and maximal aerobic power. It is done by a graded exercise using a treadmill or a cycle ergometer in which the exercise intensity is increased in progression while measurements of ventilation and oxygen and carbon dioxide concentrations in the inhaled and exhaled air is done.[2]

There occurs a natural link between nutrition and exercise. The basic foundation for physical performance is proper nutrition. Nutrients provide energy and regulate physiological processes associated with exercise, although many believe that a well-balanced diet is sufficient for better exercise performance. As shown in many studies, nutrition is found to play an important role that mediates skeletal muscle adaptations during exercise performance of an individual. Carbohydrates and fats are the main substrates that power long lasting muscular contractions that are seen in endurance exercise. One of the reliable indicators of cardiorespiratory fitness of a person is considerably due to his aerobic capacity. Appropriate cardiorespiratory function effects can be produced by an exercise program done 3-5 times a week, for 20-60 minutes per session, at an intensity of about 50 - 85% of VO2 max.[3]

Dehydration, substrate and electrolyte depletion are the major problems seen during a prolonged bout of exercise. Hence, it becomes essential to restore these substances before exercise to build up the stores. Administration of Oral Rehydration Solution (WHO) can be of great benefit to those involved in the exercise programs of longer duration.

ORS contains water, carbohydrates in the form of glucose and electrolytes like sodium, potassium and chloride.[4] Based on this aim of our study is to record the muscle efficiency parameters by performing exercise in bicycle ergometer till fatigue in male adults by administering Oral Rehydration Solution (WHO) and to compare the Rate Pressure Product without and with ORS ingestion before exercise. Also, to compare the VO2 max values without and with ORS ingestion before exercise.

MATERIALS & METHODOLOGY

This study was done as a Cross Sectional study performed in the Research laboratory of the Department of Physiology, Coimbatore Medical College, Coimbatore for one year. About fifty male adult participants were recruited after obtaining consent to participate in the study. The ethical committee of the institute approval was obtained prior to the commencement of the study. Healthy males, aged 18 - 25 years were included in the study. While women, anaemic individuals, smokers, diabetes mellitus, hypertension. Those who are on drugs for any illness. Those who refused to consent for the study were excluded.

Proforma was used to obtain detailed history and to record the clinical examination findings. Subjects were given a pre - test questionnaire for assessing nutritional status, cardio respiratory profile. All physical parameters were recorded Subjects are requested not to take any nutritional supplements or ergogenic aids atleast for two weeks prior to the study. Subjects are also advised not to consume any of the supplements during the course of the study.

Subjects were evaluated in 6 sessions. In the first session, the subjects performed cycling exercise in bicycle ergometer without ingestion of ORS. They performed exercise at 50 watts power at 60 revolutions per minute, until they were able to maintain doing cycling at moderate range of Borg criteria, The subjects were asked to discontinue the exercise if they found any difficulty like dizziness, breathing difficulty or undue fatigue. The following parameters were also recorded. Energy expenditure(c), Total distance travelled (in km). Cycling duration (minutes) for which the subjects maintained in the moderate level of Modified Borg Criteria (110-130 beats per minute). The same thing was repeated in further sessions III and IV in 75 watts,, V and VI with 100 watts . In the last session, the subjects were asked to come for the recording of VO2max. The subjects underwent a 6 – minute cycling exercise, a sub-maximal test at 5 minutes to 6 minutes duration. Then the Astrand Ryhming Nomogram was used to plot the VO2max. The watts were plotted against the maximal heart rate at which the person can cycle to maximum limit and the VO2max value was obtained from graph.

All the data were collected and entry made in Microsoft excel sheet and statistical analysis was done using SPSS version 22. .Mean, standard deviations and 'p' values were calculated. Unpaired 't' test was used to compare the mean values of cycling parameters like cycling distance, duration and energy expenditure. From the basic parameters VO2max

was calculated and mean values were derived. Pearson's correlation coefficient was calculated. 'p' value less than 0.05 was considered to denote a significant relationship.

RESULTS

A total of 50 males were included in the study. The subjects served as their own controls. Among them 25 males had normal BMI and 21 subjects were overweight males and 4 were obese. The mean age among the study population was 21.58. The mean weight and height were 59.16 and 152.3 respectively. The mean BMI was 25.56. Of the total 50 subjects who had participated in the study, the mean age was 21.58. Their mean weight was 59.16 and mean height was 152.3. Their mean BMI was 25.56.

Table 1: Comparison Of Cycling Distance

Sessions	NORMAL		OVERWEIGHT		OBESE		p Value
	Mean	SD	Mean	SD	Mean	SD	
50 w without ORS	2.60	0.56	2.96	1.26	2.85	0.31	0.047*
50 w witht ORS	2.95	0.53	3.03	0.70	3.30	0.37	
75 w without ORS	2.52	0.49	2.61	0.55	2.7	0.25	0.000*
75 w with ORS	2.67	0.45	2.82	0.48	2.87	0.33	
100 w without ORS	2.01	0.39	2.02	0.52	2.27	0.22	0.000*
100 w with ORS	2.35	0.45	2.24	0.46	2.5	0.21	

There was significant difference in cycling distance between 50 Watts session I(without ORS) and session II(with ORS). Hence the groups were comparable. There was significant difference in cycling distance between 75 Watts sessions III (without ORS) and session IV (with ORS) and 100 watts sessions V (without ORS) and session VI (with ORS).

Table 2: Comparison Of Energy Expenditure (In Calories)

Sessions	NORMAL		OVERWEIGHT		OBESE		p Value
	Mean	SD	Mean	SD	Mean	SD	
50 w without ORS	225.95	77.88	233.92	76.29	171.50	20.27	0.047*
50 w witht ORS	250.10	75.25	250.92	78.45	195.75	32.98	
75 w without ORS	221.90	71.71	227.04	66.23	182	29.08	0.001*
75 w with ORS	233.19	70.35	232.52	69.03	204	32.58	
100 w without ORS	186.19	51.05	185.16	48.6	151.50	26.71	0.000*
100 w with ORS	200.67	53.25	197.4	46.54	167.75	26.76	

There was significant difference in energy expenditure between 50 Watts sessions I (without ORS) and session II (with ORS). Hence the groups were comparable. Likewise, there was significant difference in energy expenditure between 75 watts sessions III (without ORS) and session IV (with ORS) and there was significant difference in energy expenditure between 100 watts sessions V(without ORS) and session VI (with ORS).

Table 3: Comparison Of Cycling Duration

Sessions	NORMAL		OVERWEIGHT		OBESE		p Value
	Mean	SD	Mean	SD	Mean	SD	
50 w without ORS	11.90	3.59	13.56	4.84	13.50	1.91	0.000*
50 w witht ORS	14.95	4.00	15.84	5.03	17.75	2.98	
75 w without ORS	13.62	3.59	13.96	3.92	15.75	2.98	0.000*
75 w with ORS	16.19	3.91	16.68	3.81	18.25	2.5	
100 w without ORS	11.10	3.53	11.20	2.82	12.25	2.5	0.000*
100 w with ORS	13.05	3.90	12.32	2.73	13.75	1.89	

There was significant difference in cycling duration between 50 Watts session I (without ORS) and session II (with ORS). Hence the groups were comparable. Similarly there was significant difference in cycling duration between 75 watts session III (without ORS) and session IV (with ORS) and 100 Watts session V (without ORS) and session VI (with ORS).

Table 4: Comparison Of Vo2 Max In Session Without ORS And With ORS.

Sessions	NORMAL		OVERWEIGH		OBESE		p Value
	Mean	SD	Mean	SD	Mean	SD	
Without ORS	2.25	0.21	2.16	0.46	2.17	0.17	0.000*
With ORS	2.52	0.23	2.46	0.20	2.40	0.08	

The mean VO2max values between the cycling sessions without and withORS was statistically significant with a p value <0.001.

DISCUSSION

The present study shows the relationship between the administration of oral rehydration solution and the improvement in muscle efficiency at different exercise intensities during cycling exercise on a bicycle ergometer. The energy expenditure, cycling duration and distance cycled have improved in the exercise session following ORS administration, then when exercise was done without any prior intake of ORS. The muscle efficiency has increased due to the delay in muscle fatigue thereby leading to an enhanced performance. This is due to the increased uptake of glucose by the muscles and storage as glycogen. This glycogen can be utilized during exercise, delaying the muscle fatigue. There is an increased level of glucose oxidation by the exercising muscles.

This study correlates well with the study by Preetesh Parakh et al[5] in male medical students who performed exercise on a bicycle ergometer in two sessions, each session separated by 1 week. In second session, subjects consumed a glucose drink 30 minutes before doing exercise. Work done was calculated and the time to fatigue, total distance travelled was noted in both the sessions. There was a significant difference in the time to fatigue with 12.09 ± 7.42 minutes, work done 6964.00 ± 4517.96 J, total distance travelled in the first session was 2.12 ± 1.54 km and in the second session with greater values than in the time to fatigue 7.09 ± 4.96 minutes, work done 4305.33 ± 3065.19 J, and total distance travelled was 3.55 ± 2.42 km in the first session with p values <0.001 which was highly significant. This study showed that performance is better and time to fatigue is delayed in exercise performed after ingestion of glucose drink[6].

Studies by Ricardo G. Fritzche et al investigated the role of water and carbohydrate ingestion when subjects did prolonged cycling on bicycle ergograph and Pmax was measured – maximal neuromuscular power of an individual. Eight endurance trained cyclists did cycling for 122 minutes at 62% VO2max. This study is in correlation with my study wherein ingestion of water and carbohydrates before the exercise period has proven to be of great benefit[7,8]. The mean values for VO2max during cycling without ORS administration among the normal group was 2.25 +/- 0.21 and in the cycling session with ORS administration was 2.52 +/- 0.23. This was found to be statistically significant with a p value < 0.01. This shows that there is an increase in the maximal oxygen uptake following cycling with ORS ingestion. The mean values for VO2max in the overweight group in session I (withoutORS) was 2.16 +/- 0.46 and in session II (with ORS) was 2.46 +/- 0.20. This was also statistically significant with a p value < 0.01. The mean values for VO2max In Obese Subjects Without Ors Was 2.17 +/- 0.17 And In Cycling session with ORS was 2.40 +/- 0.08. This was found to be statistically significant with p value < 0.01. The increase in the VO2max values following ORS ingestion is due to the increase in

the oxygen consumption by the exercising muscles, while performing the six minute submaximal cycling exercise protocol.

This study correlates with the study by Tarnopolsky, M.A., et al which had shown that the subjects were able to cycle 55% longer at 85% VO2max when they ingested carbohydrate protein supplements during recovery from an earlier bout when compared with a sports drink with carbohydrate alone. The subjects in the former group had 26% more functional muscle glycogen compared with the latter carbohydrate only group [9].

Studies by Mona Kharbanda et al, correlated well with the present study, wherein Physical activity Rating scale and VO2max was used to assess the physical fitness of medical students who did short term, limited duration exercise on bicycle ergograph. There was a positive correlation between physical fitness score and normal BMI value. The study also showed that aerobic capacity of an individual improves with training[3].

Based on this description of the habitual physical activity of the subject, a subjective evaluation of his fitness level was made and initial work loads of 150W, 100W and 75W at 50 pedal revolutions per minute were used for well-trained, moderately trained, and untrained subjects, respectively. The predicted VO2 max was read from the nomogram (I. Astrand, 1960). In the present study, the values of VO2max without and with prior administration of ORS was 2.25 L/min and 2.52 L/min respectively [10,11].

CONCLUSION

These inferences show that when a person is well hydrated and sufficiently supplied with carbohydrates and electrolytes prior to the exercise, there occurs an increase in muscle efficiency as can be seen in the statistically significant values of cycling duration, cycling distance and energy expenditure. The VO_2max values showed an increase following ORS ingestion prior to cycling. This shows that there is an increase in the aerobic capacity, and that is there is an increased oxygen uptake due to increased work efficiency by the exercising muscles. All these findings reflect an increased glucose and electrolytes uptake by the muscles due to ingestion of oral rehydration solution prior to cycling exercise. There also occurs an improved glucose oxidation by the exercising muscles. The fluid ingested along with carbohydrates and electrolytes help to prevent dehydration and thus delays the muscle fatigue.

Therefore, ORS proves to be a good supplementation of water, electrolytes and carbohydrates which had caused a delay in muscle fatigue, thereby increasing the muscle efficiency. Also, ORS can be freshly prepared and it is also free from preservatives unlike other commercial sports drinks. It is a cost effective way of replenishing water , carbohydrate and electrolytes prior to the exercise.

REFERENCES:

1. Michael N. Sawka, Facsm (Chair); Louise M. Burke, Facsm, E. Randy Eichner, Facsm, Ronald J. Maughan, Facsm, Scott J. Montain, Facsm, Nina S. Stachenfeld, Facsm Exercise And Fluid Replacement, Medicine & Science In Sports & Exercise2007;377-390
2. Convertino, Victor A. et al Position Stand, Exercise and Fluid Replacement. Medicine & Science in Sports & Exercise; October 1996; 28(10):1-9
3. Kiapidou IS, Velogianni L, Stergiou N, Boland A. Herodicus, the father of sports medicine.Georgoulis AD, Knee Surg Sports Traumatol Arthrosc. 2007 Mar;15(3):315-8.
4. Michael N Sawka And Scott J Montain, Fluid And Electrolyte Supplementation For Exercise Heat Stress1, Am J Clin Nutr 2000;72(Suppl):564S–72S.
5. Preetesh Parakh, Anitha K, Manjunath H, Pre-exercise glucose drink and muscle performance by bicycle ergography, International Journal of Medical Science and Public Health 2016 ; 5 (05):1-3
6. Audrey L. Hicks,1 Jane Kent-Braun,2 and David S. Ditor1, Sex Differences in Human Skeletal Muscle Fatigue. Exercise and Sport Sciences Reviews. 2001;29(3):109–112.
7. Engel D, Kramer M, Malafi T, Salomon M, Lesher L. Effect of effort and social modeling on drinking in humans ,Appetite. 1996;26:129Y138.
8. Fitts, R.H., and J.M. Metzger. Mechanisms of muscular fatigue. In Principles of Exercise Biochemistry, J.R. Poortmans (Ed.), Basel, Switzerland: Karger, 1993,38(2): 248-268)
9. Miller, A.E.J., J.D. MacDougall, M.A. Tarnopolsky, and D.G. Sale. Gender differences in strength and muscle fibre characteristics. Eur. J. Appl. Physiol;1993;66:254 –262
10. John.M. Berardi, Thomas B. Price, Eric E. Noreen, And Peter W. R. Lemon, post exercise Muscle Glycogen Recovery Enhanced With A Carbohydrate–Protein Supplement, Medicine & Science In Sports & Exercise,Nov 2005;1106-1113.
11. Enoka, R.M., and D.G. Stuart. Neurobiology of muscle fatigue. J. Appl. Physiol;1992: 72(5):1631-1648