Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/14589
DOI URL: http://dx.doi.org/10.21474/IJAR01/14589

RESEARCH ARTICLE

INFLUENCE OF 50 METER DRILL OF DIFFERENT INTENSITY TRAINING ON ANAEROBIC CAPACITY OF MALEKHO-KHO PLAYERS

Dr. Kallol Chatterjee[1] and Dr. Mrinal Das[2]

1. Assistant Professor, Department of Physical Education & Sport Science, Visva-Bharati, Santiniketan, India.
2. Assistant Teacher in Physical Education, Burda High School, Baghmundi, Purulia, India.

Manuscript Info

Manuscript History
Received: 25 February 2022
Final Accepted: 27 March 2022
Published: April 2022

Key words:-
Interval Training, Indigenous Game, Performance

Abstract

Purpose: Aim of the study was to investigate the influence of 50 meter drill of different intensity training on anaerobic capacity of male Kho-Kho players.

Method: Pre test - Post test Purposive Design was used by which total thirty two (N=32) male Kho-Kho players (Age: 17.66 + 1.34 years, BMI: 20.04 + 1.36 kg/m^2, Resting Heart Rate: 74.44 + 1.44 beats/min., Training Age: 3.78 + 0.75 years) were purposively selected and assigned into four equal groups: HIITG (n=8), MIITG (n=8), CHMIITG (n=8) and ACG (n=8). Anaerobic Capacity (Unit: Watts) was assessed by Running Based Anaerobic Sprint Test (RAST) before and after the completion of eight weeks 50 meters drill of different intensity interval training. Data analysis methods were descriptive statistics: Mean, Standard Deviation and Standard Error, inferential statistics: 2-tailed One-Way ANCOVA with Bonferroni Post-Hoc test and normality test: Shapiro-Wilk test respectively performed on IBM SPSS software (Version: 25). The alpha (α) level was set at $p \leq 0.05$ for significance, whereas the effect size was reported with the 95% confidence for all analyzed measures.

Result: The results shown that there was significant ($p<0.05$) increases in anaerobic capacity (Power in Watts) for each experimental groups (EG) in comparison to active control group (ACG).

Conclusion: The present results indicate that eight (8) weeks 50 meter drill of different intensity interval training showed an increase in anaerobic capacity of senior state level male Kho-Kho players. Not only HIIT is better and beneficial than MIIT, but also CHMIIT too is better and beneficial than MIIT.

Introduction:-

Among the indigenous games and sports of India, Kho-Kho ranks as one of the most popular traditional sports in India and in Asia Subcontinent too. The origin of Kho-Kho is difficult to trace, but many historians believe that it is a modified form of 'Run Chase', which in its simplest form involves chasing and touching a person. However, like all other games and sports it demands almost all physical fitness components, such as aerobic capacity, anaerobic capacity agility, strength, speed, stamina, reaction ability, perception ability and a certain amount of ability: such as dodging, feinting and bursts of controlled speed make this game quite thrilling than others. In the ancient times

Corresponding Author:- Dr. Mrinal Das
Address:- Assistant Teacher in Physical Education, Burda High School, Baghmundi, Purulia, India.

Kho-Kho was a recognized sport even earlier to the oldest mythological writings of classics 'Mahabharata'. One of the main points of a successful animal life is 'Active Chase' which is a fundamental principle of this game, synonymous with the phrase 'Game of Chase' (History, Origin and Development of Kho Kho, n.d.).

Intensity is nothing but it is a function of neuromuscular activation. The assessment of intensity is specific to the exercise and the sports. A sports person works at which intensity to be quantified on many ways. Such as (a) Maximum Heart Rate, (b) Based on Primary Energy System engaged during activity and (c) As a Percentage of Best Performance of the athlete etc. Then, the best performance would represent a maximum intensity. The intensity can be classified into six intensity zone, like Super-maximal (>100), Maximal (90-100), Heavy (80-90), Medium (70-80), Low (50-70) and Very Low (<50). (Bompa & Haff, 2009a)Interval training deals with low to high intensity activities where rest period or recovery time is provided between two repetitions. Generally Interval training consists of increasing intensity workouts (low to high) that are interspersed by periods of rest (MacInnis & Gibala, 2017)'("Interval Training," 2019)

High-intensity interval training (HIIT) is a time-efficient way to induce similar adaptations, such as increased maximal mitochondrial enzyme activity (Burgomaster et al., 2005) and a reduction in glycogen utilization and lactate accumulation. (Harmer et al., 2000)' (Burgomaster et al., 2006) In addition, HIIT may be more effective than conventional endurance training at improving muscle buffering capacity.(Weston et al., 1997)' (Edge et al., 2006) HIIT consists of repeated bouts of short to moderate duration exercise completed at intensities greater than the anaerobic threshold, interspersed with brief periods of low-intensity or passive rest. (Chittibabu, 2014)

On the other hand anaerobic capacity can be defined as the maximal amount of adenosine tri-phosphate re-synthesized via anaerobic metabolism (by the whole organism) during a specific mode of short-duration maximal exercise (Green & Dawson, 1993) . Several studies showed positive result on anaerobic capacity to HIIT, namely Barker A.R. et al. (2014), Chittibabu B. (2014),Foster C. et al. (2015), Jabbour J. et al. (2015), Tabata I. et al. (1996). Performance in Kho-Kho is also dependent on specific physical traits and quality like any other sports discipline, these traits and parameters considered determinant of performance. The researcher based on preliminary research reviews conceptualized to take up investigation on the influence of 50 meter drill of different intensity training on anaerobic capacity of male Kho-Kho players.

Aim of the Study:-

Aim of the study was to investigate the influence of 50 meter drill of different intensity training on anaerobic capacity of male Kho-Kho players.

Methods:-

Design of the Study

Pre test - Post test Purposive Design was developed by which the Kho-Kho players were selected as subjects with equal distribution into four groups, namely High Intensity Interval Training Group (HIITG), Moderate Intensity Interval Training Group (MIITG), Combination of High & Moderate Intensity Interval Training Group (CHMIITG) and Active Control Group (ACG). The experimental groups were trained with separate training in afternoon session from 4.45 pm to 6.00 pm for a period of eight weeks (56 days) in three alternate days per week. The training was used to start in the same time, same ground and by the same trainers throughout the eight weeks.

Participants

Initially, forty (40) Male Kho-Kho players with 16-20 years old participated in Senior State Level competition were taken from Siliguri Mahakuma Kho-Kho Association of West Bengal State, India. Through the administration of a 50 mts sprint test, they were arranged in descending order on the basis of their best performance. Finally, middle 32 players (n=32) were purposively selected as subjects in order to minimize the initial mean differences among four groups and to make the groups homogeneous in nature. All the participants were informed about the procedures and risks of the study and signed an informed consent.

The average age, height and weight of all the participants were 17.66 + 1.34 years, 145.59 + 5.88 cm and 42.63 + 2.45 kg respectively, whereas the minimum and maximum age, height and weight were 16 and 20 years, 135 and 157 cm and 39 and 48 kg. On the other hand the average training age, BMI and Resting Heart Rate were 3.78 + 0.75 years, 20.04 + 1.36 kg/m^2 and 74.44 + 1.44 beats/min. respectively, whereas the

minimum and maximum training age, BMI and Resting Heart Rate were 3 and 5 years, 17.10 and 22.80 kg/m^2 and 71 and 78 beats/min. respectively. The characteristics of the participants have been given below in table no. 01.

Table 1:- Demographic Status of the Participants.

	Mean + SD	Minimum	Maximum
Age (years)	17.66 + 1.34	16	20
Height (cm)	145.59 + 5.88	135	157
Weight (kg)	42.63 + 2.45	39	48
Training Age (years)	3.78 + 0.75	3	5
BMI (kg/m^2)	20.04 + 1.36	17.10	22.80
Resting HR (beats/min.)	74.44 + 1.44	71	78
SD: Standard Deviation, Kg: Kilogram, CM: Centimeter, BMI: Body Mass Index			

Training Protocol

For the experimental groups (HIITG, MIITG & CHMIITG), three separate types of training protocol were prepared which were given by 50 meters drill of different intensity internal training. There were three parts of each training protocol: Warm-Up Part, Developmental Part and Cooling Down Part conducted. Whereas the control group was not given any training, this group was involved with only warming-up part. Detail of the training protocol has been given in table no. 02.

Table 2:- Training Protocol to Develop Anaerobic Capacity through 50Mts Drill.

1.Warm-Up Part	**2. Developmental Part, Group: HIITG, Duration: 6.40 Min., (Duration has been changed after every two weeks)**					**3. Cooling Down Part**
Duration: 25 Min.	Week	Intensity	Workout: Interval Duration (Sec.)	Duration (Sec.)	Repetition	Duration: 25-30 Min.
	1 - 2	90%	1:5	8:40	8	
	3 - 4	90%	1:4	8:32	8	
	5 - 6	90%	1:3	8:24	8	
	7 - 8	90%	1:2	8:16	8	
1.Warm-Up Part	**2. Developmental Part, Group: MIITG, Duration: 8 Min., (Duration has been changed after every two weeks)**					**3. Cooling Down Part**
Duration: 25 Min.	Week	Intensity	Workout: Interval Duration (Sec.)	Duration (Sec.)	Repetition	Duration: 25-30 Min.
	1 - 2	70%	1:5	10:50	8	
	3 - 4	70%	1:4	10:40	8	
	5 - 6	70%	1:3	10:30	8	
	7 - 8	70%	1:2	10:20	8	
1.Warm-Up Part	**2. Developmental Part, Group: CHMIITG, Duration: 7.12 Min., (Duration has been changed after every two weeks)**					**3. Cooling Down Part**
Duration: 25 Min.	Week	Intensity	Workout: Interval Duration (Sec.)	Duration (Sec.)	Repetition	Duration: 25-30 Min.
	1 - 2	70% + 90%	1:5	10:50 + 8:40	8	
	3 - 4	70% + 90%	1:4	10:40 + 8:32	8	
	5 - 6	70% + 90%	1:3	10:30 + 8:24	8	
	7 - 8	70% + 90%	1:2	10:20 + 8:16	8	

Assessments

For the collection of data the selected dependent variable: Anaerobic Capacity was assessed by Running Based Anaerobic Sprint Test (RAST) (Running-Based Anaerobic Sprint Test - RAST, n.d.)before and after the completion of eight weeks 50 meter drill of different intensity interval training. The anaerobic capacity has been expressed as power and unit of power is watts. ("Running-Based Anaerobic Sprint Test (RAST)," 2016)

Statistical Analysis

In order to test the homogeneity of the groups and Normality of the Data Levene's Test of Equality and Shapiro-Wilk Test were applied. In table no. 03 P-value of Pre-Test and Post-Test Data were .066 and .339 ($p>0.05$). That's mean the data are approximately following normal distribution. Data analysis methods were descriptive statistics: Mean, Standard Deviation and Standard Error), inferential statistics: 2-tailed One-Way ANCOVA(Verma, 2009)and normality test: Shapiro-Wilk test respectively performed to find out the influence of eight weeks 50 meter drill of different intensity interval training on anaerobic efficiency. Whenever a significant difference was found (Med, n.d.)in ANCOVA, a Bonferroni Post-Hoc Test was used in order to investigate the pair wise mean significant differences if any, among the three experimental groups and one control group. The alpha (α) level was set at $p\leq0.05$ for significance, whereas the effect size was reported with the 95% confidence for all analyzed measures. Lastly, all statistical analyses were performed on IBM SPSS software (Version: 25) (SPSS Software - India | IBM, n.d.)

Table 3:- Test of Normality of Data on Anaerobic Capacity of Kho-Kho Players.

	Shapiro-Wilk Test	
	df	**P-value (Sig.)**
Pre-Test	32	**0.066***
Post-Test	32	**0.339***
***Not Significant at p≤0.05**		

Results:-

Table 4:- Descriptive StatisticsMean, SD & SEM of HIITG, MIITG, CHMIITG & CG in Pre Test & Post Test on Anaerobic Capacity of Kho-Kho Players.

Variable	Pre Test				Post Test	
Anaerobic Capacity (Expressed As Power) Unit: Watts	GROUP	N	MEAN ± SD	SEM	MEAN ± SD	SEM
	HIITG	8	1743.500 ± 224.873	113.170	2579.750 ± 340.929	134.849
	MIITG	8	1677.125 ± 293.570	113.170	2206.125 ± 298.805	134.849
	CHMIITG	8	1707.750 ± 336.870	113.170	2381.125 ± 445.869	134.849
	ACG	8	1672.500 ± 399.504	113.170	1684.625 ± 421.400	134.849
ABBREVIATIONS: N = Number of Subjects (32), SD = Standard Deviation, SEM = Standard Error Mean, HIITG = High Intensity Interval Training Group, MIITG = Moderate Intensity Interval Training Group, CHMIITG = Combination of High & Moderate Intensity Interval Training Group, ACG = Active Control Group						

From the table no.: 04 it was found that the pre test means and SD of HIITG, MIITG, CHMIITG and CG on anaerobic efficiency were 1743.500 ± 224.873, 1677.125 ± 293.570, 1707.750 ± 336.870 and 1672.500 ± 399.504 watts respectively, whereas, in case of post test means and SD were 2579.750 ± 340.929, 2206.125 ± 298.805, 2381.125 ± 445.869 and 1684.625 ± 421.400 watts. On the other hand, the standard error means in pre test were 113.170 watts i.e. same in respect of all groups, whereas in case of post test the standard error means were 134.849 watts i.e. also same in case of all groups. The Comparisons between pre-mean & post-mean and pre-SD & post-SD have been presented below in figure no. 03 and figure no. 04.

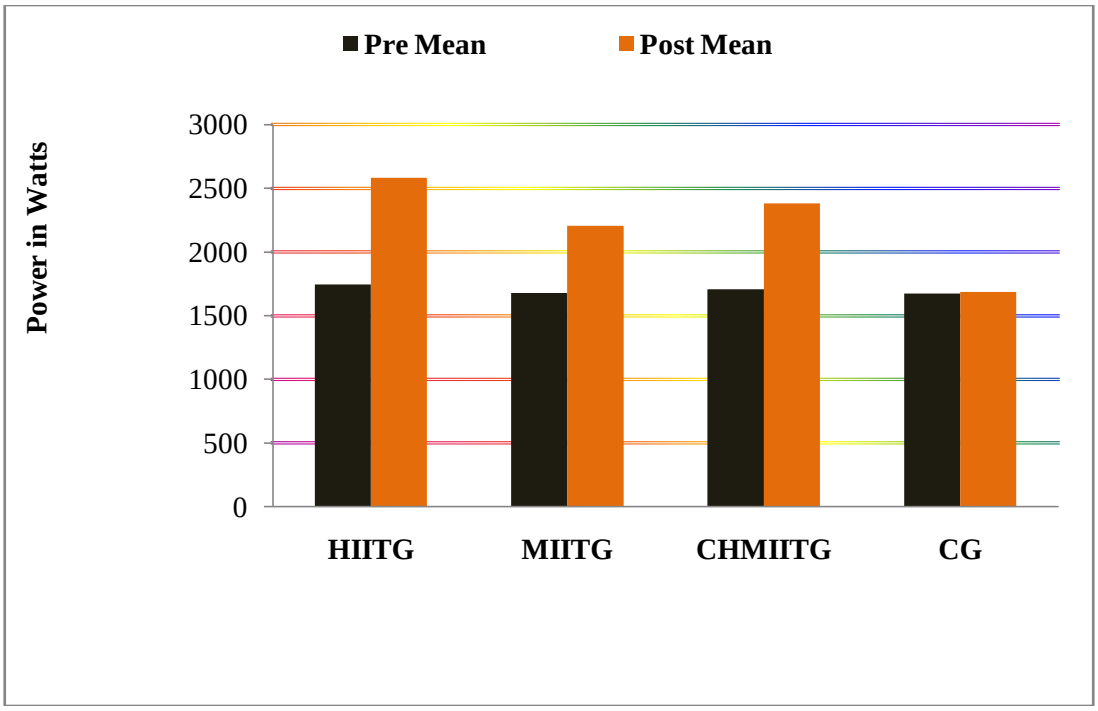

Fig. 1:- Comparison Between Pre-Mean.

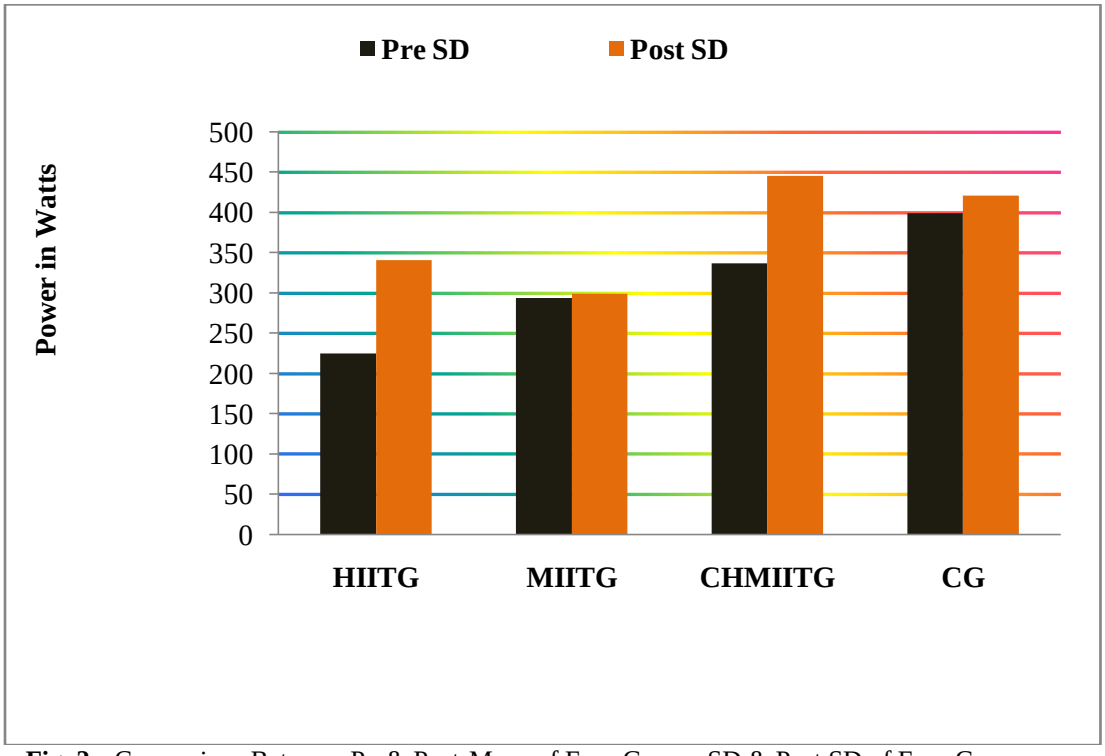

Fig. 2:- Comparison Between Pre& Post-Mean of Four Groups SD & Post SD of Four Groups.

Table 5:- One Way Analysis of Co-Variance (ANCOVA) Among Three Experimental Groups & One Control Group in Pre - Post Test on Anaerobic Capacity of Kho-Kho Players.

Variable			Sum of Squares	df	Mean Sum of Square	F- ratio	p-value (Sig.)
		A	25853.094	3	8617.698	.084	.968

Anaerobic Capacity (Expressed As Power) Unit: Watts	Pre Test	W	2868852.375	28	102459.013		
	Post Test	A	3535991.594	3	1178663.865	**8.102***	**.000***
		W	4073259.125	28	145473.540		
	Adjusted Post Test	A	3058275.081	3	1019425.027	**18.121***	**.000***
		W	1518950.769	27	56257.436		
***Significant at 0.05 level, $F_{0.05}$ (3, 28) = 2.95, $F_{0.05}$ (3, 27) = 2.96 or *p≤0.05** **ABBREVIATIONS: df = Degrees of Freedom, A = Among Mean Variance, W = Within Group Variance**							

From the ANCOVA table no.: 05, it was found that in pre test 'F'- value and P – value were 0.84 and 0.968 respectively, that's mean P-value (0.968) is greater than 0.05 level of significance (P>0.05) with 3/28 degrees of freedom. Therefore, it is clear that there is no significant difference among initial means of four groups in pre test phase in respect of anaerobic capacity.

However, in case of post test and adjusted post test mean, the 'F' - values were 8.102 and 18.121 respectively; whereas P - values were 0.000 and 0.000 respectively, which indicated that P-values (0.000 & 0.000) are less than 0.05 level of significance (P<0.05) with 3/28 and 3/27 degrees of freedom in both cases. So, it was clearly found that there was significant difference among three experimental groups (HIITG, MIITG, CHMIITG) and one control group (CG) in respect of anaerobic capacity.

Since, the statistically significant difference was found in post test and adjusted post test mean through analysis of co-variance (ANCOVA), therefore, Bonferroni Post-Hock test was computed for pair wise mean comparison which has been presented in table no.: 06

Table 6:- Bonferroni Post-Hoc Test Among HIITG, MIITG, CHMIITG & CG in Respect of Adjusted Post Test Means on Anaerobic Capacity of Kho-Kho Players.

Variable	Group				Mean Difference	p- value (Sig.)
	HIITG	MIITG	CHMIITG	ACG		
Anaerobic Capacity (Expressed As Power) Unit: Watts	2538.910	2227.916			310.994	0.087
	2538.910		2374.019		164.891	1.000
	2538.910			1710.780	828.130	**0.000***
		2227.916	2374.019		146.103	1.000
		2227.916		1710.780	517.136	**0.001***
			2374.019	1710.780	663.239	**0.000***
***Significant at 0.05 level, or *p≤0.05**						

From the table no.: 06 (Bonferroni Post-Hoc Test) it has been evident that there is significant difference of every experimental group (HIITG, MIITG, CHMIITG) in compare to active control group (ACG) in respect of adjusted final means on anaerobic capacity of Kho-Kho players. Because, the adjusted mean differences between HIITG & CG, MIITG & ACG and CHMIITG & ACG were 828.130, 517.136 and 663.239 watts respectively. Whereas P - values were 0.000, 0.001 and 0.000 which indicated that P-values (0.000, 0.001 & 0.000) are less than 0.05 level of significant (p<0.05) in all three paired groups.

Further it has been also found that there is no significant difference between HIITG & MIITG, HIITG & CHMIITG and MIITG & CHMIITG, but there is difference between these paired groups. Mean differences among them are 310.994, 164.891 and 146.103 watts whereas p-values are 0.087, 1.000 and 1.000 respectively, which indicated that P-values (0.087, 1.000 and 1.000) are greater than 0.05 level of significant (p>0.05) in all three paired groups.

Discussion of Findings:-

From literature we came to know that the energy needed for the performance of muscular activity may be supplied either anaerobically or aerobically. When the muscular activity is rapid and violent then the source of energy is through anaerobic mechanism.(Bayek, 2011)

The results showed that, there is significant effect of eight weeks 50 meter drill of different intensity interval training on the improvement of anaerobic capacity of all experimental groups (HIITG, MIITG & CHMIITG) in comparison

to active control group (ACG). The reason behind significant improvement may be the proper implementation of eight weeks 50 meter drill of different intensity interval training on experimental groups. The performance increased of the players due to the application of 50 meter drill is nothing but it is the physiological adaptations of the muscles and all body systems to the applied eight weeks 50 meter drill.

So, behind significant improvement on anaerobic efficiency, physiological adaptations and mechanical changes played a vital role. The improvement occurred on anaerobic capacity, it is due to the proper and scientific application of 50 meter drill of different intensity interval training. One of the most important principles of sports training is to increase training load slowly. When attempting to increase training load via alterations of volume and intensity. The strategies for altering the volume of training are:

1. Increase the velocity of movement over a given distance.
2. Increase the load.
3. Increase the power output of the training activity.
4. **Decrease the rest interval between repetitions or tactical drills.**
5. Increase the number of competitions in the training phase. (Bompa & Haff, 2009b)

So, in the present study the researcher considered training protocol abiding by Bompa training principles and increased training load slowly only by reducing the rest interval between repetitions after every two weeks respectively throughout the progression of training, but other things remained unchanged like intensity, volume, repetitions, duration of sessions etc. He maintained the ratio (Work : Rest Interval) between work and rest interval like: 1:5, 1:4, 1:3 and 1:2 for 1^{st} - 2^{nd} week, 3^{rd} - 4^{th} week, 5^{th} - 6^{th} week and 7^{th} - 8 week respectively and three different types of training protocol were administered. HIIT, MIIT and CHMIIT were administered through 50 meters drill with 90%, 70% and combination of 70% & 90% intensity of best performance of the subjects.

In the present study the researcher applied short and repeated bouts of intermittent high-intensity interval training through 50 meter drill. That's why the internal physiological adaptations and mechanical changes of the players happened.On the other hand especially intensity plays a great role and importance in improving and maintaining anaerobic capacity. Short bouts with high intensity used in sprints giving short recovery period between two repetitions significantly increase anaerobic capacity. That's why high intensity interval training can be acceptable for those sports which require anaerobic fitness. Kho-Kho is one of those types of game which also require anaerobic endurance throughout the match and which also involve interactions between aerobic and anaerobic metabolic system. (Bompa & Haff, 2009b)So, it can be stated that 50 meter drill of high intensity interval training has a great impact in improving anaerobic capacity of senior level male Kho-Kho players.

Applying Bonferroni Post-Hoc Test it was also evident that significant different existing between experimental groups and control group. It may be happened due to 50 meters drill of different intensity interval training. It has been already proved from the above literature that high intensity interval training is more effective and beneficial than moderate intensity interval training to increase anaerobic capacity. That's why the difference between HIITG and ACG is Maximum, between CHMIITG and ACG is second maximum and between MIITG and ACG is lowest. So HIITG secured first position, CHMIITG secured second position due to the application of both intensity training (High and Moderate Intensity) at a time. From the present study it has been again evident that not only HIIT is better and beneficial than MIIT, but also CHMIIT too is better and beneficial than MIIT.

In the present study eight weeks 50 meter drill of different intensity interval training was used. If the duration of the training is to be further extended for longer period than eight weeks, then the result may appear more effective and more beneficial. Specially, in case of anaerobic capacity there statistically significant difference among experimental groups may be happened, if duration of the training is to be extended for longer period of time instead of eight weeks training.

Mechanisms of Anaerobic Exercise:

Skeletal muscle adaptations following anaerobic training occur in both structure and function, with reported, changes encompassing increases in size, fiber type transitions, and enhanced biochemical and ultra structural components (i.e. muscle architecture, enzyme activity, and substrate concentrations). Collectively, these adaptations result in enhanced performance characteristics that include strength, power and muscular endurance, all of which are vital to athletic success. Muscle hypertrophy is the term given to the enlargement of muscle fiber cross-sectional area following training. Most notably, when ATP and Creatine Phosphate (CP) concentrations are repeatedly

exhausted following bouts of intermittent high-intensity muscular contraction, the storage capacity of these high energy compounds is increased via a 'super compensation' effect. (Bompa & Haff, 2009b)' (Gregory & Travis, 2015) MacDougall and colleagues (MacDougall et al., 1998) reported a 28% increase in resting CP and an 18% increase in ATP concentrations following five months of resistance training. Anaerobic training (Resistance, Sprint, Plyometric, Agility, and High Intensity Interval Training) in general elicits specific adaptations in the nervous system leading to greater recruitment, rate of firing, synchronization, and enhanced muscle function that enable increases in strength and power.

Anaerobic training also has positive effects on bone, muscle and the associated connective tissue; the entire musculoskeletal system undergoes a coordinated adaptation to exercise. (Bompa & Haff, 2009b)' (Gregory & Travis, 2015) High Intensity Exercise Endurance (HIEE) training tends to increase Type II muscle fiber content. (Dawson et al., 1998)Because Type II muscle fiber content is related to the maximal rate of force development (Korhonen et al., 2006)' (Effects of Power Training on Muscle Structure and Neuromuscular Performance - Kyröläinen - 2005 - Scandinavian Journal of Medicine & Science in Sports - Wiley Online Library, n.d.) maximal force generation capacity and the ability to generate peak pour outputs, (Suter et al., 1993) it is easy to conclude that HIEE may be more beneficial for sports that rely on these performance factors, especially if high-velocity or high power movements are performed repetitively. Several authors report that the use of high intensity intervals can significantly increase markers of both anaerobic and aerobic exercise endurance. (MacDougall et al., 1998)' (Rodas et al., 2000)' (Tabata et al., 1996)

Conclusions:-

It is concluded that eight (8) weeks 50 meter drill of different intensity interval training showed an increase in anaerobic capacity of senior state level male Kho-Kho players. According to the development of anaerobic capacity occurred of Kho-Kho players HIITG, CHMIITG and MIITG secured first, second and third position respectively. Another thing is that not only HIIT is better and beneficial than MIIT, but also CHMIIT too is better and beneficial than MIIT.

Conflicts of Interest

The authors of the present study declare that they have no conflicts of interest regarding the publication of this paper.

Financial Support

The authors have no funding to disclose.

Authors' Contributions

MD was responsible for study administration, contributed to the conceptualization, performed data collection, conducted statistical analysis, and drafted the manuscript; whereas KC contributed to the conceptualization, helped with the statistical analysis, revised the manuscript, discussed the content and contributed to the writing of the manuscript and supervised the study. All the authors have read the present study and approved the final version of the manuscript and thereafter agree with the order of presentation of the authors.

References:-

1. Barker, A. R., Day, J., Smith, A., Bond, B., & Williams, C. A. (2014). The influence of 2 weeks of low-volume high-intensity interval training on health outcomes in adolescent boys. Journal of Sports Sciences, 32(8), 757–765. https://doi.org/10.1080/02640414.2013.853132
2. Bayek, P. (2011). Aerobic anaerobic power and cellular body consumption of soccer players. University. http://shodhganga.inflibnet.ac.in:8080/jspui/handle/10603/103450
3. Bompa, T., & Haff, G. G. (2009a). Periodization-5th Edition: Theory and Methodology of Training (5 edition). Human Kinetics.
4. Bompa, T., & Haff, G. G. (2009b). Periodization: Theory and Methodology of Training (5th Revised edition edition). Human Kinetics Publishers.
5. Burgomaster, K. A., Heigenhauser, G. J., & Gibala, M. J. (2006). Effect of short-term sprint interval training on human skeletal muscle carbohydrate metabolism during exercise and time-trial performance. 100(6).
6. Burgomaster, K. A., Hughes, S. C., Heigenhauser, G. J., Bradwell, S. N., & Gibala, M. J. (2005). Six sessions of sprint interval training increases muscle oxidative potential and cycle endurance capacity in humans.

7. Chittibabu, B. (2014). Effect of High Intensity Interval Training on and Anaerobic Capacity and Fatigue Index of Male Handball Players. International Journal of Physical Education, Fitness and Sports, 3(4), 18–23. https://doi.org/10.26524/1443
8. Dawson, B., Fitzsimons, M., Green, S., Goodman, C., Carey, M., & Cole, K. (1998). Changes in performance, muscle metabolites, enzymes and fibre types after short sprint training. European Journal of Applied Physiology and Occupational Physiology, 78(2), 163–169. https://doi.org/10.1007/s004210050402
9. Edge, J., Bishop, D., & Goodman, C. (2006). The effects of training intensity on muscle buffer capacity in females. 96(1), 97–105.
10. Effects of power training on muscle structure and neuromuscular performance—Kyröläinen—2005—Scandinavian Journal of Medicine & Science in Sports—Wiley Online Library. (n.d.). Retrieved December 16, 2019, from https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1600-0838.2004.00390.x
11. Green, S., & Dawson, B. (1993). Measurement of anaerobic capacities in humans. Definitions, limitations and unsolved problems. Sports Medicine (Auckland, N.Z.), 15(5), 312–327. https://doi.org/10.2165/00007256-199315050-00003
12. Gregory, H., G., & Travis, T., N. (2015). Essentials of Strength Training and Conditioning 4th Edition. Human Kinetics.
13. Harmer, A. R., McKenna, M. J., Sutton, J. R., Snow, R. J., Ruell, P. A., Booth, J., Thompson, M. W., Mackay, N. A., Stathis, C. G., Crameri, R. M., Carey, M. F., & Eager, D. DM. (2000). Skeletal muscle metabolic and ionic adaptations during intense exercise following sprint training in humans. 85(5).
14. History, Origin and Development of Kho Kho. (n.d.). Retrieved December 2, 2019, from https://www.lookchup.com/read-blog/history-origin-and-development-of-kho-kho.html
15. Interval training. (2019). In Wikipedia. https://en.wikipedia.org/w/index.php?title=Interval_training&oldid=917607173
16. Korhonen, M. T., Cristea, A., Alén, M., Häkkinen, K., Sipilä, S., Mero, A., Viitasalo, J. T., Larsson, L., & Suominen, H. (2006). Aging, muscle fiber type, and contractile function in sprint-trained athletes. Journal of Applied Physiology, 101(3), 906–917. https://doi.org/10.1152/japplphysiol.00299.2006
17. MacDougall, J. D., Hicks, A. L., MacDonald, J. R., McKelvie, R. S., Green, H. J., & Smith, K. M. (1998). Muscle performance and enzymatic adaptations to sprint interval training. Journal of Applied Physiology (Bethesda, Md.: 1985), 84(6), 2138–2142. https://doi.org/10.1152/jappl.1998.84.6.2138
18. MacInnis, M. J., & Gibala, M. J. (2017). Physiological adaptations to interval training and the role of exercise intensity. The Journal of Physiology, 595(9), 2915–2930. https://doi.org/10.1113/JP273196
19. Med, J. S. S. &. (n.d.). Physical Demands of Ball Possession Games in Relation to the Most Demanding Passages of a Competitive Match. Retrieved April 22, 2020, from https://www.jssm.org/mob/mobresearchjssm-19-1.xml.xml
20. Rodas, G., Ventura, J. L., Cadefau, J. A., Cussó, R., & Parra, J. (2000). A short training programme for the rapid improvement of both aerobic and anaerobic metabolism. European Journal of Applied Physiology, 82(5–6), 480–486. https://doi.org/10.1007/s004210000223
21. Running-Based Anaerobic Sprint Test (RAST). (2016, January 26). Science for Sport. https://www.scienceforsport.com/running-based-anaerobic-sprint-test-rast/
22. Running-based Anaerobic Sprint Test—RAST. (n.d.). Retrieved April 22, 2020, from https://www.brianmac.co.uk/rast.htm
23. SPSS Software—India | IBM. (n.d.). Retrieved April 22, 2020, from https://www.ibm.com/in-en/analytics/spss-statistics-software
24. Suter, E., Herzog, W., Sokolosky, J., Wiley, J. P., & Macintosh, B. R. (1993). Muscle fiber type distribution as estimated by Cybex testing and by muscle biopsy. Medicine and Science in Sports and Exercise, 25(3), 363–370.
25. Tabata, I., Nishimura, K., Kouzaki, M., Hirai, Y., Ogita, F., Miyachi, M., & Yamamoto, K. (1996). Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO2max. Medicine and Science in Sports and Exercise, 28(10), 1327–1330. https://doi.org/10.1097/00005768-199610000-00018
26. Verma, J. P. (2009). A TEXT BOOK ON SPORTS STATISTICS. Sports Publication 7/26.
27. Weston, A. R., Myburgh, K. H., Lindsay, F. H., Dennis, S. C., Noakes, T. D., & Hawley, J. A. (1997). Skeletal muscle buffering capacity and endurance performance after highintensity interval training by welltrained cyclists.: Vol. 75 (1).