REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 24, No.2 (2023)
http://www.veterinaria.org
Article Received: Revised: Published:

A Yogic Intervention of Six Weeks on Physical and Physiological Parameters of Hockey Player

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Abstract: The objective of the study was to examine the effect of six weeks of yogic training on the physical and physiological performance of hockey players. Twenty state-level hockey players, aged 15 to 18, were selected for the study. The selected physical variables were back strength (measured by back dynamometer), muscular endurance, and flexibility (measured by sit and reach box). The physiological variables were VO2 max (measured by the Cooper 12-minute run and walk test) and resting heart rate. These variables were tested before and after six weeks of yogic training. Analysis of covariance (ANCOVA) was used to compare the experimental and control groups at a 0.05 level of significance. The results showed a significant difference between the experimental and control groups in back strength, flexibility, muscular endurance, VO2 max, and resting heart rate.

Key Words: Yogic training, physiological biomarkers, VO2 max, Isometric strength training, core stability.

INTRODUCTION

Hockey is an intermittent team sport that places significant strain on both the aerobic and anaerobic systems, necessitating robust aerobic endurance to withstand frequent intense activity. Endurance is a key component of hockey fitness, while strength is essential for quick acceleration and directional changes. Upper body strength enables players to shoot more effectively, cover greater distances, and lower body strength is crucial for explosive power.

Yoga is primarily a spiritual discipline that focuses on achieving harmony between the mind and body. It emphasizes maintaining a balance between physical and mental well-being. Yoga postures, or asanas, help in stretching and toning muscles, joints, the spine, and the skeletal system.

Previous studies have shown improved psychological, physical (strength, mobility), and physiological aspects such as internal organs, glands, and nerves through yoga practice (Lohan, 2021; Polsgrove et al., 2016; Suwindia & Muliarta, 2023; Vaidya et al., 2021).Additionally, individuals who engage in yoga exhibit better control over autonomic functions like temperature, heart rate, and blood pressure. Therefore, this study aimed to explore the impact of yoga interventions on the physiological and physical aspects of hockey players.

METHOD: Participants:Thirty male hockey players (aged 15±3 years) from Sangay Lhaden Sports Academy, Chimpu, Arunachal Pradesh, India, were randomly selected for the study from those representing the state team. A purposive sampling technique was employed, and participants were divided into control and experimental groups through randomization. Health assessments were conducted using PAR-Q+ (Warburton et al., 2011), and consent forms were collected prior to the study, adhering to the Helsinki Declaration guidelines ("World Medical Association Declaration of Helsinki," 2013).

Research Design:The study followed a single-blind randomized control trial design with two groups: a control group and an experimental group. Both groups underwent regular training, but the experimental group received additional yogic training for six weeks. Pretest data was collected to establish baseline assessments.

Procedure: Participants were given a demonstration before tests, which included measuring lower back strength using a leg dynamometer, flexibility assessment with a sit and reach test, muscle endurance evaluation of abdominal& hip flexors through a sit-up test, VO2 max estimation with a 12-minute run-walk test, and resting heart rate measurement through carotid artery palpation.

Lower back strength (LLB): Lower back strength (LLB) was assessed using a digital leg dynamometer (kg) to measure participants' lower back strength. Before measurement, the researcher ensured the dynamometer's dial was set to zero for accuracy. Participants were instructed to stand upright in a half squat position on the dynamometer's base, with feet shoulder-width apart and arms hanging parallel with palms facing inward. The chain was adjusted to bend the knees at

approximately 110 degrees. Participants were directed to steadily pull against the weight without jerky movements, ensuring their feet remained flat. (Note; Maximum performance was achieved when legs were nearly straight at the end of the lift).The dynamometer displayed a score (kg) recorded for each participant.

Pic1: A participant performing lower back strength test on the leg dynamometer

Flexibility: A standard sit and reach test was used to measure the flexibility of the lower back muscles (Wells & Dillon, 1952).Participants sat on the floor with legs extended, shoes removed, and the soles of their feet flat against the test box. With palms down and hands parallel, they reached forward maximally without bending their knees, holding the position for at least two seconds. The score was recorded in centimetres or half inches.

Muscle Endurance of Abdominal & Hip Flexors: A sit-up test measured the muscular endurance of the abdominal muscles and hip flexors. Participants started in an upright sitting position with knees bent, feet flat on the floor, and arms crossed over the chest. They had 60 seconds to complete as many correct repetitions as possible, lowering their back until the shoulder blades touched the floor and then returning to the upright position. Scores were recorded as repetitions per minute.

VO2 Max: The Cooper 12-minute run-walk test assessed aerobic endurance and estimated VO2 max (ml/kg/min)(Cooper, 1968). Participants aimed to cover the maximum distance in 12 minutes. An assistant informed them of the remaining time at the end of each 400-meter lap. After 12 minutes, the assistant whistled to stop and recorded the distance covered to the nearest 10 meters. VO2 max was calculated using the formula: (Distance in meters - 504.9) ÷ 44.73.

(**Pic 2**: Demonstration of cooper 12-minute run walk test)

Resting Heart Rate: The resting heart rate was measured using the carotid artery palpation method. Counts were taken for 15 seconds using the index and middle fingers and then multiplied by 4 (15×4=60) to determine the beats per minute. This measurement was taken early in the morning, shortly after waking up.

Statistical Technique: Descriptive statistics (mean ± standard deviation) were computed to determine the nature of the variables. Group differences were examined using analysis of covariance (ANCOVA). The least significant difference (LSD) method was used for pairwise comparisons. All statistical analyses were conducted using IBM SPSS Statistics version 21, with a significance level set at 0.05.

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Training Protocol: The experimental group participated in a five-day-a-week training session, consisting of 30 minutes of yogic training per day, for six weeks (see Appendix A, Table 1 for details).

Results:

Table No: 1 Descriptive Statistic of Experimental and Control Group

Variables	GROUP	Mean	Std. Deviation	N
LBS	Experimental Group	113.81	26.83	10
	Control Group	101.38	28.47	10
	Total	107.59	27.67	20
Flexibility	Experimental Group	35	5.86	10
	Control Group	29.8	4.15	10
	Total	32.4	5.62	20
MEAHF	Experimental Group	34.5	4.88	10
	Control Group	32.2	5.2	10
	Total	33.35	5.05	20
Vo2 Max	Experimental Group	43.42	4.17	10
	Control Group	40.23	3.12	10
	Total	41.82	3.94	20
RHR	Experimental Group	59.8	4.07	10
	Control Group	66.1	6.04	10
	Total	62.95	5.969	20

Note: LBS, Lower Back Strength (kg); Flexibility (cm/inch); MEAHF: Muscle endurance of Abdominal & Hip flexors (reps/min); Vo2 Max maximum oxygen consumption (in mL/min/kg); RHR, Resting heart rate (bpm)

Table no.1 shows the post-test descriptive statistics of experimental and control group on LBL 113.81±26.83 and 101.38±28.47, Flexibility 35±5.86 and 29.8±4.15, MEAHF34.5±4.88 and 32.2±5.2, Vo2 Max 43.42±4.17 and 40.23±3.12 and RHR59.8±4.07 and 66.1±6.04 respectively.

Table No: 2 ANCOVA result table indicating group effect on the selected variables

Variables	Source	Sum of Squares	Df	Mean Square	F	Sig.
LBS	Pre-Test	13310.32	1	13310.32	244.23	0.000
	Group	313.35	1	313.35	5.75	0.028
	Error	926.50	17	54.50		
	Corrected Total	14550.17	19			
Flexibility	Pre-Test	583.71	1	583.71	766.00	0.000
	Group	4.14	1	4.14	5.43	0.032
	Error	12.95	17	0.76		
	Corrected Total	600.80	19			
MEAHF	Pre-Test	478.98	1	478.98	2163.70	0.000
	Group	1.81	1	1.81	8.16	0.011
	Error	3.76	17	0.22		
	Corrected Total	484.55	19			
Vo2 Max	Pre-Test	155.14	1	155.14	25.24	0.000
	Group	35.93	1	35.93	5.85	0.027
	Error	104.50	17	6.15		
	Corrected Total	295.56	19			
RHR	Pre-Test	641.56	1	641.56	401.44	0.000
	Group	8.23	1	8.22	5.15	0.037
	Error	27.17	17	1.60		
	Corrected Total	676.95	19			

Note: LBS, Lower Back Strength (kg); Flexibility (cm/inch); MEAHF: Muscle endurance of Abdominal & Hip flexors (reps/min); Vo2 Max maximum oxygen consumption (in mL/min/kg); RHR, Resting heart rate (bpm)

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In the ANCOVA table 2, the "Pre" effect of the variables for LBS (F = 244.23, p = 0.00), Flexibility (F = 766.00, p = 0.028), MEAHF (F = 2163.70, p = 0.00), Vo2Max (F = 25.24, p = 0.00), and RHR (F=401.44, p = .000)was statistically significant suggesting that initial LS scores significantly influenced post-treatment scores. Furthermore the "Group" effect of variables for LBS (F = 5.75, p = 0.00), Flexibility (F = 5.43, p = 0.032), MEAHF (F = 8.16, p = 0.011), Vo2Max (F = 5.85, p = 0.027), and RHR (F= 5.15, p = 0.037) also showed statistically significant which is given accordingly and after adjusting for pre-treatment scores showed a significant difference between the control and experimental groups.

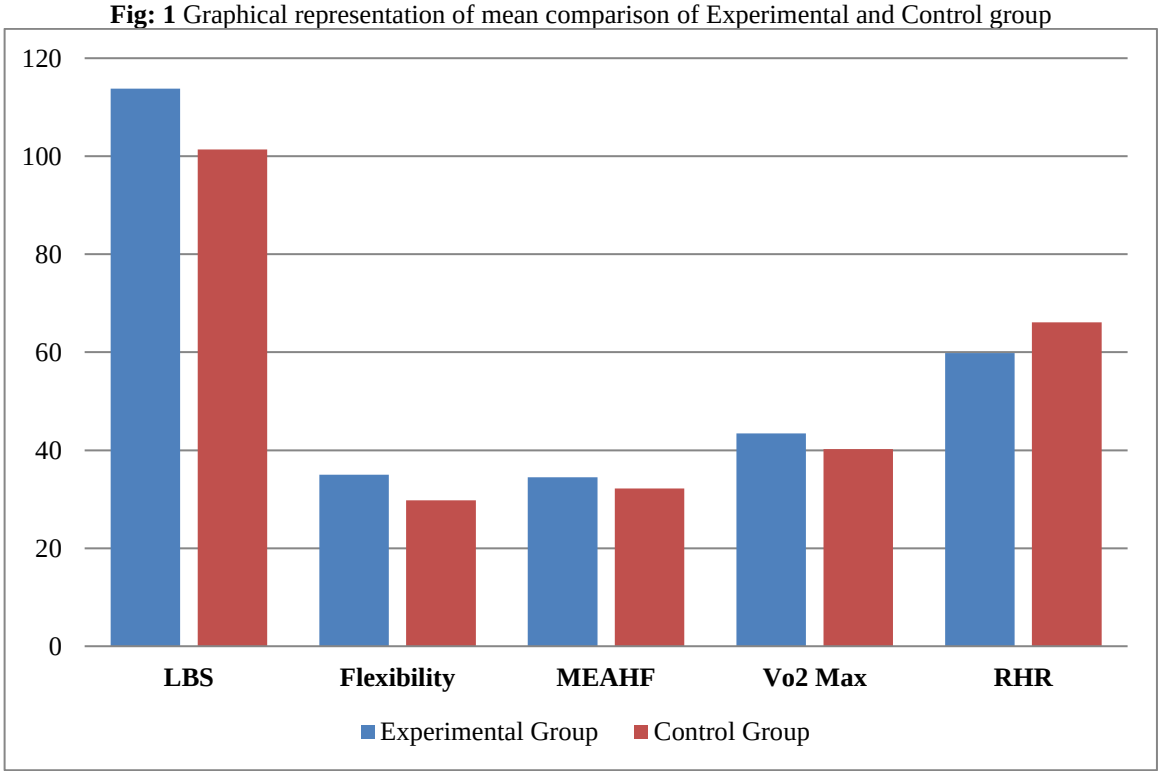
Table No: 3 Pairwise comparisons using the least significant difference (LSD) procedure

Variables	(I) GROUP	Mean Difference (Experimental-Control)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]		
					Lower Bound		Upper Bound
LBS	Experimental Group	Control Group	7.95	3.31	0.028	0.96	14.94
Flexibility	Experimental Group	Control Group	1.00	0.43	0.032	0.09	1.90
MEAHF	Experimental Group	Control Group	0.61	0.21	0.011	0.16	1.06
Vo2 Max	Experimental Group	Control Group	2.69	1.11	0.027	0.34	5.04
RHR	Experimental Group	Control Group	-1.44	0.64	0.037	-2.78	-0.10

Note: LBS, Lower Back Strength (kg); Flexibility (cm/inch); MEAHF: Muscle endurance of Abdominal & Hip flexors (reps/min); Vo2 Max maximum oxygen consumption (in mL/min/kg); RHR, Resting heart rate (bpm)

A Pairwise comparisons showed that there was significant difference between the experimental and control groups among the variables of LBS (mean difference = 7.95, p = .028), flexibility (mean difference = 1.00, p = .032), MEAHF (mean difference = .0.61, p = .011), Vo2 Max (mean difference = 2.69, p = .027), and RHR (mean difference = -1.44, p = .037) which in turn resulting to significant difference among the experimental and control group.

Fig: 1 Graphical representation of mean comparison of Experimental and Control group



The above graph (fig:1) shows the post mean comparison of Experimental and Control group.

Discussion:

Our present study investigated the interventional effect of a yogic training program on hockey players. We examined physical attributes such as lower back strength, flexibility, and muscular endurance of the abdominal and hip flexors, as well as physiological biomarkers like resting heart rate and VO2 max.

By adding yoga in our strength training plan, there was a nuanced variation inthe muscle and strength performance among the players. Previous studies have shown that yogic training significantly improves muscular strength (Bhowmik Bhunia & Ray, 2024; Rao et al., 2021; Singh et al., 2015; Vaidya et al., 2021). Specific combinations of yogic asanas can lead to significant changes. The present study also demonstrated a significant improvement in lower back strength in the experimental group of hockey players. This improvement is likely due to the specificity of the yogic training. Therefore, six weeks of yogic training appears to be sufficient to significantly enhance the back strength of male hockey players.

Flexibility, which is a crucial component of physical fitness was also evidentin the significant change in the experimental group. Practicing various yoga asanas, which involve stretching and lengthening muscles and connective tissues, has been widely recognized for enhancing flexibility. A study by Polsgrove et al., (2016)highlighted that regular yoga practice increases flexibility due to prolonged stretching, relaxation, and improved neuromuscular coordination from yoga postures. Other studies also support this finding, showing that engaging in yogic asanas can lead to significant changes in athletes (Md Iftekher et al., 2017; PetriÄ et al., 2014; Rai et al., 2022).

Additionally, muscular endurance, a crucial factor for athletic performance, was also found to be significantly improved in the experimental group.Yoga involves a combination of static postures and transitioning between different poses, which may enhance muscular endurance through sustained isometric contractions and controlled movements.The current findings are consistent with previous research, further emphasizing the positive impact of yogic training on muscular endurance in male athletes(Sharma & Sharma, 2023; Shiraishi & Bezerra, 2016).

Resting heart rate, an indicator of cardiovascular fitness, significantly decreased in the experimental group following the 6-week yogic training program. This finding is in line with previous studies that have reported similar effects of yoga on resting heart rate(Cramer et al., 2014). A study conducted by Ranjith et al., (2020)demonstrated that regular yoga practice is associated with reduced resting heart rate, indicating improved cardiovascular health and aerobic fitness.Reimers et al., (2018)in their systematic analysis further revealed that yogic intervention had a significant impact to resting heart rate.

Lastly, the present study also showed a significant improvement in VO2 max, which reflects the body's ability to utilize oxygen during exercise and is considered a measure of aerobic capacity. A study by Satheesh & Bindu, (2020) investigated the effects of yoga on VO2 max and found that participants who engaged in yoga training experienced significant increases in aerobic capacity. Similar studies also concur and correlates with the present findings which furthermore justifies that yogic intervention plays a pivotal role in the cardiorespiratory performance (Ankad et al., 2011; Bauri et al., 2016; Nagalakshmi & Badiger, 2013; Nehe & Harsoda, 2019; Satheesh & Bindu, 2020). The current study's findings further support the notion that yogic training can positively influence VO2 max in young athletes.

The present study has strengths and limitations that should be considered when interpreting the results. It employed a purposive sampling technique and a simple randomized controlled trial design. However, the study was limited to male hockey players, which may restrict the generalizability of the findings. Additionally, the sample size was relatively small, suggesting that a larger sample size may be needed for broader generalization.

Conclusions

Based on the result obtained from the statistical analysis of the data the following conclusions have been derived. The six-week yogic training program employed in this study demonstrated significant improvements in back strength, flexibility, muscular endurance, resting heart rate, and VO2 max in male hockey players. These findings align with previous research highlighting the positive effects of yoga on physical fitness outcomes. The integration of various yogic practices, including postures, breathing exercises, and relaxation techniques, appears to be an effective approach for enhancing physical fitness levels in young athletes.

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REDVET - Revista electrónica de Veterinaria - ISSN 1695-7504
Vol 24, No.2 (2023)
http://www.veterinaria.org
Article Received: Revised: Published:

APPENDIX-A

Table 1: Training protocol

Week	Warming up	Yoga training	Cooling down
Week 1	Dynamic warm-up, Static stretching	Suryanamaskar (3rep), utthai traikon, parivartta trikonasana (2 rep/holding 10 sec/15 sec), phalakasana (1 min).	Walking, Upper Body stretch, seated, forward bend, butterfly pose.
		Suryanamaskar (3rep), utthai traikon, parivartta trikonasana (2 rep/holding 10 sec/15 sec), phalakasana (1 min).	
		Suryanamaskar (3rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (2rep/holding 15 sec).	
		Suryanamaskar (3rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (2rep/holding 15 sec).	
		Suryanamaskar (5 rep), Paranayama (kapalbathi 30sec), (Anulom vilom asana R/L 5 in/out breathing, alternate 7 in/out breathing), phalakasana.	
Week 2	Dynamic warm-up, Static stretching	Suryanamaskar (5rep), utthai traikon, parivartta trikonasana (3rep/holding 15 sec/20 sec), phalakasana (1 min).	Walking, Upper Body stretch, seated, forward bend, butterfly pose.
		Suryanamaskar (5rep), utthai traikon, parivartta trikonasana (3 rep/holding 15 sec/ 20 sec), phalakasana (1 min).	
		Suryanamaskar (5 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3 rep/holding 20 sec).	
		Suryanamaskar (5 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3rep/holding 20 sec).	
		Suryanamaskar (8 rep), Paranayama (kapabathi 30sec), (Anulom vilom asana R/L 5 in/out breathing, alternate 7 in/out breathing), phalakasana.	
Week 3	Dynamic warm-up, Static stretching	Suryanamaskar (8 rep), utthai traikon, parivartta trikonasana (3rep/holding 15 sec/20 sec), phalakasana (1 min).	Walking, Upper Body stretch, seated, forward bend, butterfly pose.
		Suryanamaskar (8 rep), utthai traikon, parivartta trikonasana (3 rep/holding 15 sec/ 20 sec), phalakasana (1 min).	
		Suryanamaskar (8 rep), Bidalasana, makara asana, Chakra asana, Paschimottah asana (3 rep/holding 20 sec).	
		Suryanamaskar (8 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3rep/holding 20 sec).	
		Suryanamaskar (10 rep), Paranayama (kapabathi 30sec), (Anulom vilom asana R/L 5 in/out breathing, alternate 7 in/out breathing), phalakasana.	
Week 4		Suryanamaskar (8 rep), utthai traikon, parivartta trikonasana (3rep/holding 15 sec/20 sec), phalakasana (1 min).	Walking, upper, Body stretch, seated, forward bend, butterfly pose.
		Suryanamaskar (8 rep), utthai traikon, parivartta trikonasana (3 rep/holding 15 sec/ 20 sec), phalakasana (1 min).	

	Dynamic warm-up, Static stretching	Suryanamaskar (8 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3 rep/holding 20 sec).	
		Suryanamaskar (8 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3rep/holding 20 sec).	
		Suryanamaskar (10 rep), Paranayama (kapabathi 30sec), (Anulom vilom asana R/L 5 in/out breathing, alternate 7 in/out breathing), phalakasana.	
Week 5	Dynamic warm-up, Static stretching	Suryanamaskar (10 rep), utthai traikon, parivartta trikonasana (3rep/holding 20 sec/30 sec), phalakasana (1 min).	Walking, upper, Body stretch, seated, forward bend, butterfly pose.
		Suryanamaskar (10 rep), utthai traikon, parivartta trikonasana (3 rep/holding 20sec/ 30 sec), phalakasana (1 min).	
		Suryanamaskar (10 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3 rep/holding 30 sec).	
		Suryanamaskar (10 rep), Bidalasana, makarasana, Chakra asana, Paschimottah asana (3rep/holding 30 sec).	
		Suryanamaskar (12 rep), Paranayama (kapabathi 30sec), (Anulom vilom asana R/L 5 in/out breathing, alternate 7 in/out breathing), phalakasana.	

Cool Down session