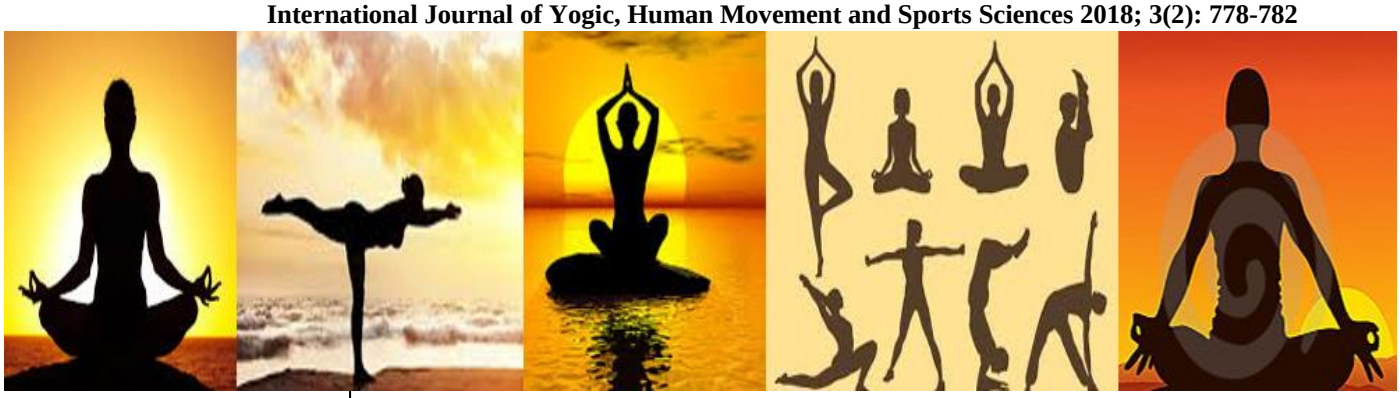
International Journal of Yogic, Human Movement and Sports Sciences 2018; 3(2): 778-782



ISSN: 2456-4419
Impact Factor: (RJIF): 5.18
Yoga 2018; 3(2): 778-782

www.theyogicjournal.com
Received: 06-05-2018
Accepted: 07-06-2018

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A comparative study of cardiovascular fitness of kayaking players among Indian northern region universities

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Abstract
The purpose of the study was to find out the difference between cardiovascular fitness of kayaking players of 4 Indian northern region universities. The total 48 male kayaking players were selected as subjects. The age of the subjects ranged between 18-25 years and subjects were divided into 4 groups. Each group of having 12 subjects (i.e., Guru Nanak Dev University, Amritsar n_1=12; Panjab University, Chandigarh n_2=12; Punjabi University Patiala n_3=12; and Kurukshetra University, Haryana n_4=12).The outcomes show that the Kayaking Inter-University Players Guru Nanak Dev University, Amritsar had (Mean ± SD: 2708.33±137.89) Panjab University, Chandigarh had (Mean ± SD: 2516.66±180.06), Punjabi University Patiala had (Mean ± SD: 2500.00±153.74) and Kurukshetra University Haryana (Mean ± SD: 2350.00±188.29). The significant differences were noted in kayaking players of Indian northern region universities. Kayaking Inter-University Players of Guru Nanak Dev University, Amritsar had demonstrated significantly better on Cardiovascular Fitness than their counterpart's Panjab University, Chandigarh, Punjabi University Patiala and Kurukshetra University Haryana.

Keywords: Cardiovascular fitness, kayaking, kayak players

1. Introduction
Kayaking sport is characterized by exceptional demand on upper body performance [1, 2]. Kayaking is a speed sport and known to be the most physically demanding of all endurance sports [3, 4]. During arm-cranking athletes of flat-water kayak racing shows high value of total body oxygen uptake and a very high value for maximal oxygen uptake [1, 5]. Similarly, in 1000 m race there is approximately 90% of oxygen consumption of that attained during maximal treadmill running. This shows activity of high aerobic exercise potential. Kayaking requires a combination of many skills like, motor coordination, physical fitness, cardiovascular endurance and anaerobic fitness. To achieve competitive success in any sport an adequate level physical fitness should be achieved. Flat-water kayakers have higher maximal aerobic and anaerobic capacities and muscular strength of upper-body [6, 7, 8]. Fitness is an essential component of health, examining the skill-related physical fitness levels of kayaking players could be useful for taking high performance in any kind of competition [3]. Changing of technique in different working conditions requires athlete's individual adaptation. Individual's selection of training means and methods, depending on athlete's biological structure and characteristics [9, 10, 11].
Flat-water kayaking places exceptional demands on the upper body and trunk musculature [12]. There are higher values of maximal aerobic and anaerobic capacities and upper-body muscle strength in kayak players [6, 7, 4, 10]. Energy requirement during kayak race is fulfilled from aerobic system as majority of race is done at around peak VO_{2max} [9, 17].
Various physiological tests have done to estimate VO_{2max} of kayak paddlers during on water analysis, ergometry, arm cranking [4, 7, 8, 13]. Estimated peak oxygen uptake by kayakers is 4.67 L·min-1 during an on water 1000m race [4]. Kayakers depend primarily on aerobic metabolism of which they remain at an intensity of ~90% of their aerobic capacity [9]. Kayaking athletes remain at Kor near peak oxygen consumption (peak VO_2) for the majority of a race [13].

Kayaking requires a high level of anaerobic and aerobic fitness to realize a successful performance [13, 14].

2. Material and Method

2.1 Selection of Subjects

The total of 48 male Kayaking players were selected having age ranging from; 18–25 years (Mean ± SD: 22.52 ± 1.75 Age years, 172.64± 4.88 Body Height centimetres, 72.56 ± 3.15 Body Mass kilograms) were selected. The participants were selected from 4 Indian northern region universities, 12 subjects each.

Table 1: Shows describe the distribution of demographic data of subjects of all 4 universities

Variables	Total (n=48)	Guru Nanak Dev University, Amritsar (n_1=12)	Panjab University, Chandigarh (n_2=12)	Punjabi University, Patiala (n_3=12)	Kurukshetra University, Haryana (n_4=12)
Age	22.52 ± 1.75	22.16 ± 1.94	22.58 ± 1.88	22.58 ± 1.56	22.33±1.55
Height	172.64±4.88	175.16 ± 6.57	172.08 ± 4.14	171.91 ± 3.72	171.58 ± 3.77
Weight	72.56 ± 3.15	72.83 ± 3.24	72.30 ± 2.72	72.64 ± 3.27	72.55 ± 3.48

N; sample size, yrs; years, cm; centimeters, kg; kilograms.

A glance at Table-1 showed that the Mean ± SD of Guru Nanak Dev University, Amritsar had (22.16 ± 1.94 Age years, 175.16 ± 6.57 Body Height centimetres, 72.83 ± 3.24 Body Mass kilograms) Panjab University, Chandigarh had (22.58 ± 1.88 Age years, 172.08 ± 4.14 Body Height centimetres, 72.30 ± 2.72 Body Mass kilograms) Punjabi University, Patiala had (22.58 ± 1.56 Age years, 171.91 ± 3.72 Body Height centimetres, 72.64 ± 3.27 Body Mass kilograms) Kurukshetra University, Haryana had (22.33 ± 1.55 Age years, 171.58 ± 3.77 Body Height centimetres, 72.55 ± 3.48 Body Mass kilograms) were selected.

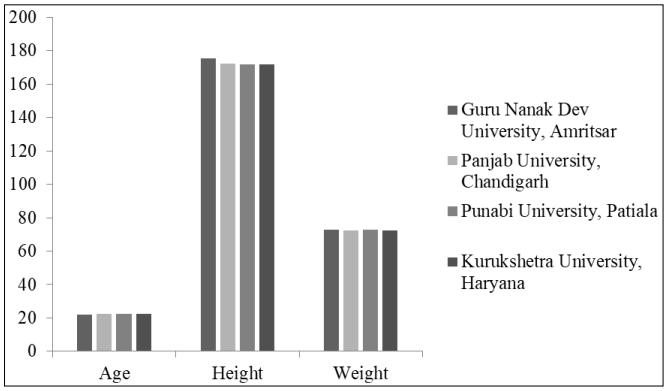

Fig 1: Distribution and demographics of subjects

3. Selection of Tools

To measure the cardiovascular fitness test Cooper 12-minute run test was used. The test measure aerobic fitness. Aerobic fitness is the ability to use oxygen by body while performing a task. Test requires equipment's as; running track, marker cones, sheet to record data and stop watch. By using equation estimated VO_2max was calculated (in ml/kg/min) from the distance score obtained.

On running track markers were placed at a fixed interval or distance to measure the distance covered in 12 minutes. Players were asked to run for 12 minute and to cover the distance as much as they can. Time is noted in stopwatch as player started running. After completing 12 minutes the distance covered was measured in kilometres. The obtained data was interpreted by putting the value in following equation:

$VO2max = (22.35 \times kilometers) - 11.29$

As per the objectives of the study data was collected from 4 Indian northern region universities Design:

To study the significant difference in cardiovascular fitness among the kayaking players of 4 Indian northern region universities statistical technique, ANOVA (analysis of variance) was applied.

The objective assumed was:

1) To study the significant difference in the cardiovascular fitness of kayaking players of 4 different universities.
2) To assess the influence of sports participation on cardiovascular fitness abilities among 4 Indian northern region universities kayaking players.

4. Statistical Analysis

Statistical analysis was done using IBM SPSS statistics data editor version-21. Data were expressed as means and standard deviations. The Student's Analysis of variance (ANOVA) was employed for comparing the groups statistically. The hypotheses were tested at 0.05 significance level.

5. Results

For each of the chosen variable, the results pertaining to Analysis of variance (ANOVA) among male inter-university kayaking players with regard to cardiovascular fitness are presented in the following tables:

Table 2: One way analysis of variance (ANOVA) results among male inter-university kayaking players with regard to cardiovascular fitness

Source of variance	Sum of Squares	Df	Mean Square	F-Ratio	P-Value Sig.
Between Groups	777291.667	3	259097.222	9.377	.000
Within Groups	1215833.333	44	27632.576		
Total	1993125.000	47			

The p-value is .000066. The result is significant at p<.05.

It can be seen from Table 2 that significant differences were found with regard to the Cardiovascular Fitness of Kayaking male Inter-University Players (i.e., Guru Nanak Dev University, Amritsar, Panjab University, Chandigarh and Punjabi University, Patiala and Kurukshetra University, Haryana as the P value (Sig.) .000 was found lower than the 0.05 level of significance (p>0.05). Since F value was found significant, therefore, there is need to apply Post-hoc test. The result of Post-hoc test has been presented in Table 3.

Table 3: Analysis of least significant difference post-hoc test among male inter-university kayaking players with regard to cardiovascular fitness.

Mean Value		Mean Difference	Sig.
Guru Nanak Dev University, Amritsar (2708.3333)	Panjab University Chandigarh (2516.6667)	191.66667*	.007
	Punjabi University Patiala (2500.0000)	208.33333*	.004
	Kurukshetra University Haryana (2350.0000)	358.33333*	.000
Panjab University Chandigarh (2516.6667)	Guru Nanak Dev University Amritsar (2708.3333)	-191.66667*	.007
	Punjabi University Patiala (2500.0000)	16.66667	.807
	Kurukshetra University Haryana (2350.0000)	166.66667*	.018
Punjabi University Patiala (2500.0000)	Guru Nanak Dev University Amritsar (2708.3333)	-208.33333*	.004
	Panjab University Chandigarh (2516.6667)	-16.66667	.807
	Kurukshetra University Haryana (2350.0000)	150.00000*	.032
Kurukshetra University Haryana (2350.0000)	Guru Nanak Dev University Amritsar (2708.3333)	-358.33333*	.000
	Panjab University Chandigarh (2516.6667)	-166.66667*	.018
	Punjabi University Patiala (2500.0000)	-150.00000*	.032

- A glance at table 2 showed that the mean value of Guru Nanak Dev University, Amritsar was 2708.33 whereas Panjab University, Chandigarh had mean value as 2516.66 and the mean difference between both the groups was found 191.66. The p-value sig .007 shows that the Guru Nanak Dev University, Amritsar had demonstrated significantly better on Cardiovascular Fitness than their counterpart's Panjab University, Chandigarh.
- The mean difference between Guru Nanak Dev University and Punjabi University, Patiala was found 208.333*. The p-value sig .004 revealed that the Guru Nanak Dev University, Amritsar had exhibited significantly better on Cardiovascular Fitness than their counterpart's Panjab University, Chandigarh.
- The mean difference between Guru Nanak Dev University and Kurukshetra University, Haryana was found 358.333. The p-value sig .000 showed that the Guru Nanak Dev University had exhibited significantly better on Cardiovascular Fitness than their counterpart's Kurukshetra University, Haryana.
- The mean difference between Panjab University, Chandigarh and Punjabi University, Patiala was found 16.66. The p-value sig .807 showed that the Panjab University, Chandigarh had demonstrated better on Cardiovascular Fitness than their counterpart's Punjabi University, Patiala though not significantly.
- The mean difference between Panjab University, Chandigarh and Kurukshetra University, Haryana was found 166.66. The p-value sig .018 showed that the Panjab University, Chandigarh had exhibited significantly better on Cardiovascular Fitness than their counterpart's Kurukshetra University, Haryana.
- The mean difference between Punjabi University, Patiala and Kurukshetra University, Haryana was found 150.00*. The p-value sig .032 showed that the Punjabi University, Patiala had demonstrated better on Cardiovascular Fitness than their counterpart's Kurukshetra University.

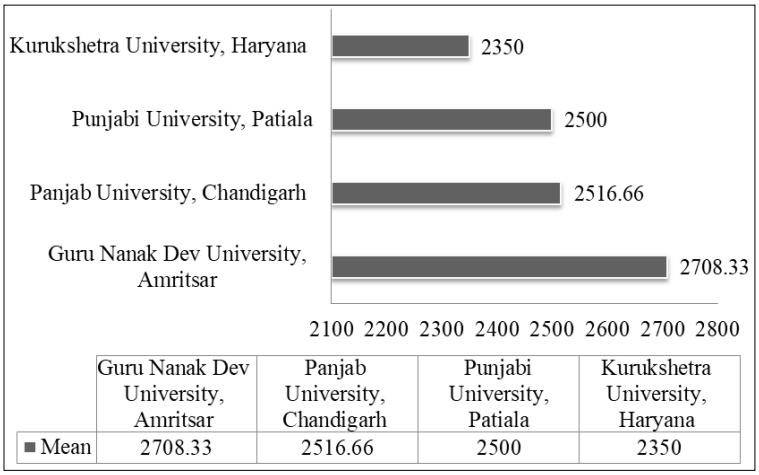

Fig 2: Graphical representation of mean scores with regard to male inter-university kayaking players with regard to cardiovascular fitness

6. Discussion

Oxygen cost increases linearly with increase in exercise intensity. Higher the exercise intensity achieved more the oxygen consumption and higher the VO2max, higher the work rate for a longer duration. VO2max is a good predictor of endurance performance of an athlete and it is the result of peak work rate achieved. Values of VO_{2max} vary with exercising by arms or legs (Astrand and Saltin, 1961) [16]. A study done by Tesch and Karlson (1982) [17] in elite kayak players of Swedish national team shows 84.5% of $VO2_{max}$ consumed during arm crank exercise. Another study by Bunc and Heller (1991) [18] shows 88.7% of VO2max value. This shows exercise specific consumption of VO_{2max} value. Performance of kayak players also depends on anthropometric variables [19, 20, 21]. Among physiological variables maximum oxygen uptake is the main physiological variable [22, 23, 1]. Larger estimated VO_{2max} values in kayakers validate their greater aerobic capacity.

Present study shows significant differences in the Cardiovascular Fitness of Kayaking male Inter-University Players (i.e., Guru Nanak Dev University, Amritsar, Panjab University, Chandigarh and Punjabi University, Patiala and Kurukshetra University). Guru Nanak Dev University, Amritsar have better cardiovascular fitness than Panjab

University, Chandigarh as the p-value sig is .007. Present study shows greater cardiovascular Fitness for Guru Nanak Dev University with p-value sig .032, than that of Panjab University, Chandigarh and also significantly better than Kurukshetra University, Haryana as p-value sig is .000. Present study demonstrates greater Cardiovascular Fitness of Panjab University, Chandigarh (p-value sig .807) than that of Punjabi University, Patiala and also than that of Kurukshetra University, Haryana with p-value of .807 and .018 respectively.

Punjabi university, Patiala (p-value sig .807) demonstrates greater Cardiovascular Fitness than that of Kurukshetra University, Haryana.

Various studies have done on Cardiovascular Fitness of kayaking players. The important factor to measure Cardiovascular Fitness taken was VO_{2max}. Various studies are supporting results of present study. Studies indicate significantly higher VO_{2max} levels than those observed ergometer and treadmill tests. (Fry and Morton, 1991; Shephard, 1987; Sidney and Shephard, 1973) [7, 20, 21] may be due to different protocols applied to estimate oxygen uptake. Study by Loures *et al*. (2014) [25] shows low values of VO_2 for elite athletes. Study done on kayakers by Fry and Morton [7] reported a value of 59.2 ± 7.1 ml·kg-1·min-1 for elite athletes, and Tesch [4] reported 58.4 ± 3.1 ml·kg-1·min-1. Nakamura *et al*. [26] observed (51.9 ± 5.6 ml·kg-1·min-1). Studies show difference in VO_{2max} in kayak players. Study done by Van Someren *et al*. favors our study, (1999) [27] it shows an average peak value of 4.27 L·min-1 and on Swedish kayak's is 4.71 L·min-1 and 4. 67 L·min-1 by Tesch *et al*., 1976 and Tesch, 1983 [1, 4] respectively for the same race distance at maximal effort. So, it may be speculated that the differences observed were a result of the subject characteristics. Fry and Morton (1991) [7] study also supports above statement. Therefore, it can be assumed that the more skilled paddlers obtain a greater rate of oxygen consumption. Mean peak values of VO_2 for the state team kayakers were higher than that of non-state team kayakers (4.78 L·min-1, 3.87 L·min-1 respextively). Stromme *et al*. (1977) [28] determined the VO2 peak of cross country skiers, rowers and cyclists during uphill running on a treadmill and during maximal performance on their specific sport activity. All athletes attained higher levels of VO2 peak during their specific sport activity than during treadmill running. A previous study shows higher absolute values of VO2 [4].

7. Conclusions

Present study concluded that:

- Guru Nanak Dev University, Amritsar have better Cardiovascular Fitness than Panjab University, Chandigarh,
- Guru Nanak Dev University, Amritsar have better Cardiovascular Fitness than Kurukshetra University, Haryana.
- Panjab University, Chandigarh has greater Cardiovascular Fitness than that of Punjabi University, Patiala.
- Panjab University, Chandigarh had greater Cardiovascular Fitness othan that of Kurukshetra University, Haryana.
- Punjabi University, Patiala had greater Cardiovascular Fitness than that of Kurukshetra University, Haryana.

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