

Haemodynamic and VO₂max Profile of Punjabi Cricket Players

Lokendra Bahadur Kathayat and Ashok Kumar

Abstract

Aims: To observe haemodynamic and VO₂max profile of Punjabi cricket players. **Materials & Methods:** There was one hundred fifty (N=150) trained Punjabi male cricketers between the ages of 15 to 25 years volunteered for this study. A queen's step test was used for estimation of VO₂ max. **Results:** The mean age, height, weight and BMI of cricketers were 17.77±2.663years, 171.19±7.526cm, 57.45±9.421Kg and 19.54±2.585kg/m². The mean Pulse Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Pressure, Mean Arterial Pressure, Rate Pressure Product, Stroke Volume, Cardiac Output, Heart Rate and VO₂ max was 116.67±18.759 (beats/minute), 144.75±14.255 (mmHg), 82.19±7.137 (mmHg), 62.55±13.086 (mmHg), 103.135±7.905 (mmHg), 237.241±36.767 (beats.min⁻¹.mmHg), 67.087±8.552 (ml/beat) , 11.01±2.00 (L/min) 163.85±19.354 (beat/minute) and 42.51±8.128 (ml.kg-1.min-1) respectively. **Conclusion:** It was concluded that the values of various haemodynamic variables of cricket players were in the normal range and VO₂ max (aerobic fitness) of cricket players was above to the normal as prescribed by the norms of queen's college step test.

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Introduction

Cricket is one of the most popular sports in many commonwealth countries. The game of cricket has long been regarded as 'the gentleman's game'. It originated in England as an aristocratic sport; a symbol of wealth and hierarchy among the British elites. Cricket over the years has received some attention from researchers, mainly focusing on English cricket and the effects it had on West Indian culture in the aftermath of industrialization (Maguire and Stead 1996). Cricket began to be played in rural southern England in the sixteenth century and since then the game has evolved considerably. There are three formats of cricket played at the international level - Test matches, One-Day Internationals and Twenty-20 Internationals. These matches are played under the rules and regulations approved by the International Cricket Council (ICC), which also provides match officials for them. Test cricket is the traditional form of the game and One Day Internationals also known as ODIs are a pacier format which started in 1971 but gained in popularity from the 1980s (ICC). Twenty-20 Internationals are the newest, shortest and fastest form of the game. Cricket has been described as an 'interval' sport with both anaerobic and aerobic components (Percival et al., 1982). Every sport has its specific requirement of aerobic, anaerobic fitness and haemodynamic variables which helps a player to perform better in it. There are a number of examples when aerobic, anaerobic fitness and haemodynamic variables make difference in performance of a player

for example Michael Phelps in Swimming, Michael Jordan in Basketball, Usain Bolt in Athletics and undoubtedly Sunil Gavaskar and Sachin Tendulkar's batting skills in Cricket, along with Glen McGrath, Shoaib Akhtar, Brett Lee and Shane Bond's bowling skills (Pradeep et al. 2013). At higher skill levels, technical performance may be limited by physical characteristics, physical fitness and performance characteristics (Saini 1996; Sidhu and Grewal 1984). High level performance in cricket requires certain physical qualities like speed, endurance, explosive power, agility, flexibility, strength etc. (Tanaka et al., 2004). In addition to the techniques, tactics and physical characteristics of a player or a team, physiological characteristics help him or them for his or their better performance (Uppal 1980). The determination of $\dot{V}O_2\text{max}$ is essential in evaluating an individual's capacity to perform aerobic work (Åstrand, 1954; Åstrand 1960). Cardio-respiratory fitness in terms of maximum oxygen uptake ($\dot{V}O_2\text{max}$) reflects physical fitness of a person. $\dot{V}O_2\text{max}$ is single best measure of cardio-respiratory capacity and is considered as a bench mark to quantify cardiovascular functional capacity and aerobic fitness (Tauseef et al., 2015). Blood pressure which is a hemodynamic variable is often used to identify the fitness level in players. An optimal blood pressure mostly indicates an extremely fit player (Fagard 1993). There are very few studies that have been conducted on male cricket players of Punjab to observe their physiological status haemodynamic variables and aerobic fitness. The present study was conducted on male cricket players to observe their haemodynamic variables and aerobic fitness.

Materials and Methods

One hundred fifty (N=150) Punjabi male cricketers between the age group of 15 to 25 years voluntarily participated in the study. Anthropometric measurements were recorded according to the standard procedure. A queen's step test was used for estimation of $\dot{V}O_2\text{max}$. The $\dot{V}O_2\text{Max}$ was calculated using the equations of (McArdle et al., 1972) used by online $\dot{V}O_2\text{max}$ calculator.

Statistical analysis was performed with SPSS version 20.0 (free trial, SPSS Inc, Chicago). Mean and Standard Deviation was observed for age, height, weight, Pulse Rate, Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Pressure, Mean Arterial Pressure, Rate Pressure Product, Stroke Volume, Cardiac Output, Heart Rate and $\dot{V}O_2\text{Max}$ (after queen's Step test).

Results

The mean age, height weight and BMI (body mass index) of cricketer was 17.77 ± 2.66 year, 171.19 ± 7.52 cm, 57.45 ± 9.42 kg and 19.54 ± 2.58 kg/m² respectively (Table 1).

The mean Pulse Rate (PR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Pulse Pressure (PP), Mean Arterial Pressure (MAP), Rate Pressure Product (RPP), Stroke Volume (SV), Cardiac Output (CO), Heart Rate (HR) (after test) and $\dot{V}O_2\text{max}$ was 116.67 ± 18.75 (beats/minute), 144.75 ± 14.25 (mmHg), 82.19 ± 7.13 (mmHg), 62.55 ± 13.08 (mmHg), 103.13 ± 7.90 (mmHg), 237.24 ± 36.76 (beats.min⁻¹.mmHg), 67.08 ± 8.55 (ml/beat) , 11.01 ± 2.00 (L/min) 163.85 ± 19.35 (beat/minute) and 42.51 ± 8.12 (ml.kg-1.min-1) respectively (Table 2).

The results of correlation showed that age, height, weight and BMI was not significantly related with $\dot{V}O_2\text{max}$. (Table 3). Further, it was found that age was negatively significantly related with CO (AST) ($r = -.180^*$; $P < 0.05$). It was also found that body height was positively and highly significantly related with SBP (AST) ($r = .306^{**}$), PP (AST) ($r = .285^{**}$), MAP (AST) ($r = .251^{**}$), $P < 0.01$. The body weight was positively and highly significantly related with SBP (AST) ($r = .364^{**}$), PP (AST) ($r = .328^{**}$), MAP (AST) ($r = .291^{**}$), RPP (AST) ($r = .231^{**}$), $P < 0.01$. Body mass index (BMI) was positively and highly significantly related with SBP (AST) ($r = .253^{**}$), PP (AST) ($r = .222^{**}$), MAP (AST) ($r = .198^{**}$), RPP (AST) ($r = .207^{**}$), $P < 0.01$ (Table 4).

Table 1. Mean ±SD Age, height weight & BMI of male cricket players

Variable(s)	Mean ± S D
Age (year)	17.77±2.663
Height (cm)	171.19±7.526
Body weight (kg)	57.45±9.421
BMI (kg/m ²)	19.54±2.585

Table 2. Mean ±SD of Haemodynamic variables and VO₂ max of male cricket players

Variable(s)	Mean ± S D
Pulse rate after step test (beats/minute)	116.67±18.75
Systolic blood pressure after step test (mmHg)	144.75±14.25
Diastolic blood pressure after step test (mmHg)	82.19±7.13
Pulse pressure after step test (mmHg)	62.55±13.08
Mean arterial pressure after step test (mmHg)	103.13±7.90
Rate pressure product after step test (beats.min ⁻¹ .mmHg)	237.24±36.76
Stroke volume after step test (ml/beat)	67.08±8.55
Cardiac output after step test (L/min)	11.01±2.00
Heart rate after step test (beat/minute)	163.85±19.35
VO ₂ max (ml.kg ⁻¹ .min ⁻¹)	42.51±8.12

Table 3. Correlations between Age, Height, Weight, BMI & VO₂ max

Variable(s)	VO ₂ max
Age	.138
Height	.078
Weight	-.008
Body Mass Index (BMI)	-.073

Table 4. Correlations among Age, Height, Weight, BMI & Heamodynamic variables After Step Test

Variable(s)	PR (AST)	SBP (AST)	DBP (AST)	PP (AST)	MAP (AST)	RPP (AST)	SV (AST)	CO (AST)	HR (AST)	VO ₂ max
Age	-.101	.125	.048	.111	.091	-.032	-.121	-.180*	-.138	.138
Height	-.136	.306**	.088	.285**	.251**	.135	.129	.039	-.078	.078
Weight	-.062	.364**	.125	.328**	.291**	.231**	.138	.098	.008	-.008
BMI	.027	.253**	.098	.222**	.198*	.207*	.087	.104	.073	-.073

PR -Pulse Rate; SBP-Systolic Blood Pressure; DBP-Diastolic Blood Pressure; PP-Pulse Pressure; MAP-Mean Arterial Pressure; RPP- Rate Pressure Product; SV-Stroke Volume; CO-Cardiac Output; HR-Heart Rate; AST-After Step Test

Discussion

Maximum values of aerobic capacity of top athletes is archived between age of 17 to 22 years, after which it linearly decrease with aging (Teplan. et al. 2013).we cannot expect some significant in (VO_2 max) in our cricket players. Insignificant aerobic capacity precludes the maintenance of high level of aerobic exercise and there with the maximal performance in certain sports as it leads to progressive exhaustion, especially in the 15 minutes of match (Vesko Milenković. et al 2013). Cricket, as a representative of sports games, requires anaerobic and aerobic exercise. Aerobic training is developed to improve the oxygen transport system (Rampinini, et al., 2007).The oxygen system is best trained by endurance workouts, that is, exercises of relatively long duration at submaximal level (Janssen 2001).This specific training improves the ability to continue exercising for a prolonged period and the ability to quickly recover from high-intensity exercises (Rampinini, et al., 2007). Aerobic metabolism increases in proportion to the mass of muscle involved and the intensity of exercise. Blood flow also increases many folds. Cardiac output and heart rate increase three to four times with increasing oxygen uptake, whereas stroke volumes increases only to a minor extent (Jyoti and Rajkumar 2017). Blood pressure, improved blood lipid profiles, and better heart efficiency. Generally, aerobic training promotes adaptations in the skeletal muscles, the cardiovascular system, the autonomic nervous system, and the hormonal responses (William et al., 2006). The Cardiovascular adaptations include a greater stroke volume and maximum cardiac output, and an enhanced ability to lower peripheral resistance during strenuous exercise (Bouchard, et al. 1995). Cardio-respiratory fitness in terms of maximum oxygen uptake (VO_2 max) reflects physical fitness of a person. VO_2 max is single best measure of cardio-respiratory capacity and is considered as a bench mark to quantify cardiovascular functional capacity and aerobic fitness (Tauseef et al. 2015). VO_2 max value quantitatively expresses a person's capacity of aerobic resynthesize of ATP. As such, it is an important factor in determining one's ability to sustain high intensity exercise for longer than 4-5 minutes (Katch et al., 2011).

Conclusion

It was concluded that the values of various haemodynamic variables of cricket players were in the normal range and VO_2 max (aerobic fitness) of cricket players was above to the normal as prescribed by the norms of queen's college step test.

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References

- Astrand I (1960). Aerobic work capacity in men and women with special reference to age. *Acta Physiologica Scandanavica* 49(Suppl.169): 1-92.
- Astrand PO and Rhyning I. 1954. A monogram for calculation of aerobic capacity (physical fitness) from pulse rate during submaximal work. *Journal of Applied Physiology* 7: 218-221.
- Bouchard, C., A. S. Leon, D. C. Rao, J. S. Skinner, J. H. Wilmore, and J. Gagnon 1995. The HERITAGE Family Study. Aims, design, and measurement protocol. *Med. Sci. Sports Exerc.* 27: 721-729.
- Christie, C.J. And King, GA 2008. Heart rate and perceived strain during batting in a warm and cool environment. *International Journal of Fitness*, 4: 33- 38.
- Fagard R.H. (1996).Athlete's heart: a meta-analysis of the echocardiographic experience. *Int J Sports Med.* Nov; 17 Suppl 3:S140-4.
- ICC (International Cricket Council) 1998. Code of Conduct Standard Playing Conditions and other Regulations.
- Janssen P 2001. Lactate Threshold Training. *Champaign, IL: Human Kinetics.* pp. 1-150.

- Jyoti Awati and Rajkumar P Malipatil 2017. Effect of aerobic training on physical fitness components of hockey players. *International Journal of Yoga, Physiotherapy and Physical Education*. 2(5) 14-16
- Katch VL, McArdle WD, Katch FI 2011. Essentials of exercise physiology 4th edition chapter 7.
- Maguire, J., & Stead, D 1996. Far Pavilions? Cricket Migrants, Foreign Sojourns and Contested Identities. *International Review for the Sociology of Sport*, 31, 1-24.
- McArdle WD, Katch FI, Pechar GS, Jacobson L, Ruck S 1972. Reliability and interrelationships between maximal oxygen intake, physical work capacity and step-test scores in college women. *Med Sci Sports* 4:182-6.
- Noakes TD and Durandt J.J. 2000. Physiological requirements of cricket. *Journal of Sports Sciences* 18(12): 919-929.
- Percival J, Percival L, Taylor J 1982. The complete guide to total fitness. A & C Black Publ. Ltd. 224.
- Pradeep Kumar, Rajender Singh, Rajvinder Singh, Mr. Sonu Kumar 2013. Comparative Analysis The Physiological Variables of All India Intersarsity Level Batsmen's, Pace Bowlers, Spin Bowlers, Wicketkeepers and All-Rounders Men Cricketers of India. *International Journal of Behavioral Social and Movement Sciences* 2: 104-117.
- Rampinini E, Coutts AJ, Castagna C, Sassi R, and Impellizzeri FM (2007). Variation in top level football match performance. *Int J Sports Med* 28: 1018-1024.
- Saini R 1996. Comparative study of psychomotor components between the athletes of individual and team sports. Unpublished Master Thesis. P.U. Chandigarh.
- Sidhu LS, Grewal R, 1984. Effect of hard training on cardiovascular system of Indian women hockey players. *J Sports Med. Phy. Fitness*. 24(1):34-40.
- Tanaka K, Nakamura Y, Sakai T 2004. Role of exercise science in maintaining overall quality of life in humans. *Japan J Phys. Educ. Hlth. Sport Sci*; 49:209-229.
- Tauseef Nabi*1 Nadeema Rafiq2 and Ouber Qayoom 2015. Assessment of cardiovascular fitness [VO₂ max] among medical students by Queens College step test. *International Journal of Biomedical and Advance Research* 6(05):418-421.
- Teplan Jaroslav, Tomáš Malý, František Zahálka And Lucía Malá (2013). Values Of Speed And Aerobic Capacity Parameters As Indicators Of Physical Fitness In U18 And U19 Soccer Teams At The Beginning of The Pre-Season Period. *Sport Science* 6 (1): 87-94.
- Teplan Jaroslav, Tomáš Malý, František Zahálka and Lucía Malá(2013). Values Of Speed And Aerobic Capacity Parameters As Indicators Of Physical Fitness In U18 And U19 Soccer Teams At The Beginning of The Pre-Season Sport Science 6 1: 87-94.
- Uppal AK 1980. Effect of 10-weeks participation in physical education programme on selected strength variables in women. *SNIPES*. 1980; 3(3):31-34.
- Vesko Milenković1 , Biljana Vitošević1 , Hadži Miloš Vidaković1 , Gorana Ranković Nedin2 , Jasmina Ranković3 2013. Values of Aerobic Capacity in Handball and Volleyball Players. *Acta Medica Medianae* Vol.52(4) :35-37.
- William Cradle D, Frank Ketch I, Victor Katch L, 2006. Essentials of exercise physiology. Lippincott Williams & Wilkins, 204.

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