

Effective Load Management and Periodization of fast bowlers in Cricket (In season)

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Abstract: Cricket is a global sport which is played in over 100 countries and fast bowlers have a vital role to play in a cricket team. The most important aspect is to talk about the effective load or the optimum load management on a fast bowler by focusing on his biomechanical patterns and injury prevention programs. This review aims at giving the physiological literature about the fast bowlers in cricket and gives us an effective and periodized program which is beneficial for the fast bowlers during there In season training regimes. It also gives us the limitations that are found in the past research and possible avenues for the future investigations. This review aims at providing a starting point for the evidence in the specific area.

Keywords: Effective Load, Periodization, In season, training regimes, performance, enhanced recovery, speed training, bio banding, slingshot, elastic strength, Range of Motion(ROM), oscillatory training, triphasic training, front foot contact, ISO hold, extensibility, flexibility, fascia, stride cadence

Introduction: Fast bowlers are vital elements in cricket but they have typically short careers as compared to batsman and bowlers. A fast bowler can approximately complete 60 bowling episodes of lower and upper body high intensity actions in a 10 over spell and covers a total distance of 1.9km with 5.3 minutes of discontinuous bowling activity. So, on the basis of above data, its important to divide the optimum load which is required for effective performance of a fast bowler. The studies has shown that elite level fast bowlers delivers ball between 129-145.8km/hr. So, with the increasing amount of matches and different formats in cricket now days, it is very essential to have effective load managements and a periodized program to be followed during there In-season matches. So, in this case evidence based intervention strategies are important with regard to fast bowling in cricket.

Factors affecting Load Management of Fast Bowlers

There are various factors which affect the load management of fast bowlers, they are:

1) Pre determined number of overs that a bowler has to bowl in a net session with maintenance of bowling action and physiological fatigue and accuracy of the deliveries bowled on the target to be kept in mind- It is important to note that while a fast bowler is bowling a 12 over or a 6 over spell with 2*6 overs spells. The study shows that the fast bowler lacks consistency. For that, if an S&C uses in match data to analyze how much overs a fast bowler has to bowl keeping in mind his training programs as well. This will give more consistent results. So, its important for an S&C to design an effective periodized program which involves lower body eccentric strength development by supramaximal loading, by increasing the eccentric tension in the muscles or Isometric pauses at the functional joint angles. More extended front knee allows better transfer of kinetic energy. So, for this eccentric training of the lower body is an effective method to deal with injuries related to lower back and ankle. So, eccentric training of lower body is an effective method to increase the duration of the number of overs a fast bowler is bowling. The number of overs that a fast bowler is bowling depends upon the run-up as well. Run-up speed affects the ball release speed. If the run-up is not smooth or is irregular then it will affect the run-up velocity and finally the ball speed as well. The bowlers who are having last 5m run-up faster are able to generate more speed. Fast Bowlers requires controlled rhythmic linear speed and these can be developed by working on motor skills of a particular fast bowler to improve their neuromuscular efficiency. Training fast twitch muscle fibre through heavy progressive loads will enhance speed measures in a fast bowler. ECC: CON overload training stimulus which makes the ankle and knee stiff are effective in speed development. Olympic lifts can be used to develop acceleration. So, in this way we have to design a effective periodized program with optimum load of a fast bowler to maximize his endurance to bowl more overs with less physiological fatigue and increased rate of accuracy.

2) Heart Rate measures and Rest Periods associated with the bowling activity- This is another aspect to be taken into consideration for fast bowlers. As ODI matches involves high intensity actions than multi day matches. So, its important to make a note that how an S&C will make an effective periodized program for a fast bowler playing an ODI format first or a multi day format first. Accelerometry and heart rate are analyzed based on the matches type and match state. Resting Heart rate(RHR) of elite fast bowlers are less as compared to medium fast bowlers. During bowling periods, there is increase in heart rate which increases the release of catecholamines, there by increasing the overall Blood Pressure at the time of bowling. Rest periods are also important and it depends upon the environmental conditions as well. If the environment is cold then a fast bowler can bowl more overs with lesser rest intervals in between the bowling spells and can bowl longer spells but if the temperature is hot and humid, then the fast bowler can bowl shorter spells thereby making the overall workload of a fast bowler more efficient and optimum in nature.

3) Blood Lactate Levels- The blood pressure levels depends upon the bowlers run-up. i.e. bowlers with longer run-ups or faster run-up speeds had higher lactate levels. Blood pressure levels does not accumulate during bowling spells which gives an indication that bowlers recover metabolically between deliveries and bowling spells. Blood glucose levels should be maintained in order to maintain high performance levels of bowling spells. This depends upon what nutrition he/she is taking in between there

bowling spells. Medium fast bowling upto 12 overs does not lead to decline in bowling speed or accuracy subject to environmental conditions.

4) Environmental conditions- The temperature plays the most important role for designing a periodized bowling program for a fast bowler. In a hot and humid temperature, shorter spells of high intensity should be given in the program and use of energy drinks and electrolytes will replenish the body's lost salts which increases the chances of high performance and rate of fatigue reduces. In cold temperature conditions, longer spells of 10-12 overs can be given to a fast bowler because rate of fatigue is very less and longer spells of 12 overs, a medium fast bowler can bowl.

5) Energy System Development- During the in match analysis of a fast bowler, blood lactate levels are high but the role of anaerobic metabolic system is moderate i.e. the ATP-PC r and the glycolysis pathways contributing to the bowling events which are helpful to design a more effective and precised periodized programs for fast bowlers. Further more, cardiovascular anaerobic energy depletion and energy supply depletion do not explain the effects of fatigue that occurs in fast bowlers. Fast bowlers do not enter into uprated high intensity acceleration- deacceleration phases which loads to specific muscular fatigue. There are increased chances of muscle damage(creatine kinase) and inflammation(C- reactive protein) that have been observed after bowling. Ability to withstand repetitive eccentric muscle action, in the lower body is very important for making a wider spectrum strength programs for fast bowlers.

It has been observed that the type of format a fast bowler is playing plays a vital role in deciding his/her effective load during that period of time. Suppose, a fast bowler has to play a full season of IPL consisting of a total of more than 16-18 matches including semi-finals and finals, then according to the research, mean heart rates are reported to be similar but peak heart rates are higher in T20 formats. Using the methods which increases the performance of a fast bowler are important.

Bio- Banding for Fast Bowlers

When it comes to the workload management of fast bowlers during there competition training phase, it is based on the stages of maturation. This is called synergistic adaptations. Synergistic training techniques should be added in order to create a holistic and balanced structure of training stress that will maximize strength gains, reduces the risk of injuries and improves overall performance. Synergistic training prevents imbalances which leads to improved movement. It involves variety of training modes to improve the body's total peak capacity. While designing an effective periodized program for a fast bowler, synergistic training should be added in order to eliminate strength and postural imbalances. The body uses repetitive movements which leads to injury. Using a variety of movement patterns in a training program will help reduce effects of repetitive movements and eliminate risk of injuries. Synergistic training for fast bowlers involves some exercises which I have used in my program, they are as follows:

Isometric Lunge banded(2.5kgs each side)	2 Sets	15 Sec each side
Banded Military Press	2 Sets	8-10 reps
Banded unbalanced military shoulder press	2 Sets	8-10 reps
Banded underhand grip shoulder shrugs	2 Sets	8-10 reps
One arm med ball vertical throws	2 Sets	6-8 reps
Core Tri set(Russian Twist, sideways KB plank crunches, Plank hold alternate changes)	1 Set	90 sec.

Physiological Reasoning behind effective periodization

1) Effective periodization should involve isometric training that leads to greatest activation levels. It means there will be recruitment of more muscle motor units. Studies has shown that a fast bowler can recruit 5% more motor units/ muscle fibre during maximal isometric phase rather than during a maximal eccentric or concentric phase. So, ISO training can be used pre training or pre tactical bowling session as a part of RAMP warm up. RAMP stands for Raise, Activate, Mobilize and potentiate.

2) Oscillatory Training enhances the potential of a positive transfer of training. These are the exercises which can be used as a great finishing exercises following the desensitization of the GTO(Golgi Tendon Organ) by ISO exercises. It is advanced type training that respects reciprocal inhibition of the agonist and antagonist muscles. OC training develops tissue tolerance. By using OC methods, the total number of signals send in a particular position are maximized in the push-pull execution of a movement as high forces are applied which increases high motor unit recruitment.

3) Triphasic Training methods are another important aspect behind effective periodization for a fast bowler. How to produce a stress on an athlete can be adjusted by changing the loading parameters i.e. changing the exercises, weight on the bar, method of movement and the number of training sessions per week. New or increased level of stress must be given to the athlete all the time to see continuous changes in the training effect. An example for a fast bowler would be an increase in the run-up speed and follow through. So, here we will be giving a sample program for a fast bowler training In-season(Age-19-20yrs):

Banded Chest Toss	3 Sets	10-12 Reps	2-3 Kg Med Ball
Med ball slams	2 Sets	8 Reps	6-8 kg slam ball
Banded Step ups	2 Sets	8 Reps	Medium/heavy/light depending upon the resistance
Rear elevated split squat jumps	2 Sets	6 Reps	
Med ball slams with 4 balls bowling with full run-up	3 Sets	4 Reps	4 Reps with Med ball and then bowl with 250g(4 Balls)- 1 st set. 4 Balls with 2Reps with med ball- 2 nd set. 4 balls with no rep. with med ball- 3 rd set.

The above program had showed a positive impact on a fast bowler by improving his overall elastic strength, ROM(Range of motion) and quick trunk movements which helped him generating more speed of the surface in the next bowling session. This is a sample program I have shared of the 12 week bowling program of a fast bowler I was training.

4) Another effective method for management of load of fast bowler during there In-season is to add more skill specific programs. Working to improve the neuromuscular efficiency of a fast bowler will improve his overall consistency. One such skill specific training program is to work on extensibility. Front foot contact(FFC) ISO hold improves structural integrity, remodeling of fascia and re-mapping the various patterns. Front leg compliance relies on extensibility, not on flexibility. Flexibility with emphasis on static stretching more leads to less elastic capacity. SSC(Stretch Shortening Cycle) is essential on FFC with longer ground contact. So, we should be very much careful in differentiating between stretching and loaded flexibility or ISO holds. There can be a reason that while designing a program for a fast bowler you misunderstand the difference between flexibility and extensibility. A fast bowler demonstrating good flexibility does not mean that he will be having good extensibility. A fast bowler needs to be as tight as possible yet extensible enough. So, to add isometrics and skill stability programs will benefit a fast bowlers overall bowling performance to bowl quick.

Speed is the Key for Fast Bowlers

Effective periodization in conditioning a fast bowler and that to In season depends upon how much distance they cover in a particular format. If I take an example of a multi day format, in a 5 day cricket, a fast bowler has to bowl a lot of overs in short spells. Environmental conditions and recovery periods after spells is another important factor to design a conditioning program for a fast bowler. Here I use the speed development program including the overspeed training. Especially the overspeed training which teaches the vestibular system to go faster in your run-up or sprint. It signals to run as fast as possible. While running faster, the body always search for safety and protection. Running faster is a high octane skill which is inhibited if we don't teach the vestibular system that- "Yes its OK to run faster, no problem in it". So, running with your full intensity in your run-up without applying any brake in between will help the fast bowlers to develop overspeed.

Bowling constantly with the same intensity in the matches, nets and training sessions develops a speed barrier which is very difficult to break if it comes into our muscle memory. This results in adapting our body to 70-80% zone, where the body will no longer feel to break that zone barrier. The body will be happy to apply that 70-80% intensity in bowling, that will carry out in the match situation as well. Try to break that 80% barrier in order to bowl fast. "Speed, Speed, Speed what the fast bowlers need". So, In season periodization , I will specifically be working on the bowling skills and bowling related conditioning skills to get developed and enhanced time by time. Three different approaches we can use with the fast bowlers, they are:

- 1) **Bowl with Longer approach(Sprint as fast as you can and bowl without any target)**- The aim is to go as fast as possible without thinking about our initial run-up. Just have to start running from a long distance with full intensity and bowl the ball without any direction constraints. If you are in your early part of your program, then try to take a mat at the landing front foot to reduce stress on the joints.
- 2) **Bowling with assistance(using bands or weighted sledge)**- Assisted bands of medium resistance or light for kids will try to pull you through the crease. This will assist you for getting off from your back foot quickly by transferring force towards front foot. This also helps to increase Ground reaction force(GRF) and overall RFD(Rate of force development) in a fast bowler.
- 3) **Slingshot Bowling system**- In this system, the bowler is only assisted with the additional resistance in the beginning of the momentum or start of his run-up and during the time of delivery there are no additional bands or resistance involved to change the kinematics of a fast bowler.

Myths Regarding Speed Training

Another effective conditioning program to add on in the speed development program is to develop running speed. The running speed depends upon two factors- Stride cadence and Stride length. Stride Cadence refers to the number of strides taken per second and stride length refers to distance travelled by each stride. If one of the factors gets improved by making the other factor constant

then running speed will improve, which will help the fast bowler to develop large force productions at the time of delivering the ball. Don't try to artificially lengthen the stride of the athlete, this will result in distributing the COM (Centre of mass) of the athlete i.e. placing the foot ahead of the COM of the athlete which is dangerous and prone to injuries. Effective stride length should be the focus. Stride cadence depends upon contact time and flight time i.e. time spent on the ground with each stride to the time spent in the air on each stride. To improve stride cadence should be there which can be improved by shortening ground contact times rather than focusing on cycling the legs faster. So, we have to focus on maximizing the horizontal impulse by exerting vertical forces to overcome gravity in order to give sufficient time for the repositioning of the legs for the successive strides. So, in order to break the myths regarding the biomechanics involved in speed training an efficient work: rest ratio with sufficient drills to add on to improve the overall gait analysis of the fast bowler. This makes the fast bowler more resistant to injuries and can make him more faster and quicker.

A sample program what I have used for fast bowlers in developing their running speed and overall speed development is given below:

Fast, faster, fastest drill to work on the initial acceleration, mid acceleration and deceleration of a fast bowler. I used a stopwatch to note the final 20m distance of the athlete. The reading of six sprints are:

1 st Sprint	2.50sec
2 nd Sprint	2.63sec
3 rd Sprint	2.63sec
4 th Sprint	2.48sec
5 th Sprint	2.58sec
6 th Sprint	2.56sec

After 6 Sprints of one set is over, arrest interval of 4 min. is given while you are focusing on Low volume, High quality sprint sessions.

Second set, I made the fast bowler to run a 40m sprint in less than 6 sec. The norms of the 6 sec of the fast bowler (aged 19 years) are as follows:

1 st Sprint	5.83sec
2 nd Sprint	5.83sec
3 rd Sprint	6.06sec
4 th Sprint	6.17sec
5 th Sprint	6.10sec
6 th Sprint	6.36sec

Limitations of Deciding efficient load and periodization of fast bowlers

The work load of every fast bowler is different. It varies with the type of fast bowler whether he/she is side on, semi-side on or front on. Due to different formats, a fast bowler may have different periodization and work load levels will also fluctuate. There are some aspects which are not considered as an in match events in the training programs. For example- In the nets, the fast bowler bowls one over and after that bowls the second one but the in match situation is totally different, where the fast bowler bowls one over and after that fields in the different area where he/she has to make an effort to stop the boundary and this makes difference in the intensity of an in match and net session situations. There are little or no data reported from competitive matches for this period. The fast bowlers after each over are placed at a position where least fielding activity will be involved so that the fast bowler can recover from his previous over fatigue. So, here considering that in relation to recovery could be an important research area for S&C coaches to investigate further in regards to the physical fatigue and optimization of workloads during in match days.

Moreover, effective workloads are easier to access for the shorter formats (like T20 and One day) but for longer formats (multi-day), these are uncertain as the number of spells may be longer or shorter depending upon the match conditions, weather, environment. Also, for elite level fast bowlers workload always varies according to their level of fitness and the total number of matches they have to play in a year. So, for elite fast bowlers who are bowling over 145-150km/hour, load management can be done but how much to do that is uncertain up till now as S&C coaches can only design a periodized program to minimize the risk of future injuries but cannot stop injuries to happen to fast bowlers. So, this point in the research is unknown up till now.

In summary different game formats, elite fast bowlers, medium fast bowlers, limited data availability and difference in bowling speeds noted across a research may affect the training strategies to be applied to make a periodized program for fast bowlers. With the coming up of so much formats and their fluctuations needs further investigation of how these formats will affect the training, performance, recovery and load distribution of a fast bowler should be a key research aim.

Practical Applications

Research has great potential to influence the professional aspects of fast bowlers in cricket. Further work is required to know the training models, work load efficiency, Program designing of a fast bowler by the S&C coaches to develop more skill based programs for fast bowlers. S&C coaches should research for other sports which have skills similar to fast bowlers in cricket. These types of applications will be useful for producing fast bowlers who can play for longer period of times without injuries.

From available evidences, fast bowling is an intermittent high intensity activity that is primarily anaerobic in nature with heart rates increasing and RHR decreasing. Although Match situations allows some recovery to fast bowlers. Fast Bowlers need a well trained anaerobic metabolic system to maintain this intermittent high intensity activity pattern. The time after the ball is delivered , S&C coaches have to design some programs in order to strategize those recovery periods after non bowling periods and after delivering the ball periods.

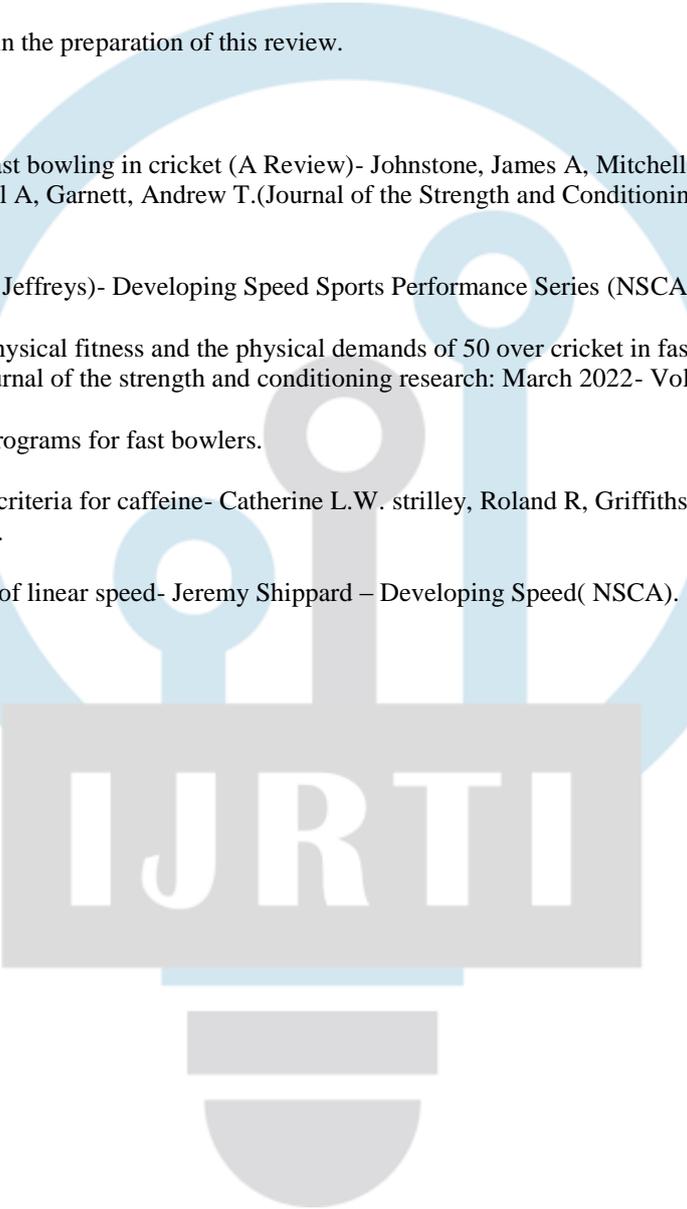
S&C coaches should design programs based on the data available to them via different research they have made or the researches which had already been made. Based on those data's, effective load management should be designed for fast bowlers with different biomechanical aspects. Moreover, In match workloads and off the match workloads should be monitored from time to time for optimal performance. So, S&C coaches should aim to develop training methods that may lead to enhancement of skills, reduced injury chances, improving the overall performance and enhanced recovery periods for longer span of fast bowling carrier.

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