

Strategic Injury Prevention in Cricket: A Periodised Strength and Conditioning Approach

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DOI: <https://doi.org/10.51583/IJLTEMAS.2025.1408000130>

Introduction

Injuries are part and parcel of every sport and player's career. Sports injuries are a big concern for all sports, albeit the frequency of injuries varies. Some sports recorded high injury rates whereas, some recorded less injuries. Contact sports have more injuries than non-contact sports. For instance, injury incidence in the sports of rugby league lies between 400-700 per 1000 hours of match play whereas, in Ice hockey, only 12 injury occurrence incidences have been recorded (1). Apart from whether a sport is contact or non-contact, a lot of sports injuries are determined by the intensity, frequency, and duration with which it is performed. While sports like basketball, football, and hockey are played at a high level of intensity, cricket is the sport that is played for the longest period of time, five days (test cricket). No other sport has such a long duration. This extended period of time not only puts a lot of strain on a cricketer's body, but it also causes mental exhaustion in the players. Henceforth, it is now necessary to consider a sport and the injuries associated with it from a broader perspective.

Cricket is an international sport, being played in more than 100 countries in the world (2). Though it was first played in Europe, later it became very famous in the western parts of Asia. Some of the prestigious international tournaments are- the Ashes trophy, Border-Gavaskar trophy, International Cricket Council's champions trophy, and the World cup. Apart from international tournaments, there are many domestic tournaments which are played in various countries, for example, Ranji trophy, Syed mushtaq ali trophy, Vijay hazare trophy etc. in India, County championship etc. in England, Sheffield shield trophy etc. in Australia (3). Cricket involves large physiological demands, being an aerobic sport at times it is classified as an interval sport with both aerobic and anaerobic aspects (4). Most of the cricket movements require less than 6 sec to complete, jumping, catching, sprinting behind the ball, slogging a ball, taking a run, or bowling a ball, these are a few examples of cricket movements (5). All of the aforementioned moves are quick and require excellent precision, such as throwing a ball by the fielder to the wicketkeeper from a distance of 80-90 meters. A player may sustain an injury as a result of these movement patterns and the demands that come with them (6).

Despite the fact that cricket is a non-contact sport, still the number of injuries among cricketers is on the rise (7). In this paper we shall cover the many causes of injuries in cricketers and what may be done to prevent them with the help of strength training. Throughout the year players play in various leagues, with no formal off-season. With the emergence of t-20 leagues in various parts of the world, it's almost impossible for players to take formal rest (8). Players have to play all their respective board matches, where they represent their own country, and along with this, they like to take part in other cash-rich leagues, for example. Indian premier league, the Big bash league, the Caribbean league, etc. (9). Private leagues are not only lucrative in terms of money but they also provide a good platform for the domestic players to showcase their talent. No player wants to lose out on such an opportunity, therefore the entire strain on cricketers has increased dramatically, which was not the case in the past (10). One of the main causes for the rising injury rate in cricket is the increased workload (11). Playing and performing at a competitive level all year is really challenging.

2021	
April to May	Indian Premier League (IPL)
June to July	World Test Championship
	India vs Sri Lanka (3 ODIs, 5 T20Is)
	Asia Cup
July	India vs Zimbabwe (3 ODIs)
July to September	India vs England (5 Tests)
October	India vs South Africa (3 ODIs, 5 T20Is)
October to November	ICC T20 World Cup
November to December	India vs New Zealand (2 Tests, 3 T20Is)
	India vs South Africa (3 Tests, 3 T20Is)
2022	
January to March	India vs West Indies (3 ODIs, 3 T20Is)
	India vs Sri Lanka (3 Tests, 3 T20Is)
April to May	Indian Premier League (IPL)
July to August	India vs England (3 ODIs, 3 T20Is)
	India vs West Indies (3 ODIs, 3 T20Is)
September	Asia Cup
October to November	ICC T20 World Cup
November to December	India vs Bangladesh (2 Tests, 3 T20Is)
	India vs Sri Lanka (5 ODIs)

Image 1- Team India's cricket schedule for year 2021-2022

There are various injuries that are sports specific, whereas few injuries that occur in almost all sports, for example, hamstring strain (12). Hamstring strain is a very common injury in almost all field-based sports (13). There are few injuries that can be considered as sports specific and position-specific. For example lower back stress fracture in the fast bowlers, tennis elbow among batsmen in cricket (14). Though the fast bowlers are more prone to injuries in cricket but with the advent of high intensity t-20 leagues, no one in cricket is immune from the injuries. There are several studies that found that two major reasons behind fast bowler injuries are workload and bowling action. Fast bowlers are the most vulnerable to injury in cricket, out of the total, 41.3 % of injuries are recorded by fast bowlers followed by fielding and wicket-keeping which accounts for 28.6% of injuries (15). Other than the bowling action and workload several other factors may contribute to injuries among fast bowlers, playing conditions is such a factor. For example, bowling against the wind on New Zealand grounds required extra effort from the fast bowlers which may increase the total workload. Henceforth, there should be a mechanism to classify injuries in sports (cricket) (16).

Sports Injuries- a way to classify injuries in sports (cricket).

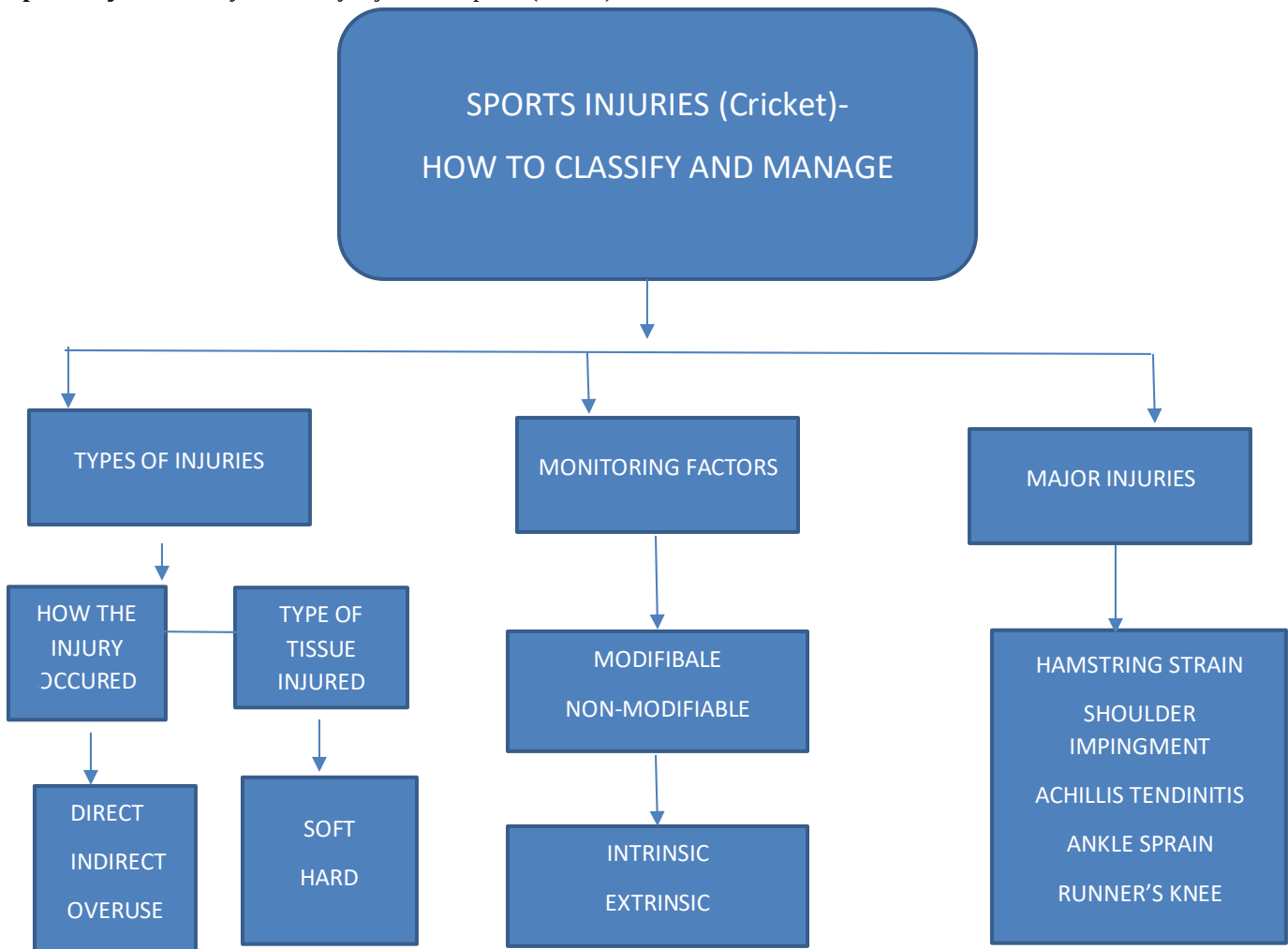


Chart1- How to classify sports injuries.

AIM-The aim of this paper is to reduce the risk of injury among cricketers through a periodised strength and conditioning plan. Most of the studies done in the field of cricket mainly focused on the fast bowlers (17), whereas in this paper we tried to cover all the cricketing positions and bring down the injury rate for players involved in cricket.

Player	League	Team	Position	Injury
Tom Abell	Pakistan Super League	Karachi Kings	Batsman	Knee
Ashton Agar	Men's International	Australia	Bowler	Illness
Taskin Ahmed	Men's International	Bangladesh	Bowler	Shoulder
Abid Ali	Men's International	Pakistan	Batsman	Chest
Jofra Archer	Indian Premier League	Mumbai Indians	Bowler	Elbow
Jackson Bird	Big Bash League	Sydney Sixers	Batsman	Shoulder
Brydon Carse	Men's International	England	Bowler	Knee
Deepak Chahar	Indian Premier League	Chennai Super Kings	Bowler	Back

Nathan Coulter-Nile	Indian Premier League	Rajasthan Royals	Bowler	Side
Tom Curran	Big Bash League	Sydney Sixers	All Rounder	Back
Josh Davey	Men's International	Scotland	All Rounder	Groin
Sarel Erwee	Men's International	South Africa	Batsman	Hamstring
Avishka Fernando	Men's International	Sri Lanka	Batsman	Knee
Harry Gurney	Big Bash League	Melbourne Renegades	Batsman	Shoulder
Mehidy Hasan Miraz	Men's International	Bangladesh	All Rounder	Finger
John Hastings	Pakistan Super League	Quetta Gladiators	Batsman	Hamstring
Shahadat Hossain	Men's International	Bangladesh	Bowler	Suspension
Shoriful Islam	Men's International	Bangladesh	Bowler	Ankle
Kyle Jarvis	Men's International	Zimbabwe	Bowler	Back
Arshad Khan	Indian Premier League	Mumbai Indians	Bowler	Hamstring
Vivian Kingma	Men's International	Netherlands	Bowler	Lower back
Sisanda Magala	Men's International	South Africa	Bowler	Knee
Tymal Mills	Indian Premier League	Mumbai Indians	Bowler	Ankle
Adam Milne	Indian Premier League	Chennai Super Kings	Bowler	Hamstring
Thangarasu Natarajan	Indian Premier League	Sunrisers Hyderabad	Bowler	Hamstring
Michael Naser	Big Bash League	Brisbane Heat	All Rounder	Strain
Pathum Nissanka	Men's International	Sri Lanka	Batsman	Back
Ollie Robinson	Men's International	England	Bowler	Spasms
Jason Roy	Pakistan Super League	Quetta Gladiators	Batsman	Suspension
Mohammad Saifuddin	Men's International	Bangladesh	All Rounder	Back
Rasikh Salam	Indian Premier League	Kolkata Knight Riders	Bowler	Back
Tim Seifert	Indian Premier League	Delhi Capitals	Wicketkeeper	shoulder
Naseem Shah	Men's International	Pakistan	Bowler	Shoulder
Steve Smith	Men's International	Australia	Batsman	Elbow
Washington Sundar	Indian Premier League	Sunrisers Hyderabad	Bowler	Hamstring
Brendan Taylor	Men's International	Zimbabwe	Batsman	Hamstring
Georgia Wareham	Women's Big Bash League	Melbourne Renegades	Bowler	Knee
Mark Wood	Men's International	England	Bowler	Elbow

Table 1- Injuries among elite cricketers all over the world in last two months.

Unlike other sports, cricket is played in a number of formats, making it more difficult for coaches to manage the workload **(18)**. In a test match, for example. In a 5-day game, fast bowlers must bowl more than 50 overs, however in a T-20 format, they can only bowl 4 overs **(19)**. As a result, before signing bowlers to any kind of strength and conditioning programme, coaches must understand the difference in workload. In the graph below, you can observe how different formats of cricket affect injury rates among Australian cricketers. The shorter the format, the higher the number of injuries. This is due to the level of intensity, short duration games are higher in intensity as compare to the long duration games. This is a pure example of how intensity and volume can push athletes towards injuries **(20)**.

Year	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Average
Batsman	5.40%	7.00%	6.70%	7.30%	9.10%	9.20%	5.60%	7.80%	9.80%	5.60%	7.40%
Wicketkeeper	0.50%	1.70%	3.00%	9.00%	8.00%	13.60%	1.20%	3.20%	2.90%	2.80%	4.70%
Pace bowler	18.80%	18.80%	19.70%	21.00%	24.20%	25.00%	19.80%	16.90%	18.70%	21.70%	20.60%
Spinner	4.00%	9.90%	3.80%	3.50%	10.80%	10.40%	10.80%	4.70%	4.70%	6.30%	6.70%
All positions	10.30%	11.40%	11.10%	12.80%	15.90%	16.00%	11.60%	10.80%	12.20%	12.20%	12.50%

Table 2- Injury prevalence by playing position in cricket Australia from 2006 to 2016

YEAR	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Average
T20 cricket	200	282	100	91	328	127	172	200	241	2k20	194
Domestic 50 over	220	233	355	290	323	440	200	250	205	152	271

Domestic First-Class	112	153	150	92	158	160	94	119	110	83	117
ODI (50 over)	222	200	217	256	407	156	250	286	296	500	263
Test cricket	91	143	83	69	122	106	95	107	207	193	118
All matches combined	143	180	167	130	215	184	133	151	160	145	155

Table 3- Injury match incidences among various formats of cricket (new and recurrent injuries /1000 days of play)

II. Short literature Review

Factors associated with injury

No athlete wants to get injured, but it is not always in their control; injuries frequently occur as a result of unforeseen circumstances for which no one has a solution. There have been multiple instances where players have been hurt off the field the night before critical matches, causing them to miss that match, and this injury can cost a team the entire tournament (21). For instance, an athlete who is sponsored by a brand is under a contractual obligation to shoot an advertisement and he must do a mock-up run for the commercial (22). The athlete who is already working round the clock on his tournament, tired down by the cyclical travelling will inadvertently be at an additional risk that he could have avoided but the binding contract demands he does so (23). Henceforth, coaches need to have a holistic approach to avoid or keep injuries at minimum.

As previously stated, various factors may contribute to the injuries of athletes. There are several modifiable and non-modifiable factors associated with the injuries (please check the table below). In simple language factors which are in control or can be modified by an athlete or the support staff can be called modifiable factors (24). For example fitness level of the players, their warm-up and strength session routines, playing time, playing surface, and equipment, these factors can be modified in the favour of the athlete to avoid certain injuries (25). Along with modifiable factors, coaches need to be aware of several non-modifiable factors, factors that can't be controlled by either the athlete or the coaching staff. Age, gender, previous injury, and weather condition are a few examples of non-modifiable factors (26).

Bowling Action- Fast bowlers known for being the most injured among other cricketing positions and bowling action is one of the prime reason for it. Bowling action in itself is complex in nature, the shoulder joint experiences aberrant torque during bowling (27). The non-bowling arm of a bowler is quickly brought down from a maximum elevated point with lateral flexion during the final bowling action, which can cause side strain in fast bowlers (28). A side strain is an abrupt tear of the internal oblique muscle. The oblique muscles are put under a lot of stress while delivering the ball and then lateral flexing aggressively when reaching the crease, which is not observed in other cricketing positions. (29).

Another injury which largely associated with the complex nature of fast bowling is a lower back stress fracture (lumbar spine injuries) (30). Due to high rotation stress and lateral flexion during the bowling fast bowlers are most likely to get lumbar spine injuries (31). Arora M et al. 2014 in their study found that 21% to 65% of fast bowler's injuries are associated with lumbar disc injury of which 4% to 33% of bowlers face disc degeneration (32).

Bowling Workload- Apart from bowling, due to high physiological demands fast bowlers are at higher risk of injury and have short careers as compared to spinners, batters, or wicketkeepers (33). Fast bowlers compete at the highest level in all forms of cricket. Fast bowlers played a vital role in any team's outlook. Fast bowlers, on average, have 35 percent less time to recuperate between high-intensity attempts than batters, spinners, or wicketkeepers. (34). Apart from bowling, fast bowlers need to run in the fielding too, which exaggerates the overall workload. In a one day match, fast bowlers covered a mean distance of 6.5 (± 0.5 km), whereas fielders and batters cover 5.9 (± 0.9 km) and 1.7(± 1.2 km) respectively (35).

AGE- According to MR Stevenson et al. 2009 research, the injury rate among players rises as they get older (36). As athletes get older, they notice changes in their bodies such as a decrease in fast-twitch (type II) muscle fibres, a decrease in overall muscle mass, a decrease in strength and power, an increase in tendon stiffness, and a loss of flexibility (37). Age not only slows down an athlete, which can lead to multiple injuries, but it also slows down the post-injury recovery process, extending the time it takes for an athlete to return to the field (38). According to many sports science research, an injured athlete under the age of 30 recovers at a rate of 15 to 18 percent faster than a similarly injured 40+ year-old athlete (39).

Gender- To reduce injury rates and increase healing among athletes, it is necessary to understand how an athlete's gender influences his or her injury. Injuries are influenced not just by training and other factors, but also by the athlete's gender. Several studies have found that female athletes are more prone to injuries than their male counterparts (40). Ankle sprains, ACL tears, and shin splints are examples of ailments that are more common among female athletes (41). Female athletes, in comparison to male athletes, are more prone to lower body injuries due to their anatomical build-up (wider hip) (42). Female athletes outperformed male athletes

not just in lower body injuries, but also in upper body injuries. Due to the lack of shoulder strength and stability as compared to the male athletes, female athletes recorded more upper body injuries too (43).

Reasons for this difference in injuries rate among the male and female athletes could be but are not limited to-

1 Anatomical structure- Female athletes, as previously noted, have a wider hip (pelvis) area, making them a strong candidate for lower body injuries. Furthermore, females have less muscular mass than males, making them more susceptible to sports-related injuries (44).

2 Looser Ligament- female athletes tend to have more flexibility than male athletes. This flexibility when combined with less muscular strength may result in injuries (45).

3 Higher estrogen Levels- it has been seen that higher estrogen levels can result in weak ligaments and tendons, henceforth, female athletes are more prone to sports injuries. A spike in women's injuries is recorded during the period when females tend to have higher estrogen levels, i.e., the period during puberty and during the menstrual cycle too (46).

4 Nutrient Deficiency- It has been seen that female athletes are more nutrient deficient than the male athletes, when combined nutrient deficiency with the menstrual cycle things may go worse, and due to these factors female athletes' body stay low in the energy level and hence they have more chances to receive the injury as compared to the male athletes (47). For example, a female who is participating in weight class sports (boxing and weightlifting) might have to cut down on her offseason weight drastically which might lead to severe nutrient deficiency. This swing of weight takes a toll on the mind and the body which makes it harder for her to maintain her weight and her performance. Unlike boxing, at the end of the day, any woman participating in the sport postpartum would require a lot of time and effort to recover from the changed lifestyle and biomechanics.

Previous injury- Previous injuries are among one of the main reasons for athletes to miss their matches. Recently incidences of recurring injuries are growing in track sprint events as well as in team sports (48). In their study Chamari et al. 2013 found out that 33% of hamstring injuries among sports-persons will recur and a majority of these recurrence episodes are recorded within the first two weeks after the player is cleared for return to play (49). In their study Hagglund et al. 2006 stated that the risk of injury recurrence remains elevated for a year and furthermore alarming issue is that, recurrence injury could be more severe than the original injury (50).

This recurrence of injuries could be due to a variety of factors, the most common of which being players' haste to return to the field (51). An injured athlete not only missed numerous critical matches from his schedule, but he also lost a significant amount of money in match fees and awards. Furthermore, an injured player is always afraid of losing his endorsements, which are crucial to an athlete's financial health. So in fear of not losing on the financial front at times a player give false feedback about his injury and henceforth, he return to play without being completely fit. For example, in a tournament like IPL, players spend a major part of their daily schedule in front of the cameras, either shooting for an ad or giving an interview or interacting with the fans and signing various merchandise for the fans. As a result of their prior commitment and contract, players cannot ignore such things. With these endorsements, not only the players get benefitted but also their respective franchises (52).

Along with the players even coaching staff these days are under huge pressure for the game result. Therefore, at times players are pressurized by the coaching staff to play without being completely fit or with light niggles, which later on causes a serious major injury.

Weather condition-

Weather circumstances can have a significant impact on a player's ability to perform. Weather conditions can have a big impact on the outcome of a cricket match (53). Unlike football and rugby, cricket is not played in wet weather, however injuries have been reported among players due to the slick and damp outfield. Major cricket tournaments in India take place from April to November, and a large portion of this time is spent in scorching heat. From April through November, the average temperature is 38 degrees Celsius. It's difficult to play in such hot weather, and players need to stay hydrated all of the time (54). Players under such situations are prone to heat stroke and heat exhaustion. Players may experience muscle cramps and soreness as a result of the harsh weather conditions (55).

Common Cricket Injuries- Injuries can be grouped into the following categories- muscle strain, ligament sprain, cartilage damage, bone fracture, over-use injuries for example tendonitis, bursitis, fasciitis, Stress fracture. Injuries further can be grouped into upper-lower body category.

Upper Body Injuries

Shoulder impingement, tennis elbow, lower back stress fracture

Lower Body Injuries

Hamstring strain, IT band friction syndrome, Ankle sprain, and Achilles tendinitis, Runners knee.

A data on various injuries among cricketers has been posted below (Table 4)

Muscle strain- Muscle strain injury is generally associated with muscle or tendons. These kind of injuries can be occur from overstretched or overuse of a particular area (56).

Muscle sprain- Muscle sprain injury is associated with the ligament. It happens due to overstretch or excessive load (57). These kinds of injuries can also be caused by lack of strength, coordination and instability in the joints to handle the external load, and exercise movement (58). Muscle sprain is further divided into grades as per the severity of the injury (as mentioned below in the figure).

Severity	Physical Examination Findings	Impairment	Pathophysiology	Acute Care
Grade I	Minimal tenderness Minimal swelling	Minimal	Microscopic tearing of collagen fibers	RICE
Grade II	Moderate tenderness Moderate swelling Decreased ROM Possible instability	Moderate	Complete tears of some, but not all, collagen fibers in the ligament	RICE Physician evaluation
Grade III	Significant swelling Significant tenderness Instability	Severe	Complete tear/rupture of ligament	Immobilization with air splint RICE Prompt physician evaluation

Image 2- Grade system of injuries, taken from the ACE manual.

Cartilage damage- Cartilage is a flexible connecting tissue found throughout the body it provides a cushion to the joints (59). The area of the knee is very common for such kind of an injury. Repetitive drills, (running, jumping) may develop such type of injury among athletes (60). Age is also a major factor in cartilage damage among the players (61).

Bone fracture- This type of injury generally occurs due to any direct impact for example collision between the players or a direct blow with a ball (62).

Overuse injuries- Common overuse injuries are- tendinitis, bursitis, and fasciitis. Tendinitis can be identified by an inflammation or pain at the tendon. Commonly occur in the ankle, elbow, knee, and shoulder (63). Bursitis is known for inflammation at bursa and common areas affected with this are the knees, hip and shoulder (64). Fasciitis can be identified by inflammation at fascia. The most common areas for fasciitis are the sole and back of the feet (65).

Stress fracture- Stress fracture can be the result of repetitive stress by compression forces on a bone. Lower back stress fracture is a common injury among fast bowlers, esp. those who bowl over 140 km/hr. (66).

Injury Prevention Strategic Plan-

DAY 1- HYPERTROPHY	WEEK 1			WEEK 2			WEEK 3			WEEK 4		
	SETS	REPS	LOAD	SETS	REPS	LOAD	SETS	REPS	LOAD	SETS	SETS	LOAD
FRONT SQUATS	3	10	60%	3	10	65%	3	10	65%	3	12	50%
DEADLIFT	3	10	60%	3	10	65%	3	10	65%	3	12	50%
HIP THRUSTS	3	10	60%	3	10	65%	4	10	65%	3	12	50%
PEC DECK	3	10	60%	3	10	65%	4	10	65%	3	12	50%
REVERSE PEC DECK	3	10	60%	2	10	65%	4	10	65%	3	12	50%
SEATED ROWING	3	10	60%	3	10	65%	4	10	65%	3	12	50%
NORDIC CURLS	3	10	BW	3	12	BW	4	10	BW	3	12	BW
WEIGHTED ANKLE EXTENSION	3	10	30%	4	10	30%	4	12	30%	3	12	30%
ABDOMINAL CRUNCHES				AMRAP (as max reps as possible)								
REST IN BTW SETS	45-60SEC			45-60SEC			30-45 SEC			45-60 SEC		

DAY 2- POWER	WEEK 1			WEEK 2			WEEK 3			WEEK 4		
	SETS	REPS	LOAD	SETS	REPS	LOAD	SETS	REPS	LOAD	SETS	SETS	LOAD
JUMP SQUAT	3	5	20%	3	5	25%	3	5	30%	4	4	BW
FAST SNATCH FROM BLOCKS	3	5	60%	3	5	65%	3	5	70%	3	5	55%
DB POWER CLEAN TO JERK	3	5	60%	3	5	65%	3	5	65%	3	5	55%
BENCH PRESS THROW	3	6	30%	3	5	33%	3	5	35%	3	5	30%
MEDICINE BALL SLAM	3	6	10KG	2	10	10KG	4	10	10KG	3	12	10KG
SCOOP TOSS	3	6	10KG	3	6	10KG	4	6	10KG	3	8	10KG
LATERAL TOSS	3	6	10KG	4	6	10KG	4	8	10KG	3	8	10KG
WOOD CHOP	3	5	5KG	3	5	7KG	3	5	10KG	3	3	5KG
REST IN BTW SETS	2-3 MNTS											

DAY 3- HYPERTROPHY	WEEK 1			WEEK 2			WEEK 3			WEEK 4		
	SETS	REPS	LOAD	SETS	REPS	LOAD	SETS	REPS	LOAD	SETS	SETS	LOAD
STIFF LEG DEADLIFT	3	10	60%	3	10	65%	3	10	65%	3	12	50%
INVERTED ROWING	3	10	60%	3	10	65%	3	10	65%	3	12	50%
CABLE ROPE PULL OVER	3	10	60%	3	10	65%	4	10	65%	3	12	50%
GROUND PRESSES(db)	3	10	60%	3	10	65%	4	10	65%	3	12	50%
ANTERIOR DELT PLATE RAISES	3	10	60%	2	10	65%	4	10	65%	3	12	50%
PRONE CURLS	3	10	60%	3	10	65%	4	10	65%	3	12	50%
NORDIC CURLS	3	10	BW	3	12	BW	4	10	BW	3	12	BW
CABLE KICKBACKS	3	10	30%	4	10	30%	4	12	40%	3	12	30%
WIPERS	AMRAP (as max reps as possible)											
REST IN BTW SETS	45-60SEC			45-60SEC			30-45 SEC			45-60 SEC		

Image 3- Four weeks Injury prevention plan for cricketers.

Body region	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	Average
Hamstring strains	3.1	8.2	12.4	7.3	7.9	10.1	11	9.4	9.8	7.7	8.7
Side and abdominal strains	5.1	7.1	5.4	6.7	4.7	7.6	7.7	7.2	4.9	4.4	6.1
Wrist and hand fractures	1.5	4.9	4.9	6.1	8.4	3	5	4.4	6.6	2.8	4.7
Groin injuries	4.1	3.8	4.9	2.2	6.3	5.6	5.5	4.4	4.4	3.9	4.5
Other lumbar injuries	3.1	5.5	1.1	3.3	6.8	5.6	3.3	5.5	4.4	1.7	4
Other shin, foot, and ankle injuries	2	2.2	4.3	2.2	4.2	5.1	3.3	2.2	2.2	4.4	3.2
Lumbar stress fractures	3.6	1.1	2.7	2.2	3.7	4	2.2	2.2	4.9	5	3.2
Medical illness	4.1	4.4	3.8	1.1	2.6	4	1.7	3.3	2.7	1.7	3
Calf strains	3.1	1.6	0.5	2.8	1.6	2.5	2.8	3.3	4.9	6.1	2.9
Quadriceps strains	2.6	1.1	2.7	2.8	1	3.5	4.4	4.4	3.3	2.8	2.9
Other wrist/hand injuries	1.5	1.6	2.7	2.2	3.7	3.5	5	2.8	1.6	2.2	2.7
Ankle and foot sprains	3.1	3.8	4.3	2.2	3.7	3.5	2.8	1.1	1.6	0.6	2.7
Knee cartilage injuries	3.1	1.6	1.6	4.5	3.1	0	1.7	2.8	1.6	0	2
Shin and foot stress fractures	2	1.6	2.7	1.1	1.6	1.5	2.8	1.7	0.5	3.9	1.9
Other knee injuries	1.5	1.1	1.6	1.7	1.6	2.5	2.8	1.7	1.1	1.1	1.7
Shoulder instability	1	2.7	1.1	2.2	1	0.5	2.2	0.6	0.5	2.8	1.5
Buttock and other thigh injuries	2	1.6	1.1	1.7	1	2	2.2	1.1	0	1.1	1.4
Shoulder tendon injuries	2	1.1	1.1	1.7	2.1	2	0.6	1.1	0.5	0.6	1.3
Other elbow/arm injuries	1	1.6	1.1	2.2	1.6	1	0.6	0.6	0.5	0.6	1.1
Other shoulder injuries	0.5	1.6	0	0	0	1.5	0	2.2	1.6	1.7	0.9
Concussion	0	0.5	0	0	0.5	0.5	0.6	0	2.2	4.4	0.9
Chest/abdomen impact injuries	1	0.5	0	1.1	1	1	0.6	0.6	1.6	1.1	0.9
Fractured facial bones	0.5	0.5	1.6	0.6	0.5	1.5	0.6	0.6	0	0	0.6
Other trunk injuries	0.5	0	0.5	0.6	0	1.5	0	0	0.5	0.6	0.4
Hip joint injuries	0.5	0.5	0	0	0.5	0.5	0.6	1.1	0.5	0	0.4
Neck injuries	1.5	0	0	0	0.5	0	0	0	0	0.6	0.3

Other head and facial injuries	0.5	0	0.5	0	0	0	0	1.1	0	0	0.2
Arm/forearm fractures	0	0	0	0	0	0	0	0	0.5	0	0.1
Heat-related illness	0	0	0	0	0	0	0	0	0	0	0
All injuries	54.6	60.7	62.8	58.6	69.7	74.2	69.5	65.4	63.4	61.2	64

Table 4- Annual injury incidence in cricket Australia (new injuries per 100 players per year).

Although data on the nature and incidence of cricket-related injuries exists, there is a scarcity of literature on injury prevention programmes and initiatives (67). The injury prevention plan should be progressive and suitable to all the positions in cricket. Furthermore, it is very important for the practitioners to keep in mind the demands of the game as per the specific position of a player. For a reference, fast bowlers need to bowl quite often more in the longer format of cricket (test match) as compared to T20 cricket. On the contrary, the major load of bowling in days cricket (test match) comes on the shoulders of spin bowlers, who at times bowl 20-30 overs a day (68). Therefore, it is very important for coaches to understand the workload as per the specific position of a player. There are several incidences in cricket where talented and bright cricketers left cricket in mid-way due to an injury, esp. in countries like India where sports science is still in its developing phase (69). The hard truth is that not only players but even coaches and medical professionals are unaware of strategies to prevent injuries. A properly researched and well implemented injuries prevention strategic plan can reduce the injury rate among cricketers, moreover, it can stop the premature termination of young cricketer's career (70). This will not only increase the participation in the game but also ensures an athlete's career longevity.

Warm-up, cool down, nutrition, corrective biomechanics, pre-post practice stretching, proper equipment, and playing surface, etc are some of the areas which at times overlooked by the coaches and as a result players suffer injury (71). In order to curb the injuries, athletes and coaches need to be aware of all the injury prevention strategies from time to time.

Periodized plan- Systematic division of year-long training interventions of an athlete is known as periodization (72). A periodized plan enables an athletes to stay in the peak condition at appropriate time and for crucial matches. Moreover, it helps them to perform at their best throughout the year (73). For the coaches it is important to ensure the training loads are managed properly, otherwise it could lead to performance plateaus, overtraining and injury. In order to keep injuries at bay it is very crucial for coaches to propose a well-researched and balanced programme spanning over the season (74). Using the team's calendar for the year 2021-2022, (Image 1), the month of June is primed for our athletes' to taper off on the intensity and recover actively.

Load Management

Cricketers have been competing around the clock since the introduction of major leagues, leading to overtraining and overload. The frequency has risen dramatically as a result of over-involvement in sports (75). This is when load management comes into play to mitigate the negative consequences of greater frequency. According to several research, increasing the workload by 15% from the previous week raised the risk of injury by 21-49 percent. The acute-to-chronic workload ratio has become increasingly important in this context. A ratio of 0.8-1.5 is suggested for acute to chronic workload. Any ratio greater than this has been demonstrated to increase the risk of injury by 2-4 times in athletes (76). We have kept the workload within acceptable ratios in our planned workout regimen.

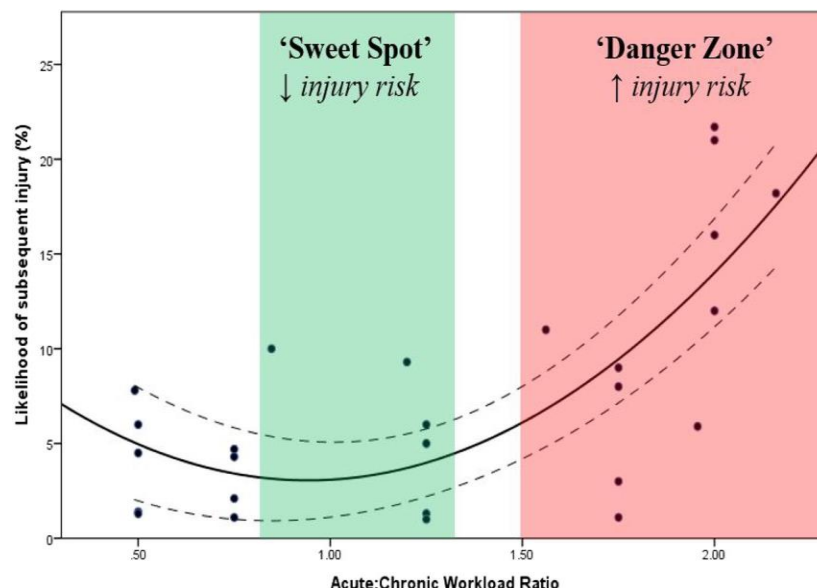


Image 3- A guide to analysing and using data on the acute:chronic workload ratio. Acute:chronic workload ratios with minimal injury risk are represented by the green-shaded area ('sweet spot'). The 'danger zone' (red-shaded area) shows acute:chronic workload ratios with a significant risk of harm.

The plan is proposed to keep our athletes mechanically balanced which goes a long way in keeping injuries at bay. Looking at the 2022' season (Image 1), the lean period lays in the month of June. Hence the plan is to keep the volume and intensity in check to allow the athletes' to enjoy active recovery (77). Every cricketer comes face to face with the injuries that haunt them the most, hence it is our duty to program exercises that work antagonistically to the common injured sites. Since the athlete will be participating in their cardio, conditioning as well as strength protocols throughout the week, it is our responsibility as a coach to minimize frequency in the lean period. Hence the number of planned session per week are limited to three, two hypertrophy sessions for active recovery and injury management and a single power session to keep the athletes' strength up for transitioning into the in-season as and when the next tournament comes (78).

Starting with Day 1, the first session focuses on hypertrophy of the muscles that keep postural imbalances as well as overuse from the sport in check (79). As established, the common sites being the hamstrings and the lower back. We address both these sites with the inclusion of quadriceps exercises both in the front squats as well as the deadlift, while the abdominal crunches takes care of the tension from the lower back (80). The workload on all proposed exercises are kept at 60% of 1RM to ensure that load remains low that allows the athlete to perform the repetitions with precision (81). The rest allowed between the exercises keeps the session short while giving ample time for recovery. Hence a rest range of 45-60 seconds gives a leeway to manage intensity when the workout is less challenging and vice-versa (82).

The concept of progressive overload allows us to keep the athlete from plateauing and or getting bored of the sessions planned, hence a weekly 5% increment in load or a decrease in rest or a combination of both can be used to keep things exciting both mentally and mechanically (83).

Power training, Day 2 focuses all on power training. This session offers a host of exercises that keep the explosive performance in check and at our disposal to easily transition into higher intensity work when the in-season comes (84). Plyometric exercises like lower body and upper body jumps and tosses enable us to work on the stretch shortening cycle and the concentric explosions that make the athlete shine on the field. Focusing on the lower body power by recommending jumping squats while incorporating exercises like ball slams in tandem with snatches ensure all round power potential (85). To keep the intensity and frequency in check, the load is set at a small 20% going up to a maximum of 60% while restricting the repetitions to only 5, allow the athlete to be in the groove of such complicated power movements. Rest is a healthy 2-3 minutes in between sets that makes the entire session fairly easy to tide through (86). Progressive overload for power training works on the same pattern of 5% increase per week be in terms of weight or sets to keep the session both mechanically and mentally engaging (87).

Day 3 brings in the last session of the week in the form of the second hypertrophy session which is the opposite of Day 1's selection of exercises and muscles targeted to boost active recovery. For instance, to ease of tension from the quadriceps family, hamstrings are targeted. Similarly, inverted rowing keeps the anterior deltoids as well as the pectorals from being overused. The same progressive overload from Day 1 as well as the rest intervals follows suit for this session too.

Recovery does not come alone from training the muscles optimally but with easing their stress with the help of passive recovery sessions. The inclusion of such activities after our sessions goes a long way in aiding recovery which prevents injuries (88). Foam rolling, PNF (Proprioceptive Neuromuscular Facilitation) and ice baths after both hypertrophy sessions will improve blood flow, ease off the lactic acid accumulation as well as the soreness from the practice sessions and matches on the field (89).

Proprioceptive neuromuscular facilitation both active and passive is the best bet an athlete and the coach can make. It perfectly overlaps our exercise selection and technique of reciprocal inhibition where the prime mover warrant the antagonist being stretched which both strengthens the former and stretches the latter (90).

Timeline

Our 2022 season as hectic as it comes is a power packed show spanning over the entire year. The 12 month schedule will be the macro-goal which shall be further divided into meso-cycles of six months each (91). The month of June is the lean month, which gives us our micro-cycle where my proposed plan shall help the athletes' recoup well for the next meso-cycle ahead while being injury free.

Our proposed plan gives the athlete three training days where two of these are designed as active recovery hypertrophy sessions which aid both strength as well as recovery for the conditioning session during the week. Keep in mind that these three sessions are independent of the cardio that the athletes will be participating in. The frequency kept to three allows the athlete to be both mentally and mechanically free from injuries in the shape of monotony and muscle overtraining respectively (92).

Feasibility

The proposed plan becomes synonymous with feasibility both from the perspective of time management as well as injury management. Having only three active session in a week punctuated by therapy sessions like foam rolling, ice baths and PNF makes it easy for the athletes to stick to the proposed plan.

Resources

Our proposed plan primarily focuses on indoor sessions which gives us a wide selection of equipment to work with. A closed controlled environment comes with its own set of setbacks. It is the duty of the coach to ensure that the equipment as well as the environment is safe for the athletes to participate in. Ensuring a clean, hygienic, motivating, injury free environment enables the athlete to perform at their absolute best while being injury free.

Justification of the specific strategy being employed

The sport of cricket demands the player to wear multiple caps, be it a batsman, a bowler, a fielder and or all. This requires training of multiple facets which inadvertently leads to overtraining for up and coming athletes and seniors who are playing round the clock throughout the year through increased frequency (93). These injuries manifest in the form of upper body injuries like shoulder impingement to tennis elbow to lower body complications like runner's knee to hamstring strain which are the most common among all (94).

As it is said, prevention is better than cure, the idea we are proposing is that a preventive program that keeps the athlete progressing in their career while keeping them injury free as long as we can. Strength training is the strongest weapon in a coach's arsenal that prevents and treats injuries of the sport (95).

Let us look at addressing such injuries individually and how these can be minimized to ensure a long and healthy career.

Shoulder Impingement

This injury is common for those who engage in upper body dominant sports (96). The athlete starts feeling a slight, nagging discomfort in their shoulder which subsides while working out but comes back at rest (97).

To address shoulder impingement, it is important to look for any postural imbalances that may be a reason for limited space between the acromion process and humeral head (98). The fascia and the tendon gets compressed between the humeral head and the AC joint which never gets the optimal time to recover since we move the GH joint throughout the day as ADL demands it to (99).

Next step could be to strengthen the scapular stabilizing muscles, including the rotator cuff, this will result in better control during any overhead movement (100). Apart than this one should need to increase the strength of the anterior shoulder muscles along with pectoralis major via controlled pushing movements. As the functionality and strength returns athlete can be introduce to overhead activities (101).

Our plan primarily focuses on strengthening the pectorals through adductions exercises while focusing indirectly on the anterior deltoid muscles with a single session of power training which keeps the frequency low while promoting strength.

Tennis Elbow

Funny as it may sound, this injury happens to any athlete that overindulges in elbow extension (102). Both tennis and cricket demand that the athlete use their wrist extensors to generate peak force to hit the ball (103). Starting from tennis, this injury was eponymously named so, eventually coming to cricket where the movement is mimicked. Hence this injury plagues both these sports.

To tackle such injuries, first thing is to limit the overuse of the injured area. Moreover, various types of grips can be introduced to the athlete for exercises (104). It is important to initiate gentle stretches in all planes of motion for the athlete. To increase wrist and hand strength exercises like wall push-up, wrist flexion-extension can be added into the athlete's program (105). Our program focuses on the wrist extensors with the incorporation of prone curls only once a week to keep the strength up while keeping the frequency low.

Lower Back Injury

Lower back injury is the most severe injury among all the injuries, it is probably the most time taking too. It starts creeping in slowly into an athlete's life as they start travelling a lot for tournaments (106). Excessive sitting while airborne, training to play at peak performance compounds with the training to create chronic pain (107).

First of all trainers need to look for any imbalance present in left and right sides. Slowly and gradually work on the external and internal rotation of the hip. In order to avoid such injuries, it is important to strengthen the posterior chain (108). Our program keep this injury at bay with the incorporation of abdominal crunches eases the tension off the erector spinae. The higher volume of the exercises both strengthens the core as well as lengthens the lower back musculature keeping the injury at bay (109).

Ankle Injuries

In cricket, sprained ankles are prevalent, particularly among fast bowlers, who are more susceptible to stretch ligaments when their foot is placed during the bowling action. Most commonly this injury occurs during the front foot landing during the final bowling stride. Due to immense pressure of landing and bearing the whole body weight on front foot may lead to ankle injury (110). In order to avoid ankle injuries address mobility and stability in the foot and ankle. It is important to improve strength in the muscles that control movement in all the three planes of motion at the ankle (111).

Hamstring Strain

Hamstring strain is among the most discussed and researched injury among all the injuries. Overlapping with lower back pain, this is an outcome of the same lifestyle choice. As the athlete starts travelling, excessive sitting elicits knee flexion which shortens the hamstrings **(112)**. When bowling, excessive running causes the hamstrings to over-lengthen which puts more stress on it as it needs to absorb the additional shock from the run **(113)**. Our proposed plan trains the hamstring to keep them strong enough to endure both the trauma from lifestyle as well as the sport. Exercise like Nordic curls has been added in the plan, several studies have found the effectiveness of Nordic curls in order to reduce hamstring strain injury among the athletes **(114)**. In order to keep a player injury free it is very important to address this particular injury, as it is the most common among the athletes.

Summary of Key Points of Strategic Plan

Even being at the peak of their fitness, athletes worldwide are susceptible to injuries that stem from overtraining, improper biomechanics or simply from too frequent change in playing environments **(115)**. It is incumbent for the coach to iron out such contingencies and making a well-rounded plan that both screens and trains the athlete at the same time.

In a country like India, where every cricketer is treated as a deity, the countryman expects to see their gods play year round. This demands our athletes to play round the clock which makes them that more susceptible to both lifestyle as well as on the field injuries.

Our plan given the sporting infrastructure in India suits the needs of our athlete the best. Having a strength program that addresses the entire season's demands while keeping the injuries at rest is the need of the hour. Given the season where the lean period spans only over a month, our program is a mix of both biomechanical as well as mental offset from the stressful demands of the sport.

Our plan recommends that the athletes train thrice a week, focusing twice on hypertrophy punctuated by active recovery session and a single session of power training to keep the strength up. Key recommendation of this plan is to train wisely and monitor the load properly.

The hypertrophy sessions promote strength to the sites that are often the most injured sites of the sport, while the power element of the program keeps the peak potential up and ready for the contests to come **(116)**. The preventive part of the program is the sweet spot where active recovery in the form of foam rolling, PNF and ice baths goes a long way in recuperating the athlete.

Limitations

Purpose of this study was to develop an injury prevention strategic plan for cricketers, despite their playing position. That strategic prevention plan was created with the goal of considering all the prime and sub factors related to injuries among cricketers. There are few studies on injury prevention among cricketers, and most of them focus on fast bowlers **(117)**. As a result, our study is the first of its kind, and it covers all players in various cricketing positions.

Every sport comes with its own set of promises, be it name, fame, and legacy, we do see athletes burning out. The reasons for the said burnout vary from sport to sport. The most common factors monotony, overtraining and excessive travelling to cite the most common of the lot **(118)**. To prevent such hiccups, the exercise program is set in place, but that too is plagued by adventitious factors that are genuinely beyond the coach's control. For instance, too frequent travelling warrants a disturbed sleep cycle which inadvertently affects the athletes' performance which sets up the perfect atmosphere for delayed recovery and this cycle goes on **(119)**. Though the strength and conditioning plan has found to be efficient to lower down the injury rates among athletes **(120)**, still there are few limitations which can hinder this progress.

Even if the ideal programme is in place, frequent changes in playing field, weather, and travel to the designated venue are all aspects that affect not only the body but also the psyche **(121)**. It doesn't matter if the player is in peak physical condition if he isn't psychologically engaged in the game. While having a year-round season may appear to be beneficial to an athlete's career and finances in terms of visibility and sponsorship from both national and international brands, some athletes feel mentally burned out as their passion becomes excessive. Imagine staying on the field all year, playing your favourite sport with no way to get away from it.

This leaves the athlete in a state of confusion, questioning his training and the sport itself. Even though our programme is biomechanically balanced, it can be mentally taxing for the overworked athlete. When it comes to biomechanics, some personal barriers emerge in the form of workout preferences. For example, an athlete may dislike certain of the activities that we, as coaches, have advised in order to prevent injury **(122)**. Such circumstances push us into a position, as we risk demotivating the athlete from the workouts we've chosen for their health.

As a result, such obstacles and contingencies must be foreseen in advance by the coach and the athlete as a team.

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