Editorial

History of Sports and Sports Medicine

Sports as commonly understood is a competitive performance activity that can bring honour and global reputation not only to the individual participants, but also to the country they represent. However, scientific intervention in sporting events, has become an inevitable tool not only to safeguard and promote genuine capabilities of sportsmen in the field, but also to deal with increasingly complex incidents of what may be regarded as highly innovative performance enhancing ruses. This edition of *Vidurava* shows how science and technology have been pushed back to the wall to devise innovative measures to help sportsmen to demonstrate their genuine and inherent talents in their respective fields of sport. On the other hand interventions through science and technology have also substantially increased to detect and to rectify physical and other abnormalities; to devise safety measures for sportsmen; to evolve measures to detect ruses; and to formulate counter measures for the prevention of ruses.

Historically, it has been claimed that the true spirit and recognition of sports at the international level began with the introduction of the Olympic Games in Greece in 776 BC by Hercules, the son of Zeus. Ancient Olympics are known to have concentrated on two major events, the Equestrian and the Pentathlon, followed later by events such as jumping, running, wrestling, javelin and discus throw. These traditional events may be conceived to reflect, what may appear to be activities that required extremes of endurance, endeavours and strenuous physical exertion, reflecting the survival and existential needs of pre-historic *Homo sapiens*. Although there is no physical or literary evidence to establish this link, it could be conceptualized that the spear used as a weapon by the pre-historic man could be the precursor of the javelin throw. Likewise the other ancient events such as jumping, running, wrestling, and discuss throw may have evolved around the survival and existential efforts of the hunter gatherers of pre-historic times.

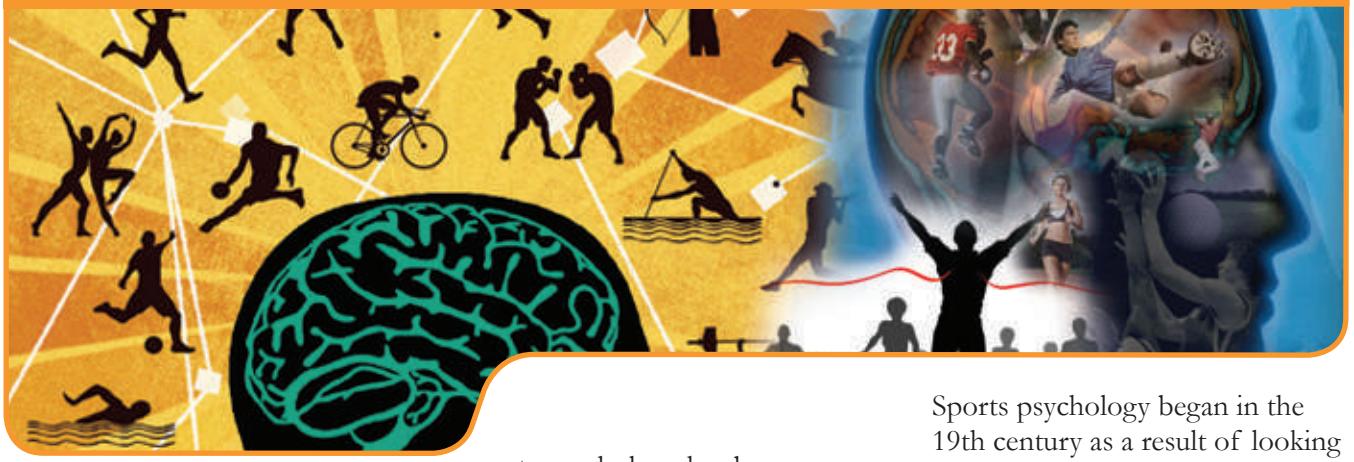
Sports medicine as such was known to have been initially co-ordinated in ancient regions of Greece and Rome where many young athletes initially had not received supervised training. Subsequently striving to improve training and provide better overall supervision of young athletes, physical education had been designed to monitor the 'gladiators' of the second century AD. Despite these early efforts, it had not been many years later that sports medicine itself had actually been conceived.

During the Olympics held in 1928 in St. Moritz, a small committee had been formed with the task of organizing the International Congress of Sports Medicine, in realization of the need to have trained medical personnel to help prevent the occurrence of injuries. Consequently, commencing with the Summer Olympics held in Mexico City in 1968, Dr. J C Kennedy had been commissioned to organize a team of doctors that accompanied the Canadian athletes to ensure that they would be cared for. Dr Kennedy thus earned the distinction of being appointed to be the Chief Medical Officer for the first medical team to be officially associated with the Olympics in the 1972 Summer Olympics held in Munich, Germany. Sports medicine has since come a long way, with the involvement of a string of new disciplines, which include Physics, Technology, and Biomechanics. Traditionally sports meant physical exertion that is necessary to enhance the capability of sportsmen. Subsequently the nutrition factor came into existence. In the current day context, a third factor has entered the field, and that is, management of emotion, for which the discipline of psychology has made its appearance. Significantly, this latter component is believed to be as high as 20 % of sports training.

M. Asoka T. De Silva

Psychology for Sports

Mr P.B.Jayathilake



The effect of psychological processes on skills in sports is a complex subject for specialists of sports and sportsmen to comprehend. It is necessary to carefully distinguish in a simple way the relationship that exists between the sporting skills and psychological factors. Sports is a social science. It makes a person active, healthy, competetive and cooperative. These are necessary for the well being of a society. Psychology can be linked to sports in many ways. European Federation of Sports psychology has identified sports psychology as a science which studies psychologycal fundamentals as emotions. As a result of the attention paid to this matter by sports related institutions it has been identified that every physical movement helps to enhance sports skills. Due to growing relationship between the patterns of behavior and training in sports the role of sports psychology has become complex. Sports psychology has become necessary to understand and study the fine differences of the behavioural patterns of sportsmen in order to develop their aptitudes and skills and to maintain them at optimum level. Generally sports psychology involves research, teaching and the provision of counselling services. The trainer is always engaged in improving physical quality while the sports psychologist is involved in improving the vision of the sportman. Achieving the objectives of the sportsman can be accomplished by briging out the intrinsic factors. This is through creating a suitable psychological fitness.

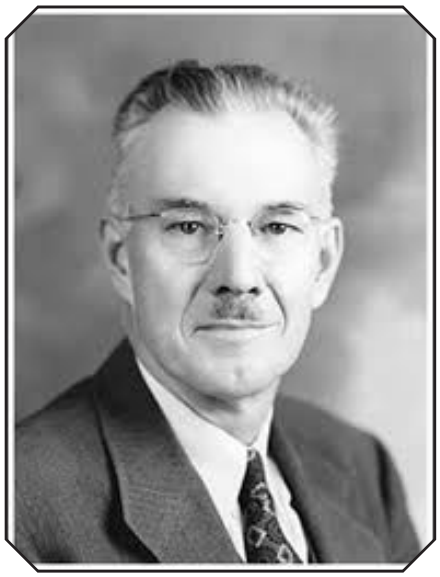
The beginning of sports Psychology

Sports Psychology originated as a special branch of psychology. Sports psychology began in the 19th century as a result of looking at the behavioral patterns of sportsmen from a psychological angle. Sports psychology began with the "team" concept used in social psychology by the American social psychologist Norman Triplett in 1898. E.V.Serepture presented a diagrammatic sketch of the personality pattern of the participating sportsmen. R.Cummins presented information on motor reactions and mental concentration. By 1920 studies on sports psychology and investigations were progressing to an advanced level. The establishment of the first sport psychology laboratory in Berlin in 1920 by Carl Diem is an outstanding event in this progress. Five years later A.Z.Puni by starting an institute dealing with sports and physical education further developed studies in sports psychology.
Sports Psychology began to develop as a subject along with the









Coloman Griffith

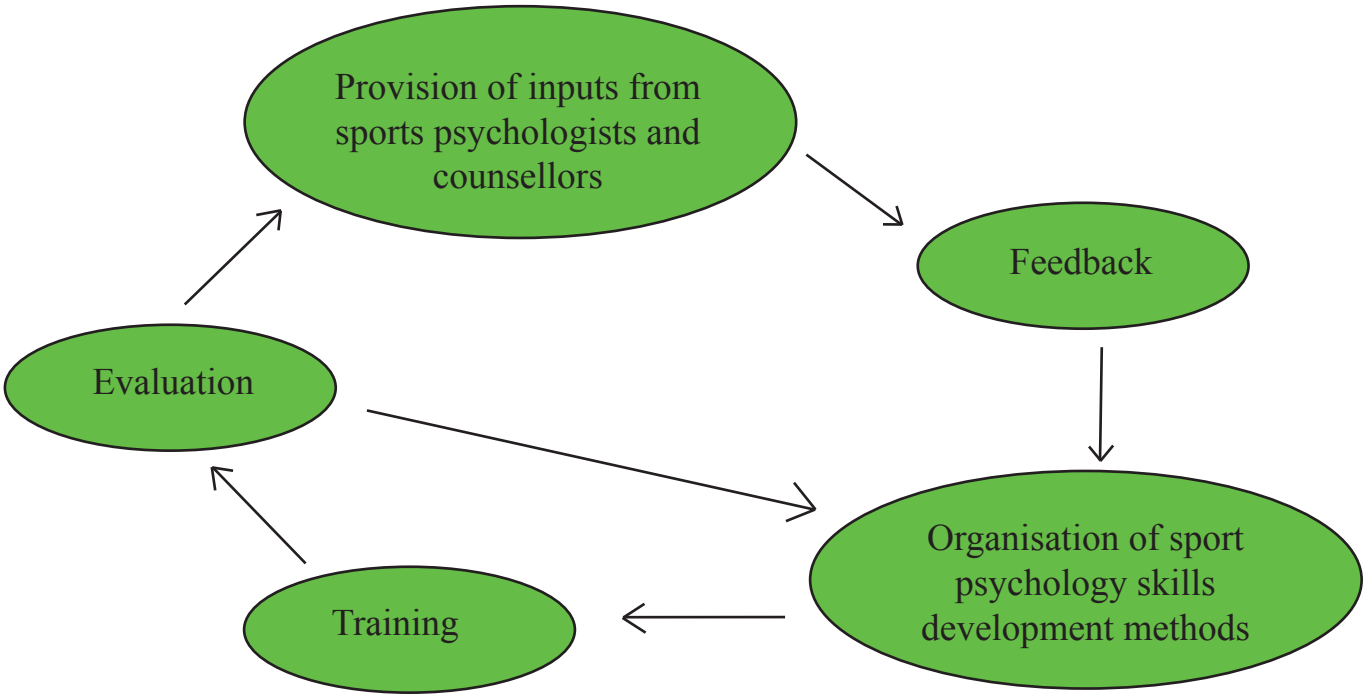
introduction of a degree course in the university of Illinois (USA) in 1925. Coloman Griffith who is considered as the father of sports psychology played a leading role in this respect. He wrote the books Psychology of Coaching and Psychology of Athletics. With the development of sports psychology as a professional subject many countries including USA, Britain, Germany and Russia began to direct their attention to the subject. In 1938 University of Califonia introduced a degree course related to sports and physical education and thereby accelerated the development of human resources associated with sports. By 1960 the relationship between sports and psychology had become very strong. There were sports psychologists accompanying the sports teams that came from European countries to participate in the Olympic sports festival held during that year. The first sports psychology conference was held in Rome in 1965 and this was of great value.

By 1965 applied sport psychology had come into being. It is Bruce Ogivie who contributed to this development. By this time a large number of articles, essays and books of considerable standard had been published on sports psychology.

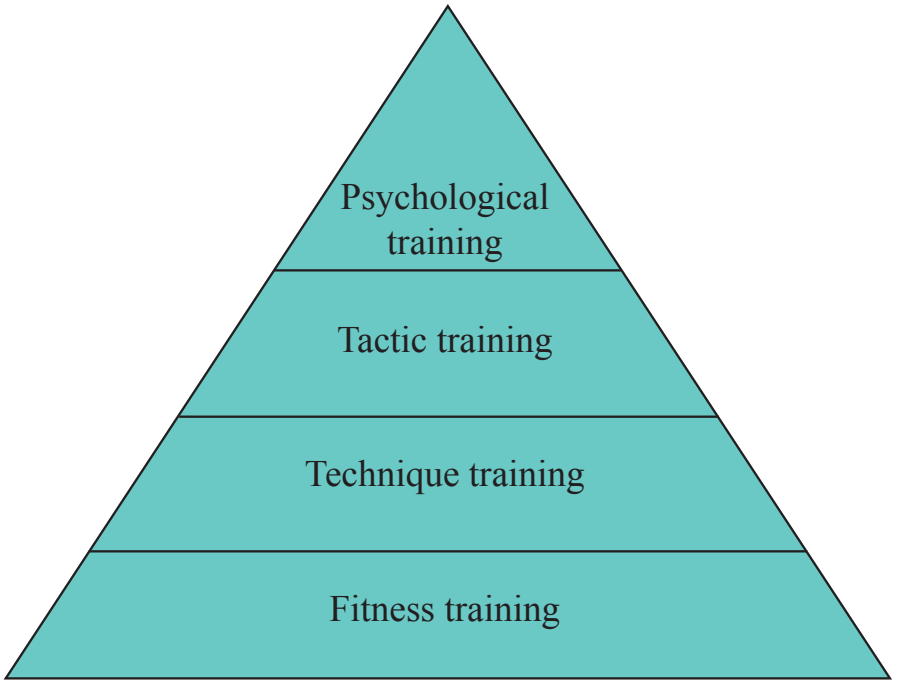
By 1970-2000 sports psychology had achieved a rapid progress internationally. Trainng in sport psychology and investigation of a high standard had begun. At the same time ethics, insurance and service of full time psychologists etc. were established and developed.

This period saw the birth of the Society of American Sports Psychology (1986), The society of British Sport and Exercise Psychology (1993) (as a branch of British Psychological Society) and Sport Psychology Society of Europe (1996). These are the outstanding developments. These





organizations were responsible for the rapid development of sports psychology. By now there is direct contribution from sports psychology to sports and to all aspects connected to sports. Sports psychology plays a wide role in many aspects such as in motor reactions, personality, motor learning, health exercises, sport training and sport counselling. By today sport and exercise psychology has expanded to cover a wide range of activities and divided into a few sub sections too. Among these clinical sports psychology and educational sports psychology have become two essential subject streams for sport training.



Psychology for sport training

It is an experimentally proven fact that training conducted on a psychological basis helps in the enhancement and development of sports skills. As shown by many sportsmen, trainers, counselors and researchers, psychological is necessary for the continuous development and maintainance of sport skills. Factors such as psychological motivation, self confidence, intensity, attention control, control of emotions create an unbroken or continuous relationship between training and sport skills.

Generally the effect of sport training and preparation help to raise the sport skills to a higher standard. Sport training always targets to enhance physical and mental prowess. It is possible to depict it as a pyramid.

Physical and Psychological Fitness Training Pyramid

Primarily in sport training 80% is







allocated to physical competence and 20% to psychological training. Although generally the above ratio is accepted, it various according to the type of sport. Sport training is conducted in several stages or phases.

The preparatory phase targets the basic physical fitness training and basic psychological training. During this phase the sportman is directed towards motivation tools, and self confidence of the sportsman is built up. Through this it is expected to enhance both technical competence in the sport and the capacity of physical competence. These are the main skills that are built up during the pre-preparatory phase. Subsequently during the preparatory phase training is continued using mental relaxation techniques and evaluation techniques.

In sports training the competitive phase is a very vital phase. It is divided into the pre competitive and the competitive phase. During the first phase the capability for the sport is organized by building self confidence of the sportsmen and thereby develop the positive thinking required to face the competition. It helps to reach ones maximum levels of skills through enhancing physical capability, specially by developing physical fitness. During the competitive phase, through visualization of the skills that one possess, the skills level is maintained continuously through responsibility, intensity and by the realization of the competitive targets.

Based on the competitive skills and emotional training of the sportsmen psychological training helps to achieve the competitive skills of sportsmen. It require daily sports psychological training.

Sports training is conducted through daily evaluation. Conscquently psychological training also has to be carried out along with evaluation. This training is expected to prevent causing any disabilities in sportsmen with psychological weaknesses. Sport improve daily through competetiveness. The contribution made by the emotions and organization of the emotions in sportsmen through the inclusion of psychological aspects is used to help in continuesly maintaining the competitive skills of sportmen. On the other hand the psychological training brings about a complex and a challenging effect on the sport skills. At the same time through psychological training sportsmen can build up the emotion that is necessary to compete during the competition. Psychological training is a basic help to achieve ones objectives and targets by building up the maximum capability.

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Technology in Sports

Dr. Pujitha Silva



Introduction

I recall the night Sri-Lanka won the Cricket World Cup in 1996, by beating the Australians, an experience that would be celebrated many times over, as a nation united in one accord to find a new confidence and strength and a sense of patriotism like never before, (Figure 1). Such was the power of a sporting moment to infuse courage and inspire hope for a nation for many years to come.

It's been twenty years since that iconic win and Sri-Lanka has not been able to repeat the same heroics although the inborn talent and passion may have remained the same. Sport and the game of cricket have progressed much since and the role of technology has become a key deciding factor in the performance of a cricketer and the success of the game as a whole. It is regularly stated that the difference between a good performer and the best performer in sports is based on the use of technology to harness talent, rather than on the individual skill level of an athlete. Simply having talent and skill is not sufficient in professional sport anymore – a little insight, a more directed push, and consistent monitoring and a well-planned development process are required for the talent to convert into results. That is what technology now provides in the area of sports development.

Role of Technology in Sport

Sports of all type have changed greatly from the start of modern Olympics in 1896 to the present day. There is a stark contrast in how players are selected, trained to perform better with improved times and reach overall higher standards. For instance.in 1936, Jesse Owens won the 100m sprint in 10.2 seconds. In 2013, Usain Bolt finished the event in 9.77 seconds – a highly significant difference for sprinting events (Figure 2). This improved performance was aided by the track that Bolt ran on, a special fabric carpet, and he propelled himself from the starting block. By contrast Owens ran on cinders (ash from burnt wood), and propelled himself from garden shears that were dug into the cinders.

Swimming is another sport that has shown significant improvement in



Fig 1 : Sri Lanka wins Cricket World Cup in 1996



Fig 2: Jesse Owens (1936) and Usain Bolt (2013)

performance times over the years. These improvements overlap with changes in how the sport was essentially performed. Tumble-turns were introduced to reduce the time that elapsed between laps, gutters were introduced into the pools to carry away splashed water that could otherwise cause turbulence in the water, traditional swimwear were replaced by full body synthetic material swimsuits which streamlined the body during swimming.

These changes in how sports were performed, changed the level of performance that athletes could reach. These changes were not made on a whim. Rather, they were the calculated result of empirical findings from science. Sports science refers to the combination of understandings from a number of disciplines such as physics, physiology, psychology etc. that help to understand how athletes perform. Sports science draws heavily from biomechanics – which is the study of human motion, that helps to understand which conditions help and prevent humans from performing to their maximum. The learnings and findings from sports science have been critically applied in the field of sports engineering – where technological advancements in sports are made to help improve the conditions of the sport to enhance performance. These changes are not simply at face value. In 2009, Professor Stephen Haake, while assessing the effects of technology in sport, found significant performance improvement indices for the Olympic events, the 100m sprint, pole vault, javelin throw, and cycling. For track based events such as sprinting, 4% of the performance improvement index was attributed to better and more aerodynamic clothing. Technological developments in the sporting equipment were accounted to improve athletic performance by 20%.

Given these encouraging statistics, sports engineering which can be understood as the applications of technology in sports science, has scope in a number of areas. Performance analysis is an area where sportsmen's performance is measured and evaluated using a number of measures to better understand the nature of their performance. The information from performance analysis is used to inform performance improvement strategies, where coaches use empirical data to guide specific coaching regimes. The information from performance analysis is also used to advise injury prevention in athletes where the understanding of a sportsman's level of capacity and endurance are used to ensure that overexertion does not occur. Sports engineering has also informed changes in the sporting equipment and clothing, and has also helped to make



Fig 3: Motion Analysis using Markers

advancements in the promotion of para athletics.

Performance analysis

Technology from the field of biomechanics has much scope in the area of performance analysis. Of most significance is motion capturing technology. Motion capturing relies on capturing signals from the body during motion, often done in a biomechanics laboratory and interpreting them through software. Markers are placed on the body at specific anatomical locations, and the 3D motion in the body is configured to a high level of accuracy using a system of cameras (Figure 3). While this method of motion capturing provides high quality and accurate representations, the costs are very high and hence unaffordable to many in the developing world. In 2010, Microsoft released Kinect which is a 3D depth sensing camera that has revolutionized the gaming experience. A set of infrared pattern of dots that bounce off an object or person are picked up by an infrared camera and configured through algorithms to give 3D positional information. Although the output from such technology can be at a lower level of accuracy, the significant lower cost makes such technology a more affordable alternative for motion capturing for sport .



Fig 4: Monitoring health levels of athletes

Besides capturing the trajectories and patterns of movement, motion capturing techniques also help understand the characteristics of the motion. Accelerometers are equipment that help measure the accelerations of human dynamic motion. The reaction forces involved in walking, balance, starts, takeoffs, lands, swings, etc. can be measured using force plates. The resulting data pool gives rich information on movement patterns, forces and accelerations which when analyzed helps decode the true nature of movement in a person.

Performance Improvement

Technology plays a crucial role in performance improvement. Simply capturing and analyzing a player's movements cannot immediately produce results. Rather, it is how these analyses are used to inform strategy and coaching that has an effect on performance. As UK Sport Technical Scott Drawer says, "it is in the hands of the coach." If coaches were given access to high quality analyses derived from technology based measurement, and trained on how to use such data to inform coaching strategy, this will vastly improve the quality of advice given by them and the overall performance management of the player throughout their career from younger age to mature level.

Sport engineering contributes



Fig 5: Monitoring health levels of athletes

to designing equipment and clothing in a way that enhances and promotes human body functions for peak efficiency. Sports equipment is built to be lighter, yet stronger, and outfits are more streamlined to reduce frictional drag, so as to improve the overall performance. Results from motion capturing performance analyses help understand the very nature of an athlete's performance styles. This provides coaches with valuable information on how to design targeted training regimes to specifically focus on key areas for the sportsmen. Proof of this is clear and apparent in the Olympics. The English Olympic teams for rowing and cycling have been working tirelessly since 2000 to perfect their game. Using analytic tools and maintaining a game focus on improvement and development, the teams are seeing results now winning at London in 2012 and at Rio in 2016. Targeted training can help athletes focus their attention on their Achilles heels – eliminating obstacles that hinder them from performing at their best.



Fig 6: Assessments for fair play following Muralitharan controversy

Injury Prevention

Injury prevention too can be achieved using data related to muscle activity to give insight into when an athlete should play and when an athlete is/will be at their peak. For example, a modern day professional cricketer is at greater risk of injury through wear and tear due to the increased number of games played in a year. Technology can manage this by constantly monitoring and evaluating the conditions of muscles and evaluating injury proneness therein (Figure 4). This is achieved by using measures such as electromyography, which helps understand the tensile strength in muscles.

Other scientific measures can look into other health parameters regarding physical and psychological health (Figure 5). A holistic understanding of the current status and situation of a sportsman can enable coaches, trainers, physiotherapists and others to make training and lifestyle recommendations based on actual facts – ranging from diets to exercise routines to mental stamina improvements.



The current Minister of Sports expressed his concern at the loss of sporting talent in Sri-Lanka from school level to national level. According to him, many star sportsmen and women leave the game too early due to injuries sustained at school level without proper rehabilitation and player management. This is largely due to the absence of correct coaching and advice on managing these injuries that prevents them from persevering in the sport. The current Sri-Lanka Cricket's performance manager shares the view that younger bowlers need to be managed well without over exertion while their bodies are developing, so that they can have lengthier careers.

Monitoring all aspects of an athlete's fitness from earlier on in the development trajectory using technology based measurement analyses, can help coaches guide trainings in such a way that injury and illness does not occur due to overexertion and wrong technique.

Improvements in Equipment and Clothing

Understanding human motion, and the factors that promote and inhibit efficient motion, has allowed science to contribute towards various modifications and adjustments to the designs of sports equipment and clothing. From the type and style of fabrics that are used for athlete outfits, to the architectural design of the sports equipment,



Fig 7: Wearable sensors for analyzing bowling in cricket

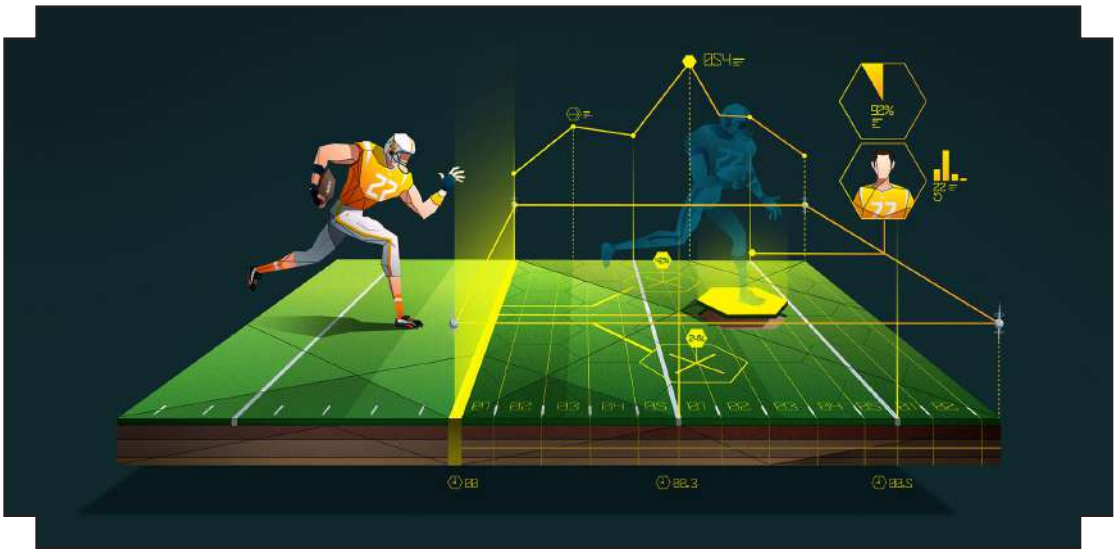
science has enabled to create supporting material for sportsmen that enhance, rather than inhibit the effort that is put into their techniques.

Sporting suits are built of synthetic polymer fabric which is light, and also has a streamlining effect on the body, tucking it in neatly to reduce drag. The track surfaces too are built using special fabric carpets which help an athlete to run at their fastest.

Fair-play and Equality

Technology has been introduced to a number of games to improve the decision making when human judgement proves to be erroneous or subjective. In situations where human judgment is insufficient to reach a final verdict, a technological intervention can help make the better decision. The use of a simple camera is so vastly helpful. This happens live, in real-time, on the field. In cricket and tennis, when the field umpires are unable to come to a verdict, a "third umpire" has access to a technology called 'hawk eye' that can give a better picture of an otherwise ambiguous situation

Technology has also contributed





in assessing sportsmen who are accused of having incorrect technique, or using illegal movements in the game such as chucking. Thanks to technology, it was possible to clear Muttiah Muralitharan, when he was called for 'chucking', a controversy that polarized the cricketing world at the time (Figure 6).

Promoting Equality

One of the most inspiring applications of technology in sports is its application in supporting the sports performances of people living with disability. Advancements in the build of prosthesis has helped to design a prosthetic leg that helped Marlon Shirley of the US to break the 11 second barrier for finishing a 100m race. Advancements in motion capturing technology has enabled to measure the motion and analyze performance in wheelchair bound athletes – ensuring that even para-athletes can benefit from the applications of technology in sports, and enjoy the benefits of targeted training.

Trends in Sports Technology Advancements

The traditional motion capturing techniques, typically administered within the confinements of a laboratory, is being replaced with the developments in wearable technology to provide performance related data. By using an arm band/attachment to clothing, measurements can be received real time (typically on a mobile phone), when sportsmen are working in their natural environments.

The National Football League (NFL) uses motion sensing tags embedded into the players' outfits to track player movement and performance. These tags record data on player acceleration, speed, routes, and total running distance. This information can be used to analyze the individual and collective patterns of a team's game. Currently in Sri-Lanka, 3D motion capturing technology using Inertial Measurement Unit (IMU) sensors is being developed at the University of Moratuwa for use in sport and rehabilitation applications. So far this technology has been used to provide a wearable solution for detecting chucking in cricket (Figure 7).

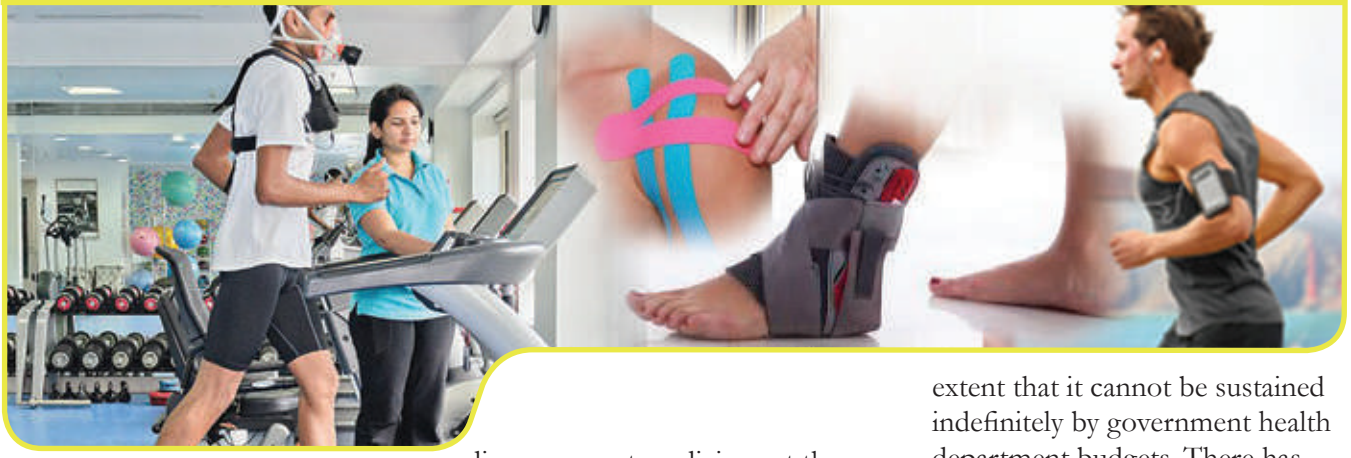
Conclusions

The future success in sports will be determined by those who have access to technology versus those who do not, where the advantage of natural talent will be largely outweighed by that provided through technology, making the use of technology almost an ethical issue. Needless to say that for countries like Sri-Lanka to excel in sports, there will need to be a well-coordinated effort among government, sporting bodies, private sponsorship and research institutions. Such arangements would enable players to be coached and trained within an environment that facilitates technology to be used to optimize their performances, informed by relevant local research, the sport and players alike.

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Medical Sciences in Sports

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Principles of prevention of sport injuries

Sports is no longer only a physical activity. Whether it is a competitive sport or recreational sport it involves sport sciences. One field of sport science is sport medicine. It helps not only to prevent and manage sports related injuries and diseases, it also helps to enhance sport performances. This field in sports has evolved through decades and now it is an essential part of sports, without which even a small scale sport meet cannot be held. Sports medicine always believes in team effort and has an integrated team approach whether it deals with sports performances or managing injuries or illnesses. When it comes to performances, the sports medicine doctor develops a close relationship with players, coach, fitness trainer, sports massage therapist, physiotherapists, sports nutritionist, sport psychologists, performance analyst, bio mechanical analyst, and management. All these people are involved and have very important roles in modern day sport. When one deals with sport injuries and diseases, sport medicine get the help of physiotherapist, specialist in relevant field of medicine, biomechanics analyst, and athletic trainer, and manage the injuries and illnesses.

As mentioned above sport medicine team has different roles to play. (Fig1)

In the case of population health, the personal and economic health burden of non-communicable diseases has escalated to such an extent that it cannot be sustained indefinitely by government health department budgets. There has been a significant global emphasis on sport and exercise as key elements to address this pandemic by organizations such as the International Olympic Committee (IOC), FIFA and other institutes and organizations of Sport and Exercise Medicine which promote physical activity programs in the community. The sports medicine physician has a key role in the promotion, integration and facilitation of exercise as medicine within the primary and secondary

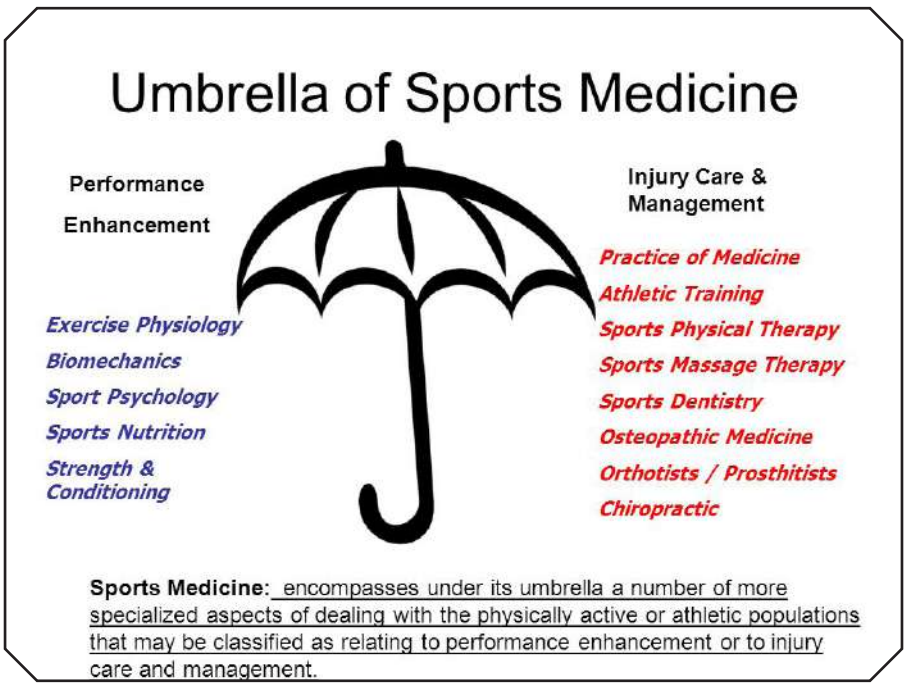


Fig 1: sport medicine team has different roles to play.

healthcare systems.

In addition to 'the promotion and implementation of regular physical activity in the prevention, treatment and rehabilitation of chronic diseases of lifestyle', Sport and Exercise Medicine has been defined as that scope of medical practice which focuses on:

(a) The prevention, diagnosis, treatment and rehabilitation of injuries that occur during physical activity, and
(b) The prevention, diagnosis and management of medical conditions that occur during or after physical activity.

The words protect, prevent and promote often feature prominently in defining the roles and scope of practice of sports medicine physicians.

Pre-participation health assessment - where each and every athlete who is expecting to engage in strenuous physical activities undergo a thorough medical examination and investigation to find out whether the particular athlete has problems or potential health problem, and if found necessary to provide appropriate remedial measures to avoid injuries and diseases. In addition in some instances pre competition medical tests are done just before the competition, to assess the fitness of the particular athlete for the particular event.

In 2013, while participating in sporting activities, unfortunately four school children died suddenly. That condition is called sudden cardiac death. That could have been prevented if proper pre .participation medical examination was performed.

During the pre-participation medical examination, it is mandatory to prepare a comprehensive history regarding player and player's immediate family members. Some families have such genetically transmitted heart diseases where most of those who have heart diseases die prematurely. For example hypertrophic cardiomyopathy is a disease, where the heart is unusually bigger than the normal heart. Such persons are prone to premature death. In fact this condition is the most vulnerable cause for sudden cardiac death (36%). Comprehensive family history even without an examination of the athlete will indicate whether the athlete has a high risk of having sudden cardiac death, in cases like hypertrophic cardiomyopathy. Most of the other common causes for sudden cardiac death also can be diagnosed with a proper history and clinical examination including electro cardio graph (ECG) examination.



Fig 2 : two main indications for the use of braces and tapes

Other common diseases like respiratory diseases such as bronchial asthma and exercise induced bronchial asthma also can be assessed and diagnosed with pre participation medical examination. .Proper management of such conditions will help to improve sport performances. Some anatomical abnormalities will also make athletes prone to injuries, and these also can be identified during pre-participation medical examination and remedial measures taken before anything serious happens. For example abnormalities of the foot and back if not diagnosed early may lead to many serious biomechanical problems, which can be prevented by taking appropriate remedial measures. In fact correct biomechanics not only prevent injuries but also enhance performances.
"Prevention is better than cure". The problems and weaknesses identified during pre-participation medical examination will be addressed and sometimes a comprehensive exercise program will be introduced to strengthen weak muscles and joints of the body.

Although different people can have different problems and different diseases, once the problems are identified they can engage in physical activities safely knowing their limitations. That is one of the main advantages of having a pre participation medical examination. Not only pre participation medical examination there are other things that can be done to prevent injuries and improve performances.

Proper warming up prepares the body for exercises. The most effective warm up consists of general and specific exercises. General exercise may include jogging, general stretch and resistance exercises. Specific exercises include stretches and movements appropriate for the particular activity to be undertaken. For example, a hundred meter runner after general exercises do short sprints several times to adequately prepare for the event. Possible benefits of warm up includes, increased blood flow to muscles, increased release of oxygen to muscle, enhanced production of energy in the cells, stimulation of nerves, decreased injuries due to increase range of motions of the joints and muscles, increased relaxation and concentration.



Fig 4 : mouth guard

When warming up it should be kept in mind that warming up last only for about 30 minutes, so it is important not to warm up too early. Also the time of warming up depends on the environment, cold climate needs warm up for a longer period than warm climatic conditions. When sweating appears on the forehead, it is considered that the body has adequately warmed up.



Fig 3 : kinesio tapes, which are stretchable tapes.

Taping and bracing

Taping and bracing are used to restrict undesired, potentially harmful motion and allow desired motion. There are two main indications for the use of braces and tapes, (Fig. 2)

Prevention- taping is used as a preventive measure in high risk activities (e.g. football and basketball players' ankles), while rehabilitation – taping is used as a protective mechanism during healing and rehabilitation phases. Although taping and bracing are used in injury management of numerous joints, there is evidence that only in ankle joints that taping and bracing prevent reinjures of ankle joints.

There are many different types of tape but if the purpose is to restrict movement it is appropriate to use non stretchable, rigid tape. If the purpose is to limit the movement of muscles and tendon it is appropriate to use kinesio tapes, which are stretchable tapes. (Fig. 3)

Protective equipment

Protective equipment are being designed to cover certain parts of the body, which are vulnerable to injuries during playing, and to

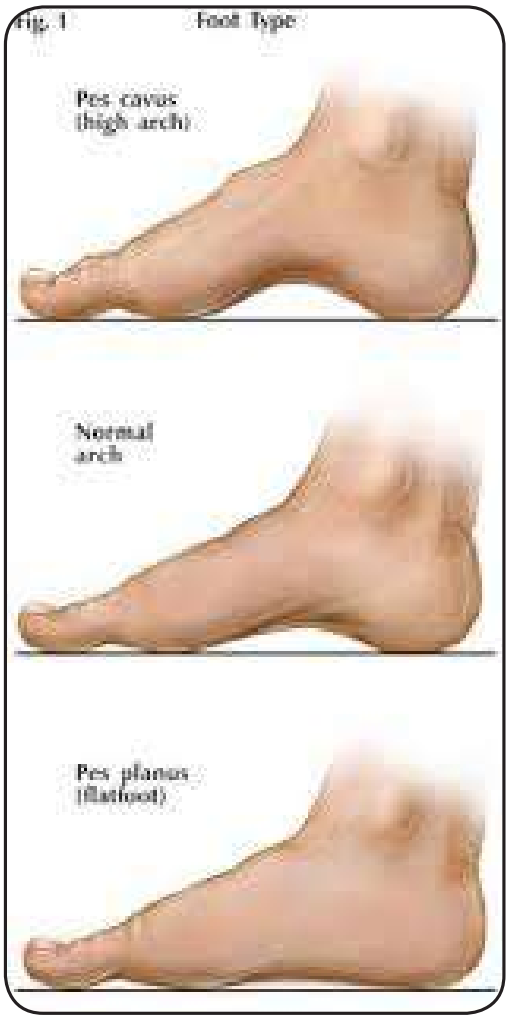


Fig 5 : rotational movements of the foot

protect the injured parts temporally while returning to play from an injury.

For example helmets are mandatory in certain sports like motor racing, cricket and cycling. Some other equipment includes mouth guard in combat sports, rugby, shin guard in football, combat sport, gloves in cricket, hockey. (Fig. 4)

Other equipment and sport clothing

Sports shoes are very important gear to prevent injuries and for better performance. Different people have different foot arches. While most people have normal foot arch, some people have either a flat foot where foot arch is flatter, or a high arch foot, where foot arch curve is higher than normal. When selecting appropriate shoes, for a particular sport, it is advisable to select shoes according to the athletes foot type or arch. Sometimes it is necessary to wear sport insole fit in to the flat foot arch to make it comfortable and prevent excessive rotational movements of the foot and leg to avoid possible injuries. (Fig. 5)

It is also important to select shoes according to the playing surface. It is advisable to change sport shoes frequently before wearing off, since slightest rotational force or defect in shoes can give rise to lifelong injuries. Cotton socks are the recommended socks and cleanliness of socks and shoes are also very important since dirty socks will cause infections.

Sport clothing is also very important to make athletes comfortable while playing and prevent them from environmental hazards. Some features of sport clothes include, sweat absorbability, minimum seam or seamless, ensure cooling effect, well-padded in certain places to prevent friction, and prevent environmental hazard like excessive heat and cold.

Appropriate surfaces

Any kind of sporting activity should take place in a safe environment and appropriate surface. Hard uneven, slippery surfaces can give rise to injuries and best avoided.

Appropriate training and preparation

An athlete is fit to play only when the athlete trains the body for the particular activity. Then the muscles and the systems of the body can tolerate the stresses of the sport. Otherwise they can get injured.

Sports recovery

In recent years, high priority is given to recovery following heavy bouts of exercises, training or competition. That is because when performing exercise, muscle energy gets depleted, muscles get micro injuries, and waste products accumulate in the muscles. Sometimes an activity has to be repeated on the same day. It is essential to get the muscle to recover fast, then only anyone can perform again and again. To perform better, it is necessary to do



Fig 6 : cool down the body.



Fig 8 : treatment depends on suspected causes

hard training each and every day. To do hard training every day it is essential to recovers your body as quickly as possible.
There are several recovery methods available. A Carbohydrate rich diet just after the competition or training will replenish the energy stores. It gives nutrients to injured muscle to help recover and gives energy to build up new tissues, which is the expected outcome of the training.

Ice bath after the cooling down exercise further cools down the body. An Standing waist deep in 10-15^{o} C cold water for five minutes will be sufficient to cool down the body. (Fig. 6)

Deep water running either in a swimming pool or any other place like a river after training will enhance recovery.

Sport massage

Regular massage helps to relax the sore muscles thereby increasing



Fig 7 : RICE treatment

circulation, which helps to give nutrients, oxygen, as well as removes waste product from the muscles.

Meditation and listening to music also helps to relieve mental fatigue.

Management of common sports injuries

Although we try to minimize sport injuries, it is a very common occurrence in sport. When it happens proper treatment is a must.

Initially first aid treatment and RICE treatment should be done (R- rest, I –ice, C- compression, E –elevation). (Fig. 7) Ice is the main component of RICE treatment.For the soft tissue injury it is advisable to keep ice at least for three days. After clinical examination, and investigations, a diagnosis can be made. Injury treatment includes proper rehabilitation exercises. If the player is physically fit only the player should be allowed to play. Muscle cramp is a very common condition in sport. It is caused by non-coordination between muscles and nerves. This condition also has so many causes like, lack of minerals, lack of water, muscle fatigue, excess heat, and excess cold etc. If someone gets a cramp, water and minerals should be given irrespective of the cause and the rest of the treatment depends on suspected causes. (Fig. 8)

Any serious injury should be dealt with experience hands and properly rehabilitated. Serious injuries include muscle and ligament tear , cartilage and bone injuries, concussion and spinal injuries.

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The possible adverse effects of the use of prohibited stimulants on sportsmen

Dr Seewali Jayawickrama



The sportsmen who have brought fame to our country by winning many gold and silver medals, and thereby raised Sri Lanka to international standards and received applause from the global community deserve pride of place and honour. Due to this honour our sportsmen have become famous nationally and internationally. Today sportmen have been able to achieve a unique position by receiving gold and silver medals in the school system too. It is very important to maintain this pride and international fame without a blemish. If this victory is blemished due to whatever the reason the resulting disgrace will be unbearable to the sportman and the country. There are instances when certain sportmen who have reached the pinnacle of victory have been unable to safeguard their fame in an untarnished manner. This is due to the use of substances (stimulants) banned by the World Anti Doping Agency (WADA) in order to enhance the sports skills by some sportmen. If it is proved through investigations that a sportman who has won a position and achieved this victory by using such prohibited substances the particular sportsman will be debarred from participation for a period of four years. In this article we discuss the serious health problems faced by the sportsmen due to the use of banned stimulants. In certain instances such sportmen have even lost their lives in their youth itself, in addition to the disgraceful victory. What is the use of a victory if it makes a person a patient for life and even cause death. Dr. Seevali Jayawickrama the Director General of the Sri Lanka Anti Doping Agency who is a Doctor in sports medicine has expressed his views regarding how the sportsmen who have indulged in using banned stimulants have paid with their lives. There are several banned substances such as steroid Beta 2 Agonists, Diuretics and Growth Hormones used by sportsmen to enhance their skills in sport. However some of these are pharmaceuticals recommended by doctors for the control of certain diseases of patients. But medical science has proved that although the use of such drugs provide some sort of power to the sportsman he will have to face many health problems which may be fatal. The way in which the prohibited stimulants are used differ according





to the type of sport. Some sportsmen use various synthetic hormones to increse their physical strength. Marathon runners use the hormone Erytheopoetin as an injection. This is in order to run with grater power and enhance their endurance by increasing the red blood corpuscle concentration. Sportsmen such as boxers and weight lifters who indulge in sports of the weight category try to reduce their body weight by using diuretics. The purpose is to achieve the same body weight as of the opponent by increasing the urine output by taking the diuretic drugs. Similarly some persons use narcotics such as heroin and cannabis in order to minimize the pain when carrying out sports activities. Even though patients with urinary diseases and with high blood pressure get relief by using directics as recommended by doctors, when healthy persons use these drugs they get dehydrated and may even have kidney failure.

Certain marathon runners withdraw their own blood into syringes and store them in the fridge and a few days closer to their competitive event, the blood they removed is injected back into their body.

Sportsmen use this method to increase the amount of blood in their body. Generally a few days after a blood donation, the amount of blood returns to its previous volume along with all the components in the blood. Specially the long distance runners use this type of irregular methods to increase the haemoglobin content in their blood, so that running is made easier by supplying more oxygen to the muscles. Sometimes this may be so dangerous even to cause the death of the athlete. If even a drop of the blood gets clotted or an air bubble is present in the blood the sportmen may even die.

Although this practice gives a certain degree of power to perform the sport, blood pressure may increase and the sportsmen may die even during the race. Sportmen use as stimulants steroid type of drugs recommended for the control of asthma in patients. Becoming addicted to these drugs is highly dangerous. When sportmen use these steroid type of drugs these may affect the heart. At the same time the deposition of fats in the coronary arteries and other blood vessels may result in heart attacks. Also they increase the cholesterol content in the blood. Further more they affect liver enzymes and cause liver damage, and the liver may become cancerous.

Sportsmen use food supplements to receive more nutrition. Marketeers have misled the sportsmen to the extent of not believing that a balanced diet can provide more nutrition than food supplements. Through examination of samples in order to verify whether these sppliments contain the nutritional constituents as claimed in the labels of the supplement pack the Antidoping Agency has found that they contain more chemicals than the claimed nutritional constituents. The manufacturer does not take responsibility for these additional chemical substances and therefore do not take responsibility for the use of these supplements by sportsmen.

Some sportsmen use as stimulants medicinal syrups which are meant

for cough. They are also harmful to the body.

The general ill effects that may be caused in sportsmen by using prohibited stimulants

Diseases associated with joints may result. The bones may even deteriorate. In males the size of their sex organs may decrease. They may become impotent. Even though sexual desire is increased there is inability in sexual performance. The size of the testicles begins to decrease and males begin to develop female characteristics. Specially their breasts may increase in size. They may become bald. Acne may also develop. Blood pressure increases. If it is a female she will develop male characteristics. Her voice becomes gruff. Hair follicles increase. Causes sub fertility. Has adverse effects on conception. Have a tendency to cause miscarriage. The use of stimulants by sportsmen and getting addicted to them is very harmful. Such sportsmen are liable even to face sudden death due to the sudden deveopments of ill effects caused by stimulants. Even those between the age group of 3D - 3S years may face death due to these stimulants.





It is a common occurance for sportsmen who use stimulants to enhance their skills to become addicted to them. The sportsmen gradually increase the dosage of stimulants with time. Finally they reach a point when they cannot compete without using stimulants. It is the trainer of the sportsman who has to be blamed for this state of affairs. Or else the friends of the sportsman, sometimes his parents, the teacher in charge of sports, the instructor of the body building institute are responsible. Some people illegally mislead the sportsmen by saying that stimulants are necessary to win in sports. These people are under the impression that the victories at international level are due to the use of stimulants. So in order to realize their dream of winning they use prohibited substances. In order to protect or save sportsmen from this situation urine samples are tested before and after the sports event. All sportsmen of international sports associations are bound to obey this world wide rule. They are bound to supply urine samples at any time.

The urine test

Testing of the urine is carried out within an hour after the completion of the event. Unlike the urine tests carried out in a hospital these tests are carried out under very strict legal requrements. The sportsman is given water to drink to bring about proper filtration of urine. More over the bottles of water should be sealed. The urine is collected into specially sealed glass beakers. The responsibility for this procedure lies entirely with the sportsman and a special officer is appointed to keep the sportsman under his surveillance. The urine samples are sealed and are sent for testing to a lab approved by the World Anti Doping Agency. In Asia these laboratories have been set up in countries such as India, China, Thailand, Japan and Korea. If it is proved that the sportsman has used stimulants the disciplinary committee will hold an investigation and impose relevant punishments.

The Law in Sri Lanka

The guilty sportsman will be banned from participation for four years. The persons who aided and obetted the sportsman will be charged in the supreme court and if found guilty will be imprisoned for a period of two years and will be fined 5-10 lakhs of rupees.

For individuals suffering from diseases such as asthma and diabetes who take part in sports, Steroids-Beta 2 Agonists may be included in the medicines used for the control of asthma. Such

sportsmen may sometimes develop respiratory problems during long distance races due to oxygen deficiency. Then it is necessary to use an inhaler and these also may contain steroids. So sportsmen suffering from this type of ailments must inform the relevant authorities about it right at the beginning. Then medical investigation will be carried out regarding the disease condition of the sportsman and medical reports will be obtained. The drug prescriptions recommended by the doctors to control the ailment should be submitted. The sportsmen suffering from such diseases will be subjected to continuous medical investigations and will be allowed to take the recommended drugs. These regulations are applicable to all sportsmen suffering from any ailment.

What sportsmen should do in order to ensure victory in sports

All sportsmen must be conscious of their nutrition.
It is extremely important to get advice from a sports doctor or a nutritionist or a physician. The diet must be planned in such a way as to provide a balanced content of carbohydrates, proteins, vitamins and fats. This has to be done on the advice of a nutritionist who will make his recommendations according to the height, weight, age and the degree of activity of the sportsman and the type of sport concerned. The sportsman should exercise regularly according to the sport. Food intake should be balanced according to the calories that are burnt. Daily comfortable sleep is necessary. Mental balance is an essential factor. Disturbed and provoked mental or emotional state is not conducive for sport. A sportsman is strickly liable for any misconduct or intake of prohibited substances. He should never be on the defensive. His main duty is to safegaurd his life and body. Therefore he must pay special attention to every thing that he has taken into his system.

The problems that may arise in females

- Decrease in breast size
- Excessive growth of facial and body hair
- The voice becoming hoarse or gruff
- Irregularity of the menstrual cycle
- Enlarged clitoris

Drugs prohibited by the World Antidoping Agency (WADA)

1. Anabolic agents

These contain drugs which mimic the male hoimones testesterone and dihydroteste sterone. They increase the development of muscles by enhancing protein synthesis in cells.

Expected effects

- Increase of the male hormones testcsterone and epiteseslerone
- Development of muscles, strength and power. Increase in the ability to face competetiveness and endurance

2. Peptide hormones and substances associated with growth substances

- Erythropoesis stimulants
- Chorionic gonadotrophin, leutenising hormones
- Insulin
- Corticotrophins
- Growth hormones : responsible for muscle and tissue development

Side effects

Causes disfiguration of body due to abnormal growth of legs, hands and jaws

3. Beta - 2 - Agonists

Other types except salbutanal and salmetazole (used with an inhaler)

4. Hormone Antagonists and modulators

- Aromotase inhibitors
- Selective oestrogen receptor modulators
- Other anti-oestrogenic substances
- Agents bringing about changes in the activity of myostatin

5. Diuretics and other masking agents

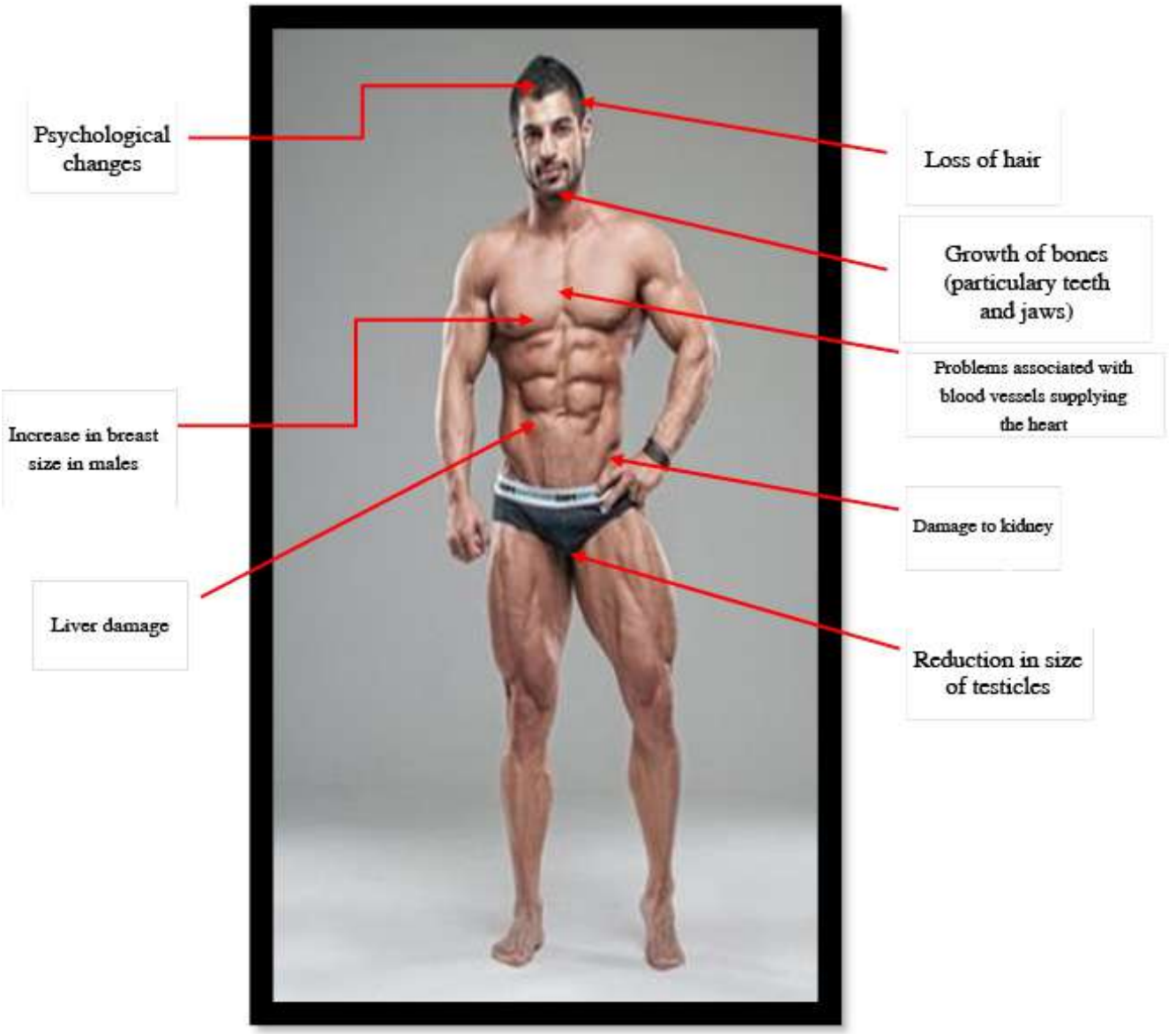
These assist in the removal of fluids from the body.
Cause decrease in weight. Dilutes the urine so that it is difficult to detect other drugs in the urine

Side effects
Excessive dehydration and renal failure

6. Stimulants

Enhance the awareness, competitiveness and aggressiveness. Heips to fight against fatigue.

Side effects
Incresing blood pressure and body



temperature. Causing irregularities in the heart beat. As a result heat attacks and strokes may result. Example: Cocaine, Adrenaline, Methyl hexane amine

7. Narcotics

8. Cannobis

9. Glucocorticosteroid types

All ghicocorticosteroid types are prohibited when administered through the mouth, intravenously, intramuscular or through the anus example Prednisolone

Prohibited Practices

Increasing oxygen transport

- Blood doping agent. The artificial increase of red blood cells. Removing the blood of a competitor, storing it and injecting it back into the competitior closer to the time of competition.

Dangers and Complications

Infections (including AIDS) of kidneys and liver failiure, brain damage. Increasing the supply, transport and distribution oxygen in an artificial manner.

- Chemical and physical manipulation
- Gene doping

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Physics in Sports – Cricket bowling action

Dr Shanika M. A. Arachchi



Work and energy play a significant role in sports. Every sport's discipline depend on the ability of an athlete to exercise a force. In Physics, if a force moves an object to a certain distance, it is defined as a work. Force and work are directly proportional to each other. Understanding the physics behind the sports will improve the overall performance. It includes better performance by improving the game related techniques, injury prevention, planning of efficient training and developing aerodynamic equipment and clothing.

Physics can be used to monitor the precision timing of athleties movements, as timing is one of the key things that take them to the winners' podium. Wearable sensors will measure forces applied during the play. This information can be used to improve their timing as well as precise postures during the game. Their coach can review a graph of force at different times during the training sessions and improve the game based techniques. In running, cycling and summing, a resistance force is experienced due to air or water in which they are moving. A cyclist can minimize this resistance force by changing the position, which results to reduce the cross sectional area. They can further reduce the drag force by hugging their bodies tightly to the bike's frame. Rather than pushing against the resistance force, a right design of materials may lead to more fluid flow around his/her body. In swimming, wearing a full body swimming suits will squeeze swimmers into smaller cross-sectional area, which results in eliminating skin friction and allowing water to flow over the body more easily.

Understanding the aerodynamics of the ball is important in defining its trajectory in all high speed ball sports such as cricket, baseball, golf, tennis, volleyball and football. The aerodynamics behaviour results to deviate the anticipated trajectory of the ball resulting in a curved and unpredictable trajectory. In most of these high speed ball sports, the lateral deflection is produced by spinning the ball about an axis perpendicular to the line of flight/ delivery. This lateral deflection is

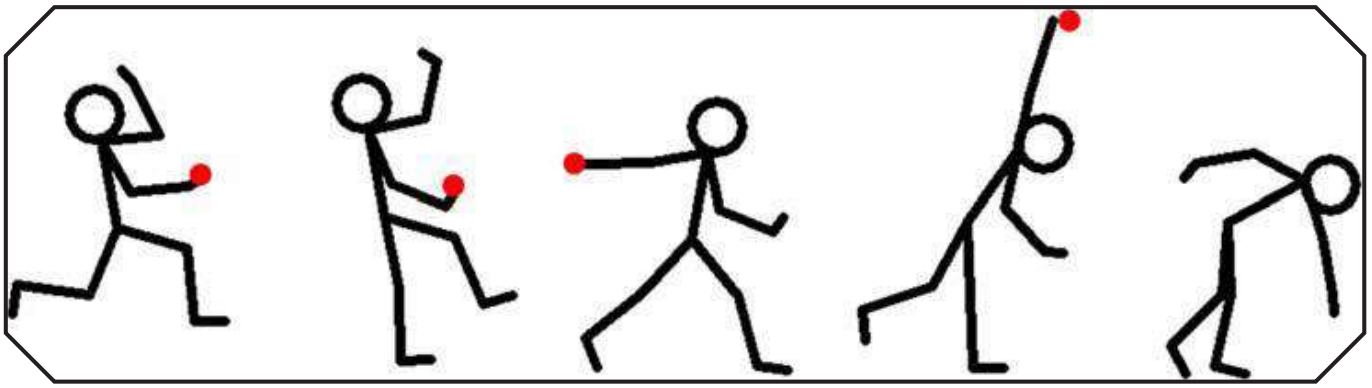


Fig 1: Strike of bowling action sequence: delivery jump, back foot contact, front foot contact, ball release and follow-through

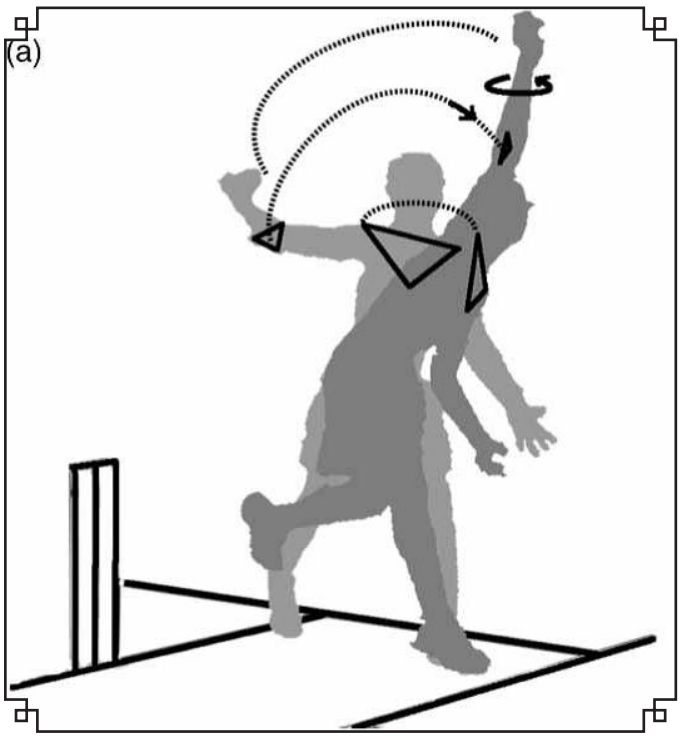


Fig 2: Spin bowler going from the start of the bowling action to just before ball release

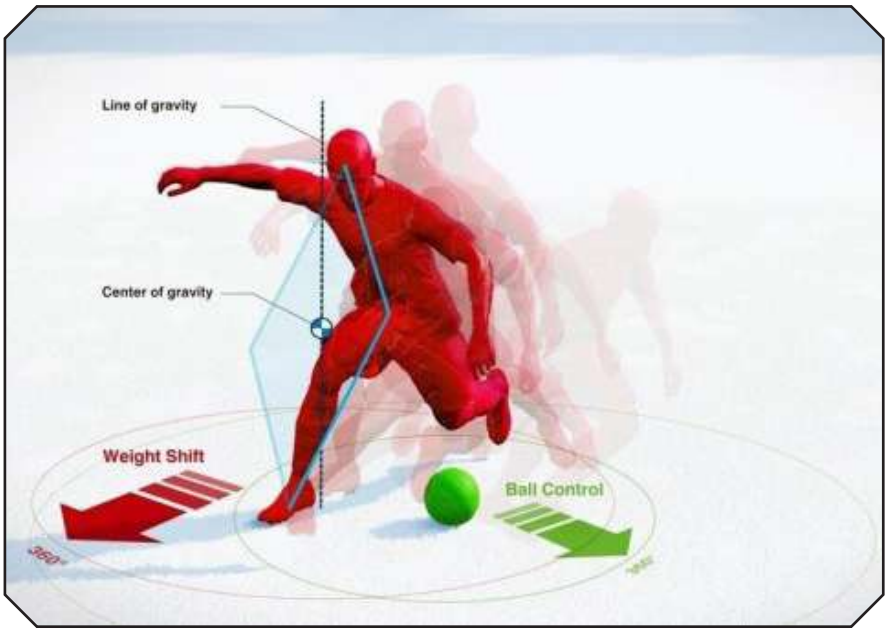
commonly known as swing, swerve or curve.

Cricket is one of the most favourite games in the Indian sub-continent. It is a bat and ball game. It has three major parts; batting, bowling and fielding. The batsman is supposed to hit the ball hard and score the runs. Theoretically, heavier the bat and faster the bat (stroke) acceleration, greater the force applied on to the ball. When an accurately timed and accelerated bat hits a ball, which would cause an increase in the momentum, this consequent result would be a great shot, a four or a six. In the case of a defensive shot, a ball hits a stationery bat, which results in a loss of momentum.

The basic cricket bowling action has a run-up phase. It is similar to javelin throwing. The bowler's run -up begins slowly. He then gradually increases the speed until the pre-delivery phase when he leaps into the air in preparation for the phases to follow: back foot contact, front foot contact, ball release and follow-through as shown in Figure 1. The aim of this article is to discuss the bowling action in detail.

According to the International Cricket Council (ICC) regulations, a fair delivery of the ball is achieved when elbow joint is not partially or completely straightened from the point the arm has reached the level of shoulder until the ball has been released. Identifying the illegal bowling action of the player in the juenile stage is very important. It helps to biomechanically correct his/her bowling action according to the ICC standards. In addition, biomechanical examinations of those players at the early stage helps them to eliminate game based injuries by improving muscle strengthening.

Chucking in bowling is becoming one of the key issues in the cricket world. The infamous no-balling incident of Muttiah Muralitharan during a game in 1995 against Australia, where he was no-balled seven times in the same match for chucking, led the ICC to alter the rules regarding this controversial issue. Since then, ICC has introduced the Law 24.2 to identify illegal bowling action. This law states that, if an umpire suspects the bowling action of a player, then the player is directed to carry out an independent analysis of his/her bowling action by an approved human motion specialist under laboratory conditions. According to ICC report for 2009, the legally permitted elbow extension angle is 15° during the period between



upper arm being horizontal and the ball releasing instant. This angle does not include any elbow abduction angle changes or hyperextension. In Biomechanics of the bowling action, the elbow joint is a hinge joint. It moves through flexion and extension. The elbow flexion is the forward and upward movement of the forearm, while extension is the backward and downward movement of the forearm. Theoretically, the bowler should maintain the same elbow extension angle until the latter parts of the delivery (Figurer 2). As the bowling arm circumducts to the position of ball release, a 15° tolerance threshold is applied to the limit of elbow extension between the arm at horizontal and the position of ball release. This horizontal position is considered when the arm is parallel to the ground, while the ball releasing position is considered as the last moment of the ball release from bowler's fingers. This tolerance threshold was introduced by ICC in 2005, after a biomechanical assessment of the bowling action of 130 first-class bowlers. A well-recognized method is needed to accurately measure the elbow extension angle during a delivery and to identify when the arm is horizontal. Such a method will help identify the possible hyperextension of the elbow. A video analysis is a possible method that can be practised to measure the elbow extension angle in the event of the elbow axis being parallel to the video camera axis during the bowling action. However, it is not possible to use this method because the elbow axis changes throughout the bowling action. Therefore, laboratory marker method is commonly practised.

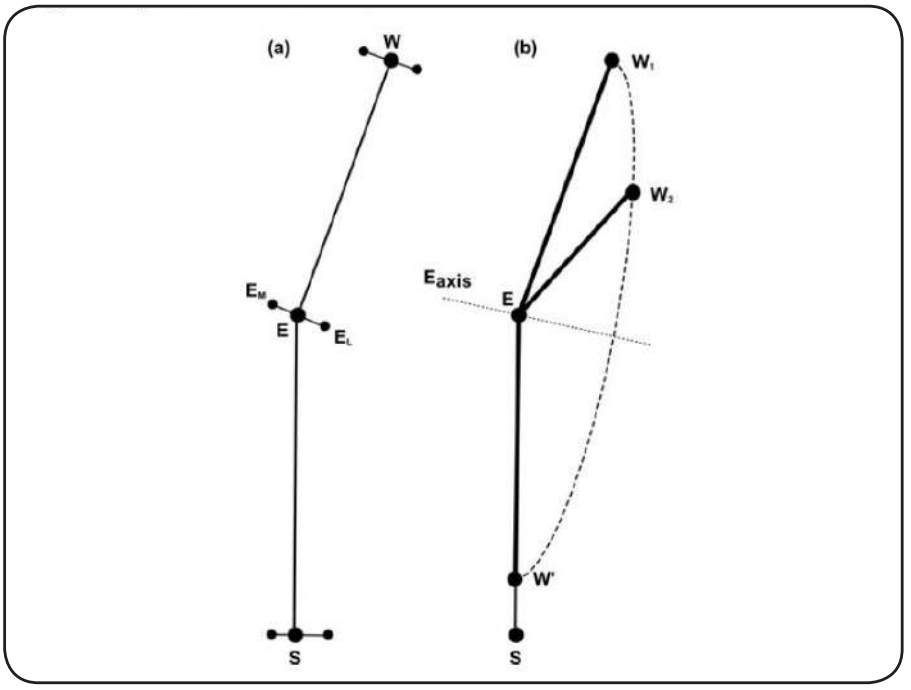


Fig 3 : a) Shoulder, elbow and wrist markers b) elbow axis calculation. W-Wrist, E- Elbow, S- Shoulder, W1 and W2 are recorded positions of wrist from elbow flexion calibration trial for extension angles of approximately 1800 and 900. W` is an assumed point on the upper arm.

The definition of the elbow flexion or extension axis may affect the quantity of elbow extension angle for a specific bowling trial. The current ICC testing protocol (2009) refers to the methods described in Lloyd *et al* (2000) for flexion/extension axis, which is defined to be perpendicular to the longitudinal axis of upper arm in frontal plane. The elbow flexion/extension angle is derived at shoulder-elbow-wrist angle. 0° being full extension and 180° being full flexion. Furthermore, this elbow flexion/

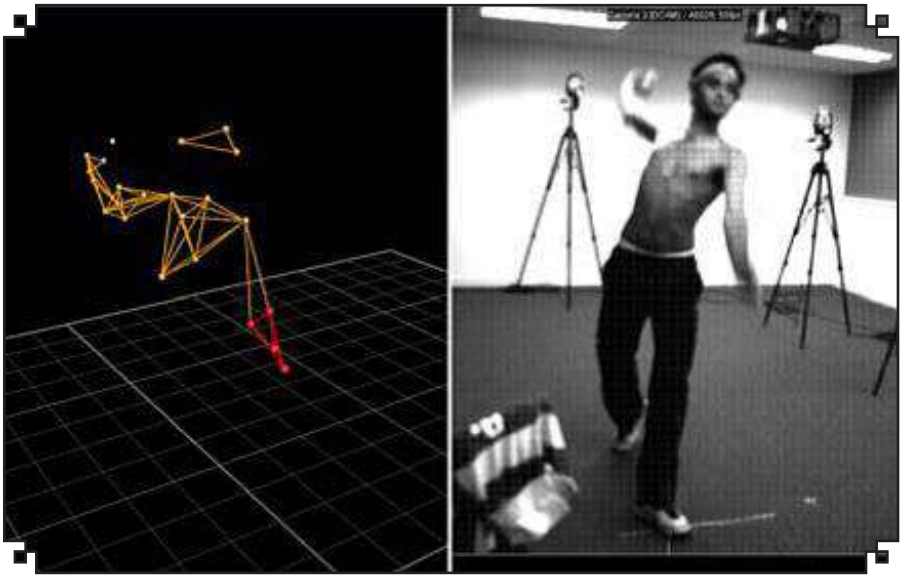




Fig 5 : ii) Determining the lateral elbow epicondyle position

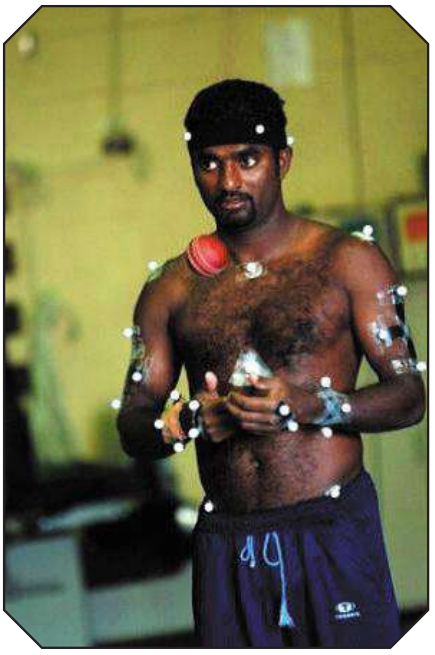


Fig 5 : i)Upper body model

extension angle is defined about the flexion-extension axis of the elbow. Elbow flexion-extension occurs along this axis. This elbow extension determines whether a bowler is 'throwing'. Figure 3 shows the calculation of elbow axis.

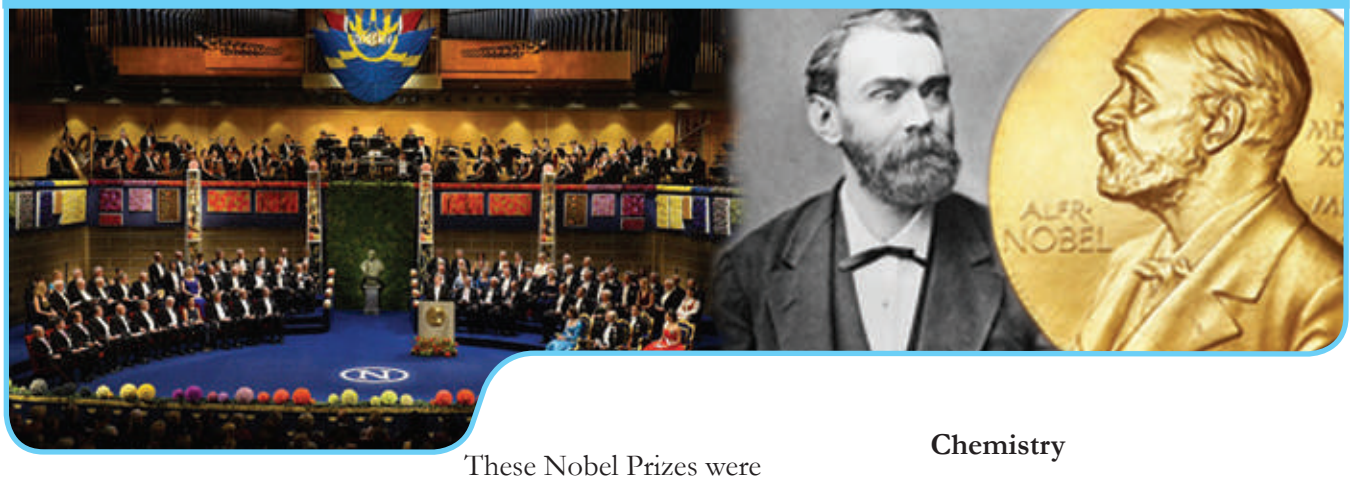
The kinematics models of upper limb during cricket bowling action is created to describe the movements of upper arm and forearm during each delivery. With that, the flexion-extension angle of elbow is analysed during the bowling action. In addition, the range of motion and physical characteristics of bowling action can be measured (Figure 4).

Furthermore, motion data capturing of traditional biomechanical models were performed by positioning the markers over the selected anatomical landmarks to define the joint centers as shown in Figure 5. As a result of excessive skin movement, significant errors were introduced in joint center and the axes of rotation. This effect is significantly evident in full elbow extension, while external markers placed on elbow epicondyles results in elbow flexion artefact. As a result, errors can be attributed to transepicondylar axis of the elbow joint (felxion/ extension axis). This artefact effect is further worsen with individuals having joint abnormalities. Therefore, these traditional models failed when applied to analyse the biomechanics of bowling action of players with joint abnormalities, Such as Muthiah Muralitharan, Shoaib Akhtar and Jenny Gunn. In such abnormal anatomical orientations of the arm (Ex; hyperextention or higher carrying angles), these traditional models should be implemented with caution to address such abnormalities. Different research groups have been developing and validating biomechanical models for motion analysis over the last decades. Furthermore, these biomechanical models are capable of measuring the elbow joint angle by eliminating soft skin effect and blower based anatomical abnormalities.

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The Nobel Prizes - 2016

Thusitha Malalasekara



On December 10th the Nobel laureates received the Nobel Medal, Nobel Diploma and a document confirming the Nobel Prize amount from King Carl XVI Gusaf of Sweden: The Nobel Peace Prize Laureate received his prize from the Chairman of the Norwegian Nobel Committee in the presence of King Harold (V) of Norway

These Nobel Prizes were established by Alfred Nobel by signing his last will and testament to set aside the bulk of his estate, on 27th November 1895 at the Swedish Norwegian Club in Paris. His request was to make these awards to the most distinguished scientists in the fields of Chemistry, Physics, Physiology or Medicine, Litereture and Peace, without any kind of discrimination.



Jean-Pierre Sauvage

In the year 2001 Peter nobel the great grand neprew of Alfred Nobel requested the Bank of Sweden to award a Nobel Memorial Prize for Economics. Since then Nobel Prizes are awarded for Chemistry, Physics, Physiology or Medicine, Literature, Peace and Economics. Summarized below is an introduction to the 2016 Nobel Award Winners.

Chemistry

Jean-Pierre Sauvage (France), Sir J.Fraser Stoddart (British-American) and Bernard Lucas Ferringa (Dutch) were the three chemists



Bernard L.Feringa

who were awarded the 2016 Nobel Prize for Chemistry. They won this award for the design and synthesis of molecular machines.
These three chemists had made molecular knots, shuttles, rotors, chains, pumps, axles, switches, memory devices and also a nano car. All these products are at the scales of molecules. Nanoscale machines including, what were



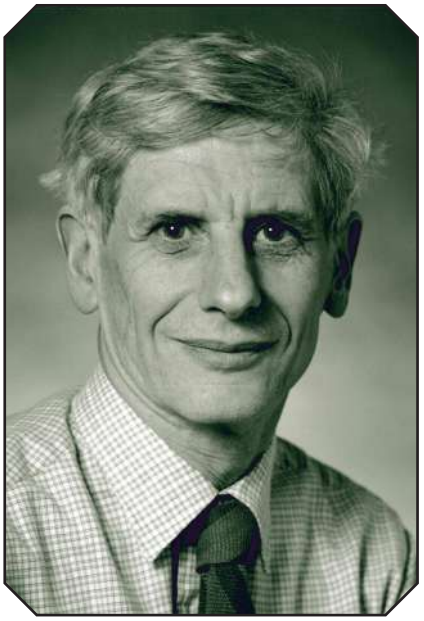
discussed here are yet to find applications, but the researchers say that their future use could range from delivering drugs to computer memory.

Jean-Pierre Sauvage

He was born on an 21st October. 1994 in Paris, France and presently working as a coordinating chemist at Strasbourge University in France. Sauvage earned his PhD from the University of Louis Pasture. His scientific work was mainly focussed on creating molecules that can mimic the functions of machines. He is a member of the French Academy of Science since 1997.

Sir J.Fraser Stoddart

Sir James Fraser stoddart who is a British-American born on 24th May 1942 in Edinburgh in UK, and is the professor of Chemistry in the Northwestern University in United States. He is a specialist in the areas of supramolecular chemistry and nanotechnology.
University of Edinburgh has awarded the Bacheler of Science degree in 1964 to Stoddart,



David James Thouless

followed by Doctor of Philosophy degree in 1967.
Sir Stoddart has won number of awards during his career and includes Albert Einstein Award for Science (2007) and Arther C.Cope Award of the American Chemical Society (2008).

Bernard L.Feringa

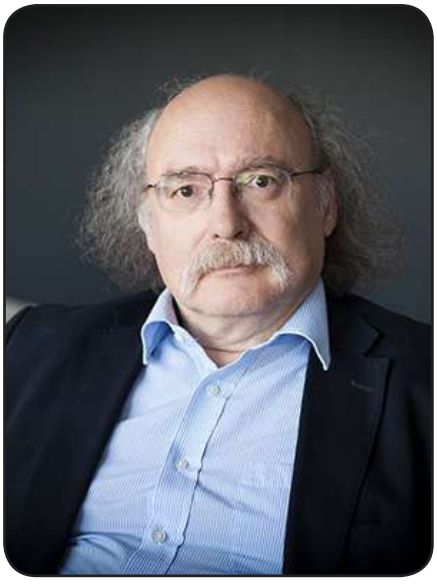
Bernard Lucas Feringa is affliated to University or Groningen in the Netherlands and is a synthetic organic chemist specializing in molecular nanotechnology and homogeneous catalysts.
Born on 18th May 1951, in Berger-Compascuum in the Netherlands, has received the MSc degree (1974) and Ph.D (1978) from University of Groningen. He has also served as an editorial member of several scientific journals.
Ferringa was elected as a Fellow of the Royal society of Chemistry in 2004 and won the Arthur. C.Cope Award from American Chemical Society in 2015.

Physics

2016-Nobel Prize for Physics was also awarded to three physicists but it was not divided equally among them. David J.Thouless received half of the prize while the other half was shared between F.Duncan M.Haldane and J.Michel Kosterlitz. The award was presented for the theoretical discoveries of topological phase transitions and topological phases of matter.

David James Thouless

Is a British condensed matter



F.Duncan M.Haldane



Yoshinori Ohsumi



Bengt Holmstrom

Oliver Simon D'Ary Hart

physicist. He was born on 21st September 1934 in Bearsden in the U.K. Before the Nobel award he had won the Wolf Prize in 1970 for his scientific discoveries.
He is a Bachelor of Arts degree holder from Trinity Hall, Cambridge, and received his Ph.D from Cornell University in USA. Presently he is working at University of Washington as the Professor or Physics. He has also been the Professor of Physics and Mathematics at the University of Birmingham and at Yale University in USA.

F.Duncan M.Haldane

Duncan Haldane is the Professor of Physics at the Princeton



J.Michel Kosterlitz

University in USA. He is also a British American born on 11th September 1951 in London.
Haldane worked as a Physicst at Institute Lane-Langevin in France, where he conducted a number of researches on condensed matter physics.
Haldone obtained his Bachlor of Arts and Ph.D from Christ College, Cambridge. He is a member of number of Scientific professional associations and also a member of the American Association for the Advancement of Science.

J.Michel Kosterlitz

Michel Kosterlitz is a British American physicst presently attached to Brown University in USA as a Professor of Physics.
He was born on 22nd June 1942 in Aberdeen, USA and obtained his Bachelor of Arts and Master of Arts degrees from Gonville and Calves College. He obtained his Ph.D from Brasenose College, Oxford in 1969.
He and his other two co-Nobel award winners explained how certain kinds or matter transit from ordinary matter to exotic matter.
He has also won several British and American awards before the Nobel award.

Physiology or Medicine

Yoshinori Ohsumi

The 2016 Nobel award for Physiology or Medicine was awarded to a Japanese professor working at Tokyo Institute of Technology, for his discoveries of mechanisms for Autophagy.
Autophagy is the process that cells



Juan Manuel Santos

use to destroy and recycle cellular components.
Born on 9th February 1945 al Fukuoka, Japan, Ohsumi obtained his BSc in 1951 and D.Sc in 1974, both from the University of Tokyo.

He has won several international and Japanese awards and prizes for his scientific work including the prestigious Kyoto prize in 2012.

Economics

Nobel Memorial Prize for Econimic science which is funded by Sveriges Riksbank was awarded to two ecomonists jointly. They are Oliver Hart and Bengi Holmstron. The reason attributed to making this award is for their contributions to contract theory.

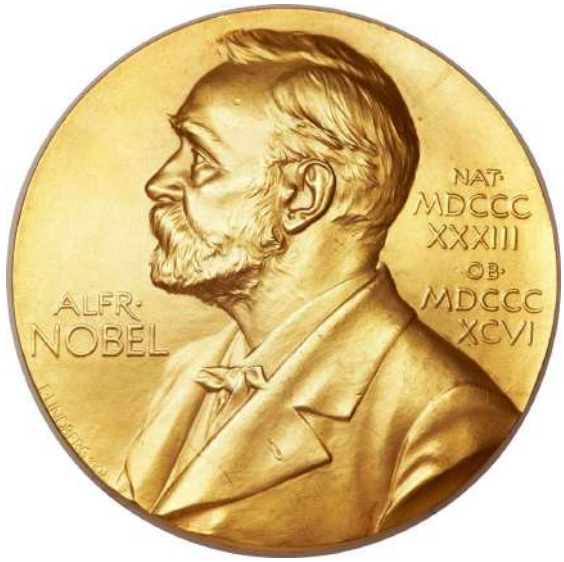
Oliver Simon D'Ary Hart

He is a British born American economist. He was born on 8th October 1948 in London UK. Presnetly he is the Professor of Economics at the Harvard University.
He earned his BA, in Mathematics at Kings College Cambridge in 1969 and his MA in Economics from University of Warwick in 1972 and Ph.D from Princeton University in 1974.

Bengt Holmstrom

Bengt Holmtrom who was born on 18th April 1949 at Helsinki, Finland is presently attached to the Massachusetts Institute of Technology USA as a Professor of economics.

Bengt received his BSc in mathematics and Science from the University of Helsinki, Master of Science from Stanford University and Ph.D from the School of Business at Stanford.
Before winning the Nobel Prize he has won several international awards, for his work.



Literature

The 2016 Nobel Prize for Literature was awarded to American Bob Dylan, a song writer, singer, actor and writer for having created new poetic experiences within the great American song tradition. Bob Dylan was born on 24th May 1941 at Duluth, Minnesota, USA. His most celebrated work dates from the 1960s.

Peace

The most prestigious Nobel award is the Peace Prize. The Nobel Peace Prize 2016 was awarded to the current President of Colombia Juan Manuel Santos, for his resolute efforts to bring the country's more than 50 year long civil war to an end.
Santos was born on 10th August. 1951 in Bogota, Columbia and is an economist by profession and a Journalist by trade.

Thusitha Malalasekara
07777685639



Bob Dylan