Disability Athletics

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by Jürgen Schiffer

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Introduction

Disabled sports are sports played by persons with disabilities. As many disabled sports are based on existing able-bodied sports that have been modified to meet the needs of persons with a disability, they are sometimes referred to as adapted sports. However, not all disabled sports are adapted. Several sports specifically created for persons with a disability have no equivalent in able-bodied sports (e.g. Goalball for visually impaired athletes and wheelchair racing within athletics).

Organised disabled sport is generally divided into three broad disability groups: the deaf, people with physical disabilities and people with intellectual disabilities. Each of these has a distinct history, organisation, competition programme and approach to sport. Of all the movements and organisations in the broader world of disabled sports, the one with perhaps the biggest impact on athletics is the Paralympics.

The aim of this article is to provide a background briefing on disabled sport and key issues in disability athletics as a basis for further discussion and study. It addresses the following topic areas:

- History
- The Paralympic Movement
- Eligibility and Classification of Disabled Athletes
- Assistive Technology in Disability Athletics
- Cheating in Disabled Sport
- Inclusion of Disabled Athletes in Able-Bodied Athletics Competitions

History

Organised sport for persons with physical disabilities existed at least as early as 1888, taking place under the auspices of sport clubs for the deaf in Berlin, Germany, and, starting in 1899, at a cycling club for the deaf, in Paris, France. A “Cripples Olympiad” held in New York, USA, in 1911 received positive press attention and there are a small number of documented cases of physically disabled athletes competing in mainstream sports events and even in early editions of the modern Olympic Games around the turn of the 20th century. But it was not until the 1924 Silent Games for deaf athletes in Paris, France, and the post-World War II development of what eventually became the modern Paralympic Games that disabled athletes would have the regular international platforms to express their sporting abilities and ambitions we see today.

The 1924 Silent Games were organised by the *Comité International des Sports Silencieux* (CISS), which is now known as the *Comité International des Sports des Sourds* or the International Committee of Sports for the

Deaf (ICSD). These Games evolved into the summer and winter Deaflympics, the name first being used in 2001. The ICSD, which has national federations in 108 countries and is recognised by the International Olympic Committee (IOC), also organises world deaf championships in several sports. Among the reasons for the current separation of deaf sport from the wider Paralympic movement are the unique communications requirements of the athletes – the cost of providing interpreters at the Paralympic Games would be prohibitive – and the large numbers of deaf competitors in the various sports. The Deaflympics are also distinguished from other disabled sports by the fact that they are organised and run exclusively by members of the community they serve. Only deaf people are eligible to serve on the ICSD board and executive bodies.

The timeline of the Paralympic Games and the Paralympic Movement starts in Great Britain when sports activities were introduced as an element of the therapy and rehabilitation of ex-service members and civilians with spinal injuries. The pioneer of this approach was the neurologist Dr Ludwig Guttmann of the Stoke Mandeville Hospital, who encouraged his patients to move from rehabilitation sport to recreational sport and then to competitive sport. On the day the Opening Ceremony the 1948 Olympic Games was taking place in London, Guttmann staged an archery competition, known as the Stoke Mandeville Games, for a small group of British war veteran wheelchair athletes. In 1952 these became the International Stoke Mandeville Games and later evolved into the multi-sport summer and winter Paralympic Games, which now include athletes with limb amputations, visual impairments, cerebral palsy and intellectual disabilities. The development of the Games coincided with that of the International Paralympic Committee (IPC), which is discussed further below.

Sport for persons with intellectual disabilities began in the 1960s through the Special Olympics movement, which grew out of a series of summer camps organised by children's health and disability advocate Eunice Kennedy Shriver, the sister of US President John F. Kennedy. In 1968 the first international Special Olympics were held in Chicago, USA. Today the Special Olympics organisation provides training and competition opportunities across a variety of sports. In 1986, the International Sports Federation for Persons with Intellectual Disability (originally called INAS-FID but now known as INAS) was formed to support elite competition in contrast to the more participative, "sport for all" approach of the Special Olympics. In addition to promoting the interests of athletes with intellectual disabilities, the INAS organises World and Continental Championships in 11 sports and the INAS Global Games, which include seven sports and take place every four years. As mentioned above, sports for athletes with intellectual disabilities are also included in the Paralympic Games.

The Paralympic Movement

Organisation

In 1960 the World Federation of ex-servicemen set up a working group to study the problems of sport for persons with physical impairments. This led to the 1964 establishment of the International Sports Organisation for the Disabled (ISOD), which its founders intended to offer opportunities to disabled athletes who could not participate in the International Stoke Mandeville Games (visually impaired, amputees, persons with cerebral palsy and paraplegics) and to be a world governing body for disability sports – essentially what the IOC was to the Olympic Games. Cooperation with a number of disability-oriented organisations and the IOC led to the ISOD evolving in 1982 into the International Coordinating Committee of World Sports Organizations for the Disabled (ICC) with the mandate of advocating for the rights of athletes with disabilities in front of the IOC. After the success of the cooperation, which among other things resulted in the staging of 1988 Summer Paralympic Games in Seoul, Korea, the ICC determined the need to expand and include representatives from all nations that had disability sports programmes

and to include athletes in the decision-making structure. Consequently, ICC was reorganised as the International Paralympic Committee (IPC) in 1989 and now comprises 176 national Paralympic committees (NPCs).

The IPC, which is headquartered in Bonn, Germany, is responsible for organising the summer and winter Paralympic Games. It also serves as the international federation for 10 sports (IPC Alpine Skiing, IPC Athletics, IPC Biathlon, IPC Cross Country Skiing, IPC Ice Sledge Hockey, IPC Powerlifting, IPC Shooting, IPC Snowboard, IPC Swimming and IPC Wheelchair DanceSport). This role requires the IPC to supervise and coordinate the world championships and other competitions for each of the sports. The IPC also recognizes media partners, certifies officials and is responsible for enforcing the bylaws of the Paralympic Charter.

Other international organisations, such as the INAS, the International Wheelchair and Amputee Sports Federation (IWAS), the International Blind Sports Federation (IBSA), and the Cerebral Palsy International Sports and Recreation Association (CP-ISRA) are responsible for sports that are specific to their respective disability groups. In addition, certain single-sport federations govern sports for athletes with a disability, either as part of an able-bodied sport federation, such as the International Federation for Equestrian Sports or *Fédération Equestre Internationale* (FEI), or as a disabled sport federation such as the International Wheelchair Basketball Federation (IWBF). In most, if not all, cases these organisations cooperate and coordinate with the IPC and the wider Paralympic Movement.

The IPC has also maintained its cooperative relationship with the International Olympic Committee and in the capacity of head of the IPC, the IPC president is a member of the IOC. In 2001 the two organisations signed an agreement that guaranteed that host cities would be contracted to manage both the Olympic Games and the Paralympic Games, formalising an arrangement that had already been in place since 1988. This agreement was to remain in effect until the 2012 Summer Olympics but was recently extended to include all editions of the summer and winter Paralympics up to and including 2020.

The Paralympic Games

The Paralympic Games are a major international multi-sport event involving athletes with a range of physical disabilities. Both winter and summer Paralympic Games are staged once every four years. The Games are designed to emphasise the participants' athletic achievements not their disabilities and official communications at recent editions have focused on ability and rather than disability.

The 9th edition of the International Stoke Mandeville International Games (Rome, 1960) was retroactively designated as the first summer Paralympic Games. Like previous editions of the International Stoke Mandeville International Games, they were open only to athletes in wheelchairs and 400 competitors from 23 countries took part in five sports, including athletics. In 1976 athletes with different disabilities were included and the Paralympic Games in Toronto, Canada, (also known as the Torontolympiad - International Olympiad for the Physically Disabled), which expanded to 1,600 competitors from 40 countries in 13 sports. At the 2012 summer Paralympic Games in London there were 4,269 competitors from 164 countries in taking part in 503 medal events in 20 sports. The events in London attracted a total of 2.7 million spectators and a cumulative television audience of 3.8 billion viewers around the world.

The first winter Paralympic Games took place in 1976 in Örnsköldsvik, Sweden, with 53 competitors from 16 countries. The most recent winter Paralympic Games were in 2014 in Sochi, Russia, where there were 541 competitors from 45 countries.

IPC Athletics

In addition to the athletics events at the Paralympic Games, the IPC has organised in-

ternational competition in athletics since 1994, when it staged the first IPC World Athletics Championships in Berlin, Germany, for 1,154 competitors. The Championships, now known as the World ParaAthletics Championships, were initially staged every four years but from 2011 they have been organised on a biennial schedule. The most recent edition in Doha, Qatar, attracted 1,230 competitors. The IPC Athletics Grand Prix was inaugurated in 2013 with seven international meetings on four continents at which a total of 1,004 athletes from 67 countries competed. The 2016 series is expected to include 10 meetings on five continents. The IPC also organises Area championships and athletics coaching courses to support the development of disabled athletics.

Events for athletes in wheelchairs remain a major element of disabled athletics. Wheelchair disciplines include the throwing events (shot put, javelin and discus) plus racing on the track (sprints, middle and long distances and relays) and road, where many major marathons and other races have wheelchair sections. As wheelchair racers are usually faster than able-bodied runners, the wheelchair sections at road races are started separately to minimise the safety issues of having both types of athlete on the road at the same time.

The IPC and the IAAF

In 2011 the IPC and the International Association of Athletics Federations signed a memorandum of understanding to create a strategic partnership for promoting all forms of athletics in the presence of Wilfried Lemke, the Special Advisor on Sport to the United Nations Secretary General. The agreement formalised a relationship that started in the 1990s when the IAAF began inviting the IPC to stage exhibition wheelchair races during the IAAF World Championships in Athletics to help raise awareness of disability athletes and promote the World ParaAthletics Championships. Normally the races were the 800m for women and the 1500m for men, but at the 2005 championships in Helsinki the events staged were the men's wheelchair javelin and 200m and the women's 200m for visually impaired athletes. The memorandum of understanding included the aim of the two organisations working together to get future IAAF World Championships in Athletics organisers to also stage the World ParaAthletics Championships in the same city in much the same way the Olympic Games and Paralympic Games are linked. This will be achieved in 2017 when both events take place in London.

Eligibility and Classification of Disabled Athletes

A key feature of all disabled sport is classification. Some sports are only held for certain disability types. For example, Goalball is only for visually impaired athletes. Other sports are open to competitors with a variety of impairments where all the athletes compete together, like in swimming, or where the athletes only compete against others with similar disabilities or similar levels of physical function, like in athletics. In all cases it is necessary to make classifications in order to ensure the athletes are eligible to compete and for sports like athletics it is also necessary to ensure relatively fair competitions. In the history of disabled sport two approaches to classification have been used: medical classification and functional classification.

Medical classification system

From its inception, the Paralympic system for classifying athletes consisted of a medical evaluation and diagnosis of impairment. An athlete's medical condition was the only factor used to determine in what class he/she competed. For example, an athlete who had a spinal cord injury that resulted in lower limb paresis would not compete in the same wheelchair race as an athlete with a double above-knee amputation. The fact that their disability caused the same impairment did not factor into the classification determination, the only consideration was their medical diagnosis. It was not until views on disabled athletics shifted from just a form of rehabilitation to an end in itself that the classification system changed to a focus on the functional abilities of the athlete.

Functional classification system

While there is no clear date when the shift occurred, the functional classification system in use today became the norm sometime in the 1980s. In a functional system the focus is on what impact the athlete's impairment has on his/her athletic performance. Under this system, athletes with total loss of function in their legs will compete together in most sports, because their functional loss is the same and the reason for the loss is immaterial. The only current exception to the functional system is the classification format used by International Blind Sport Federation (IBSA), which still uses a medically based system.

For the Paralympic Games the allowable disabilities are broken down into the following ten eligible impairment types:

- Impaired muscle power,
- Impaired passive range of movement,
- Limb deficiency,
- Leg length difference,
- Short stature,
- Hypertonia,
- Ataxia,
- Athetosis,
- Vision impairment,
- Intellectual impairment.

Within different sports this list may vary, especially if there are differences in how disabilities impact performance. A big challenge for functional classification systems is how to account not just for the wide variety of disabilities but also for the range in the severity of impairment. In athletics for example, competitors are assigned to eligible disability classes that vary according to how they affect performance in an event group (track and jumping event classes are prefixed with a "T" while throwing event classes are prefixed with an "F") and then are further classified according to their level of impairment. Athletes in classes T11– T13 and F11-F13 all have a visual impairment that is severe enough to affect performance in their events but T11/F11 athletes have a very low visual acuity and/or no light perception, T12/F12 athletes have a higher visual acuity than athletes competing in the T11/F11 class and/or a visual field of less than five degrees radius, and T13/F13 athletes have the least severe visual impairment but their visual field is still less than 20 degrees in radius.

Athletes who are in a wheelchair due to spinal cord injury or are an amputee are in classes that take into account if they are completely functional from the waist up, have restricted movement in their abdominals, restricted movement in their upper limbs and cerebral palsy.

Assistive Technology in Disability Athletics

Assistive technology is the array of devices created to enable athletes who have disabilities to compete. These can be simple, "low-tech", or highly advanced technology, with some even using computers. More complex assistive technology devices have been developed over time, and as a result, disability sports have evolved from being a clinical therapeutic tool with a link to competition to a solely competition-oriented activity. Some of the assistive devices currently available for different impairments are given in Table 1.

Of all the forms of assistive technology, the two that have had the most impact on disability athletics have been sports wheelchairs and the highly controversial running blades used by amputee athletes.

Table 1: Assistive technology for disabled sport

For Mobility Impairments
• Light-weight wheelchairs for basketball, tennis, and racing • All-terrain wheelchairs with rugged frames and wheels for rolling over unpaved surfaces, like hiking trails, snow, or beach sand • Handcycles, or recumbent bicycles, which are like bicycles with pedals and steering using only the rider's arms

- Cross-country sit skis that allow skiers to sit down and push along the trail with tips that dig into the snow
- Weights that users strap onto their wrists rather than having to hold them with the hands
- Gym equipment that lets users stay in a wheelchair while using arm exercise machines
- Mitts with Velcro straps that help users to hold onto an exercise machine if their grip isn't strong enough
- Elastic band or tubes that exercise muscles through resistance instead of weight
- Paramobile devices such as specialised golf carts with support for standing assist players with mobility disabilities
- Bowling balls with hand grips assist bowlers with limited use of their hands
- One-handed fishing rods assist fishers who have limited mobility

For Visual Impairments

- Softballs that beep, so that people with visual problems can locate the ball to hit and catch it
- Basketballs with jingle bells inside for people who have limited or no eyesight

For Hearing Impairments

- Portable light units to visually transmit the sign of the starters gun

Sport wheelchairs

Sport wheelchairs are designed for the requirements of specific sports. Desired functional improvements can be made to chairs by evaluating the chair and athlete separately or in performance conditions together and, in fact, for some researchers the athlete and the wheelchair are viewed together as a unified performance system.

Examples of sport wheelchair design include:

- Light-weight frame wheelchairs used in sports requiring sharp, fast turns and overall agility, such as tennis, basketball and track or road racing.
- Racing chairs are also designed with bucket seats, angled wheels for improved stability and a t-frame with a third wheel in front, allowing precision steering as well as improving balance.
- Chairs with reinforced frames and impact protection required for contact sports, such as wheelchair rugby or basketball.
- Power chairs can be fitted with assistive devices that are temporary adaptations to meet the demands of a sport, such as a kick plate for powerchair football (power soccer).

There are rules for each sport and in some cases, like athletics, for different disciplines within the sports regarding the athlete's equipment. In wheelchair racing the rules cover a number of points such as the minimum number of wheels (at least two large, one small), the diameter of the wheels (maximum 70cm for the large, 50cm for the small), mirrors (not permitted), mechanical gears and levers to propel the chair forward (not permitted), steering devices (mechanical, hand operated only) and backward extension of the chair (no part may protrude behind the vertical plane of the back edge of the rear tires).

Running blades (and the Oscar Pisotorius controversy)

In 2007 the South African Oscar Pistorius, a double below-the-knee amputee who, like many other single and double leg amputees, competed in disability athletics competitions using carbon-fibre "Flex-Foot Cheetah" running blades, applied to compete in able-bodied events. He was accepted at first, but questions quickly arose about whether the blades gave him an unfair advantage. The IAAF amended its rules to ban the use of "any technical device that incorporates springs, wheels or any other element that provides a user with an advantage over another athlete not using such a device."

The blades used by Pistorius and others depend on special carbon-fire reinforced polymer that is strong and light-weight. Because of their curved design, they have to be slightly longer than a runner's biological leg and foot would be. They replace the hinge of the ankle with elastic compression that bends and releases the blade with every stride, so the uncompressed blade leaves the user standing on tiptoe. They are designed to move forward, so have no heel support in the back, and they seem to bounce of their own accord. It is impossible to stand still on them, difficult to move slowly and, once the athlete gets going, they are extremely hard to control. In races it was clear even to untrained observers that Pistorius moved differently and had a different race pattern than his competitors.

The IAAF commissioned a study by Prof. Peter Brüggemann of the German Sport University in Cologne and IAAF technical expert Elio Locatelli who found that Pistorius had about 25% less energy expenditure than able-bodied athletes once he achieved a given velocity and showed major differences in running mechanics, with significantly different maximum vertical ground return forces. Brüggemann said that Pistorius "has considerable advantages over athletes without prosthetic limbs who were tested by us. It was more than just a few percentage points. I did not expect it to be so clear." Based in these findings, Pisitorius was ruled by the IAAF to be ineligible to compete in able-bodied competitions.

In a second study, a team of seven researchers in Houston, USA led by Prof. Peter Weyand found that during constant-speed, level treadmill running Pistorius' energy usage was 3.8% lower than average values for elite able-bodied distance runners, 6.7% than for average able-bodied distance runners and 17% lower than for able-bodied 400m runners. They also found that:

- The blades have an elastic energy return of about 92%, whereas biological legs provide a 93-95% return;
- At sprinting speeds of 8.0, 9.0 and 10.0 m/sec, Pistorius produced longer foot to ground contact times, shorter leg swing times, and lower average vertical forces than able-bodied sprinters;
- The prostheses reduce the amount of force applied to the ground when running, in turn reducing the ability to propel oneself forward;
- The shape of the blade foot is a longer lever than the human foot, providing a contact point further away from the axis of rotation and allowing greater torque generation when an identical amount of force is applied, but because of the springy quality of the blades, blade runners are unable to exert the same force as able-bodied runners during push off from the ground;
- The lightness and rigidity of the blade compared to muscle and bone may allow blade runners to swing their legs faster than able-bodied runners (it was noted that Pistorius re-positioned his legs 15.7% faster than most world class sprinters, allowing for a 15 to 30% increase in sprint speed).

The research team concluded that running on blades appears to be physiologically similar but mechanically different from running with biological legs. Based on these findings the Court of Arbitration for Sport (CAS) ruled that it had not been fully shown that the blades provide a net competitive advantage and cleared Pistorius to compete in the 2008 Olympic Games. In the end, Pistorius was unable to qualify for the South African Olympic team and took part in only the Paralympic Games where he won three gold medals.

Pistorius did eventually qualify for the 2011 IAAF World Championships in Athletics, where he ran in the semi finals for South Africa's silver medal winning 4x400m relay team, and for both the 2012 Olympic Games and Paralympic Games. At the Olympic Games he finished eighth in his 400m semi-final, after running a season's best 45.44 in his first round heat, and was a member of South Africa's eighth place 4x400m relay team.

In the 2012 Paralympics, Pistorious complained that Brazilian runner Alan Oliveira used blades that artificially lengthened his running strides to win the 200m, an infringement of the IPC rules, regardless that the blades were within the allowable height limits for the athlete concerned. His complaint was supported by single-leg amputee runners including Jerome Singleton and Jack Swift, who called for the T43 double blade and T44 single blade classes to be separated in future events, as single blade runners are unable to adjust the height of the prostheses, and must always match the length of their biological leg with the running blade. In fact, Pistorius' stride length was actually 9% longer than Oliveira (2.2m vs 2.0m), but Oliveira took more strides (99 vs 92). The incident raised public awareness of how difficult it is to ensure fairness and the so called "level playing field" when expensive technology is central to performance and showed that the controversy about running blades is not fully unresolved.

Cheating in Disabled Sport

As in able-bodied sport, cheating is an issue in disabled sport, particularly at the elite level. Amongst the known forms of cheating are the abuse of the eligibility and classification systems, doping and what is known as boosting.

Eligibility abuse

After the 2000 Paralympic Games it was found that members of Spain's gold medal winning intellectual disability basketball team had not taken the required mental tests to show they had an IQ of less than 70 and that 10 out of the 12 members of the team were, in fact, not disabled. It turned out that Spanish participants in table tennis, athletics and swimming were also not disabled and that a total of five medals had been won fraudulently. In what has been called one of the most outrageous moments in sporting history, the Spanish Federation of Sportspeople with Intellectual Disabilities (FEDDI) was required to return the medals and all events for the intellectually disabled were suspended from Paralympic sport until 2009 after an anti-corruption drive had been completed.

Doping

The Paralympics have also been tainted by cases of banned substance abuse. There were five doping cases at the 1992 Games in Barcelona and the 2000 Games in Sydney saw positive tests for steroids and sanctions for ten power lifters, one track and field athlete and three other competitors. After that, out-of-competition testing was introduced across Paralympic sport by the IPC. At the 2008 Paralympic Games in Beijing, three power lifters and a German basketball player were banned after having tested positive.

Boosting

Another concern now facing Paralympic officials is the technique of boosting. Athletes with spinal injuries can have difficulties with autonomic functions and their bodies may be unable to control blood pressure and heart rate. Because of this, their bodies do not adapt to the increased demand of physical activity. Without this adaptation they can become fatigued and suffer from a lower level of endurance. Boosting works by tricking the body into a state of high blood pressure and heart rate, with an increased utilisation of oxygen that in turn improves the athlete's performance.

Athletes who perform boosting before or during an event will often self-harm, with some taking extreme measures to achieve the desired boost level. Techniques include:

- clamping the catheter to ensure that the bladder becomes overly full
- overly tightening leg straps
- electric shocks or stress to the feet, legs, scrotum, or testicles
- breaking a bone, usually in the toe.

Boosting simulations were conducted on wheelchair marathon athletes in 1994 and showed that significant performance gains could be made. The athletes attained on average 9.7% improvement after their bladder had been over-distended or after sitting in the

racing chair for 1–2 hours prior to competing. Some experts believe boosting can enhance performance by up to 15%.

There are many possible negative side effects of boosting, including the occurrence of a cerebrovascular or cardiovascular event such as a stroke or heart attack. Other complications include: aphasia, bradycardia, cerebral haemorrhage, epilepsy, hypertension, hyperthermia, neurological abnormalities, and visual disturbances.

Although the IPC made boosting illegal in 1994, a survey conducted during the 2008 Paralympic Games showed that 16.7% of the respondents indicated that they had tried boosting in training or during a competition, with more than half of them being competitors in wheelchair rugby. The use of boosting continues in Para athletes but is very difficult to detect.

Inclusion of Disabled Athletes in Able-Bodied Athletics Competitions

The controveries around Pistorius along with the recent case of German long jumper Markus Rehm, who, wearing a prosthetic blade, achieved a spectacular personal best and world-class result of 8.24m in the 2014 German national championships against able-bodied athletes, have given rise to further discussion in athletics about whether disabled athletes should be able to take part in competitions of able-bodied athletes.

According to fomer IAAF Council Member Helmut Digel, prosthetic blades of the type Rehm used give an illegal competitive advantage. He said that it must therefore be considered almost irresponsible to allow disabled athletes to take part in important able-bodied competitions. At the most, participation as an unofficial competitor could be considered. But even in such a situation, extreme caution would be appropriate because whenever a disabled athlete is allowed to take part another athlete is simultaneously denied a place. In any case, qualification for able-bodied national teams and setting able-bodied records are both out of the question.

On the other hand, Digel holds that disabled athletes' concerns are obvious and understandable. That a disabled athlete wants to compete with able-bodied athletes, that he or she wants to achieve the highest athletic goals possible for him or her are logical. But it is no less logical that politicians, the media and sport leaders all understand that rules define the sport. For good reason, technical aids other than those that define the discipline (i.e. the pole in the pole vault) are not allowed. Throwing this rule deliberately overboard would mean the abandonment of the principle of fair competition and in the end would do the cause of inclusion more harm than good and could even be fatal for athletics.

"It is in nobody's interest if we come to a situation where able-bodied athletes and disabled athletes using technical aids are considered equal in competition," he says. "If this happens, inclusion will have trumped fair competition, and the point of sport will be lost."

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Influence of Visual Impairment Level on the Regulatory Mechanism Used in the Long Jump

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ABSTRACT

The purpose of the study was to investigate how visually impaired long jumpers regulate their strides during the approach and adjust the technique of the final strides to prepare for the take-off. The attempts of 35 visually impaired class F11, F12 and F13 long jumpers at the 2009 International Blind Sports Association European Championships in Rhodes, Greece, were analysed. No significant differences ($p>.05$) were observed among the jumpers of different classes concerning velocity, stride frequency and stride length in the last steps of the approach. Analysis revealed that visually impaired athletes are able to perceive time-to-contact to the take-off area and act in a regulatory manner. Additionally, angle of takeoff increased as the visual impairment increased. Finally, a more rapid knee flexion of the take-off leg was observed for F13 jumpers ($p<.05$), resulting in a larger maximum knee flexion ($p<.05$) during the taken off. It is possible that factors such as the size and surface properties of the take-off area used in F12 and F13 competitions contribute to these differences.

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