at sea level to adapt for maximum exercise at medium altitude seemed to be correct.

The postulated dangers of running at altitude also gained some credence in the performance in the 10,000 m final of Australian distance runner and world record holder at many distances, Ron Clarke. Leading the race with 600 metres to run, Clarke slowed precipitously in the last 400 m, finishing fifth. He collapsed unconscious at the finish. When he regained consciousness 20 minutes later, he could not speak. Fourteen years after that collapse, Clarke underwent corrective heart surgery for a ruptured mitral valve. The relationship of his collapse at Mexico City to the subsequent development of his heart condition is a matter of debate to this day.

Interest in the effects of medium altitude on athletic performance has never again enjoyed such sustained scientific interest, attesting to the power of the Olympic Games for focusing the minds of scientists. Indeed the holding of the finals of the 1995 Rugby World Cup and the 1996 Africa Soccer Cup of Nations at moderate altitude in Johannesburg, South Africa, failed to initiate any substantive research on the effects of such altitude on performance in team sports in which high intensity exercise alternates with periods of rest. What new challenges might we expect future Olympic Games to excite in the minds of sports scientists?

The first will continue to be the elimination of unfair drug use in Olympic and other competition—a topic that grows annually more complex and seemingly ever more resistant to solution. But one doping issue that could be answered with appropriate testing is the list of drugs that are truly ergogenic and which should therefore be banned.

For example, the true ergogenic effects of the sympathomimetic amines, responsible for a large number of positive doping tests, often as a result of the athlete’s unwise but nevertheless inadvertent use of over-the-counter ‘flu and cough preparations, needs to be determined. If, as we found,4 there seems to be no measurable ergogenic effect of some of these agents, at least in some events and at therapeutic doses, then there is a need to re-evaluate the wisdom of listing such agents. A list of banned drugs comprising exclusively those agents which have a documented ergogenic effect on athletic performance would (a) eliminate the unfair censoring of athletes who have unwittingly used currently banned but ergogenically ineffective substances, for the treatment of legitimate medical conditions, and (b) discourage the widespread use of drugs, like the sympathomimetic amines and other stimulants, by athletes who incorrectly believe that the IOC would only ban such agents if they are effective. In fact, the majority of the drugs on the IOC banned list are included because of a lack of evidence proving that they are not effective, a subtle distinction that is lost on most athletes and indeed on the general public as a whole.

The IOC Medical Committee would do international sport a major service if it were to initiate this line of research.

Drug control programmes

Drugs in sports has been a popular topic during the latter part of this century. Drugs used in sports can be divided into three groups: therapeutics, performance enhancers, and mood alters (drugs of abuse). In the world of sports, especially in an Olympic year, the performance enhancers become a top priority. Within this group of drugs are included anabolic agents, stimulants, enhancers of oxygenation, and relaxants. Performance enhancers

The second issue concerns the increasing time demands placed on young athletes competing in international competition. While much of the attention has been on the effects of such training and competition on the physical maturation of young athletes,5 it would seem that more attention should be placed on the long term psychological risks and benefits that such participation can bring, not only to those who are successful but, perhaps more importantly, to the much larger number of children who fail to fulfil their own and (often) their parents’ dreams. Many have pointed out that committing a young person to a rigorous training programme during childhood is an experiment, the long term results of which cannot be predicted. Yet few children give informed consent for their participation in these experiments. This produces a moral dilemma that is yet to be addressed adequately, but which must have an impact on the future development of those sports.

It is my prediction that, in the next 20 years, there will be a gradual de-emphasis in international competition on those sports that favour early specialisation and intensive training at a young age. As the premier promoter of such sports, the Olympic movement through its medical committee will probably become a primary focus determining the way in which those sports evolve in the future.

The third issue concerns the pressures to which sports-persons are exposed by the increasingly nationalistic zeal incited by modern international competition. The recently completed Cricket World Cup on the Asian subcontinent brought those passion into stark relief when there were fears that their own supporters would threaten the lives of the members of the defeated Indian and Pakistani teams. When this occurs, there is a need to question whether victory in international competition has become too important. Perhaps there are less inflammatory ways in which a nation’s patriotic zeal can be developed.

Fortunately the more accepting approach of the British to “losers” is still respected in South Africa. If it were not, this editorial contributed by a medical member of the losing South African World Cup cricket team might never have been written. Perhaps our profession needs to encourage debate on ways in which the ire of defeat in international competition can be defused.

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3 Bennett R. A debt was paid off in tears. Sports Illustrated 1968, November 1:12-3.
are used by athletes at the time of the event (stimulants, relaxants, enhancers of oxygenation) or in the training period (anabolic agents). Any programme which is designed for drug or doping control must recognise the periods of highest utilisation for the different substances. An important point to be remembered is that performance enhancers are coercive drugs. If an athlete's competitor is using these drugs and a competitive advantage is perceived to be attained, the athlete believes that some drug must be taken to "level the playing field." The athlete is then coerced to use a drug to remain competitive because of a perceived lack of control by the overseers of the sport.

A successful drug control programme must include a policy, education about the policy and the drugs, a testing component, and discipline. The goal of the programme should be stated in the policy and should be reasonable and attainable. While the eradication of drug use is the ultimate goal, a more realistic goal is to make it difficult for an athlete to use banned performance enhancers without detection. The deterrence of use, if successful, will allow an athlete to compete without the perceived need to use a performance enhancer to remain competitive. This is a difficult goal to attain when an entire class of drugs (anabolic agents) is used during the training period and many programmes limit testing to the time of the event. The policy must be uniform for all competitors accepted by all competitors. This is extremely difficult in the international competitions such as the Olympics in which so many different countries and cultures are involved.

The education of the athletes, coaches, medical personnel, and administrators involved in sports is essential if the programme is to be accepted and effective. This can be accomplished by presentations at key events, for example, international events, written documents, or video presentations distributed to members of the above mentioned groups. In the international arena, this task can be delegated to the individual country. However, the material should be developed and distributed by the international organization, for example the IOC.

The success of the testing programme is dependent upon three factors: the time of the test, the collection procedure, and the technology in the laboratory. A year-round random testing programme will be effective in deterring the use of anabolic agents, while an event testing programme is necessary for deterring the use of stimulants, enhancers of oxygenation, and relaxants. The collection procedure must ensure that the athlete's urine is indeed provided in the sample. Direct frontal observation from urethra to cup is the best method available. Strict chain of custody must be followed so that the entire athletic community has confidence in the programme. Technology continues to improve but so do the available types of performance enhancers. Continued research is necessary if the drug control programme is expected to effectively deter the use of performance enhancers. Recent advances by the laboratories include the development of a high resolution of GCMS which will increase the sensitivity of the test. This will further close the window of opportunity to use a training type drug during a time period near the competition. Tests are being developed to detect human growth hormone and erythropoietin. The criteria for a positive test for testosterone are also being re-evaluated, with hopes of increasing the sensitivity of testosterone detection. Profiling of athletes' urine continues to be discussed and explored as a possible detection method. Continued research in this area will always be necessary if drug testing is to be a successful deterrent.

Discipline is a key component of any drug control programme. Most decisions in life are based on the ratio of risk to benefit. If there is no discipline, the risk is minimal and increased drug use will occur.

Drug control programmes must be maintained and continuously improved in competitive sports. If the use of performance enhancers is to be deterred, the programmes must be constructed in a manner to afford the greatest opportunity for success. If drug control programmes are unsuccessful or removed, rampant and unbridled use of performance enhancers will result.

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