Editorial

Journal of the South African Sports Medicine Association

Olympic Issue

The growth and international acceptance of sports medicine owes much to the modern Olympic Games.[1] The first significant event was the creation of the International Olympic Committee(IOC) Medical Committee in 1964 with the express responsibility of controlling drug use in Olympic competition. The work of that committee focused global attention on our profession and its role in contemporary issues in international sport.

More recently that committee has been responsible for selecting the first recipient(s) of the IOC Olympic Prize which honours scientists with a lifetime of exceptional achievement in the sports sciences. This award, perhaps the equivalent of a Nobel Prize in the Sports Sciences, will be bestowed on Professors Ralph Paffenbarger and Jerry Morris prior to the start of this year's Atlanta Olympic Games, and will further enhance the stature of the profession before a massive global audience. Professor Ralph Paffenbarger has been a friend of South African sports medicine for many years; he spoke at our International Congress in Cape Town in 1989 and has completed both the Two Oceans and Comrades Marathons, the latter when he was well into his sixties. The work of these two visionary giants has established that physical inactivity is a major factor for coronary heart disease and also contributes to the aetiology of a number of other diseases including hypertension, diabetes and cancer of the large bowel. It is appropriate that the Olympian life work of these two great gentlemen of the sports sciences should be appropriately recognised; their work proves the value of physical activity and provides the intellectual anchor which our professional credibility is secured.

The second Olympic event that has helped in the growth of the sports sciences was the quite dramatic rise to dominance of the Eastern German Democratic Republic(GDR), in Olympic competition. During the 1968 Olympic Games, the first Games in which the GDR competed as a team separate from West Germany, their athletes won 25 medals. In the 1988 Olympic Games, athletes from that country won 102 medals, one more than the total medal count for athletes from the United States, a country with a population almost tenfold larger than that of the GDR. Other nations perceiving that this success resulted from a more "scientific" and professional approach to sport in the GDR, began to investigate ways in which science could be profitably applied for the enhancement of human sporting performance. Of the Commonwealth Countries, Australia and perhaps to a lesser extent Canada, have taken the lead in these developments.

The third important factor was the holding of the 1968 Olympic Games at Mexico City at an altitude of 2270m. Never before had the Olympic Games been held in a city so high above sea-level. This single event first exposed, on an international scale, the very embarrassing inadequacies in our knowledge of some quite basic issues in the applied sports sciences. For at that time, the real effects of medium altitude on athletic performance were simply not known. Nor had the potential health risks associated with holing Olympic competition at altitude been studied. Many of the great exercise scientists of the modern era first cut their scientific teeth in the research of that question. I would suggest that analysis will show that it was after 1968 and the scientific stimulus provided by those Olympic Games, that our profession really took off. Mindful of the importance of Olympic Games for our profession, it is appropriate that this issue of our journal should be devoted to sports medical issues of special relevance to the Olympic Games.

It is often useful to begin in the past. To set the scene, Dr Floris van der Merwe reviews some of the great moments of South African achievements in Olympic track and field competition. He reminds us that only 5 South African athletes have won medals in the Olympic track and field competition. Only one of those gold medals has been won since the Second World War, suggesting that our international standing in international competition has fallen. He points out that politics robbed South Africa of some of its greatest recent track and field athletes like Sydney Mare, Mark Plaatjies and Freddie Fredericks, world-class athletes who might well have won Olympic medals for South Africa in the more recent Olympic Games.

If political factors, since corrected, restricted our Olympic potential in the past, I would suggest that the future success of our Olympic athletes will require that they receive the best that our profession can offer, including our capacity for innovation. For analysis of the great Olympic athletes reveals that most were in the forefront of innovative training methods. The great Finnish distance runners who dominated the early Olympic Games owed their success to the introduction of distance training during the winter months.[2] These methods were refined by Paavo Nurmi, one of the first runners to include regular speed training in his preparation. Nurmi is considered to be the greatest Olympian of all time.[3] Emil Zatopck refined the techniques of speed training, winning a total of 4 gold medals at the

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

1948 and 1952 Olympics including the 42km marathon which he considered the "most boring race" he had ever run! The next great Finnish runner, Lasse Viren, won 4 gold medals in 1972 and 1976 with this introduction of the concept of racing infrequently and "peaking" only for the Olympic Games, a technique also followed by Frank Shorter, gold and silver medallist in the 1972 and 1976 Olympic Marathons respectively. What innovative training techniques will our athletes have followed in their preparation for the 1996 Olympic Games?

The articles by Drs John Hawley and Helgo Schomer and Ms. Elske Schabort review the physiological and psychological factors that contribute to the success in international sporting competition. Hawley and Schabort review the progression of world running records and ask whether there are identifiable physiological changes that might explain the progressive pattern of improvement in these records. They conclude that the maximum oxygen consumption of the modern world record holder is not likely higher than that of earlier record holders. Rather the variable that has changed, is the specific endurance which is the capacity to sustain a high percentage of the maximum oxygen consumption for longer during competition. Factors that could explain this change include improved running tracks, commercialism, professionalism, more numerous competitive opportunities, improved nutrition, and perhaps the use of pharmacological agents in training.

In his detailed yet practical article, Dr Helgo Schomer reviews the psychological preparation for Olympic competition. He begins with the premise that there are no physical differences between the very best athletes in any sport. Rather the winner is the athlete who is mentally the strongest on the day of competition. Schomer identifies the four important psychological factors determining success and describes the psychological skills training programmes that are crucial for developing those skills. He suggests that sporting success comes when these techniques become second nature. He provides appropriate guidelines for psychological training and concludes that lifelong practice is required to perfect these mental skills. Of course, the value of these mental skills extends beyond the Olympic arena, to all levels, of sport and to daily life.

But the major Olympic challenge remains the promotion of fair competition by eliminating the use of performance enhancing drugs including the anabolic steroids, erythropoeitin and growth hormone. Dr George van Dugteren of the National Olympic Committee of South Africa (NOCSA) has prepared an Anti-Doping policy on behalf of NOCSA and the South African Institute for Drug-free sport. This policy is reproduced here, as is the latest(1996) edition of the IOC list of banned drugs. This is crucial information for all who treat or advise our Olympic athletes.

Another important source of this information, the MIMS book, Permitted and Banned Drugs in Sport - has recently been published but is perhaps not as widely known as might be hoped. The additional value of that publication is that it provides lists of banned and permitted drugs according to their trade names. This allows the athlete and his or her medical consultant to be absolutely certain of the status of any medication available in South Africa. The book is available only from the MIMS office (PO Box 2059, Pretoria, 0001: phone number 012 348 5010).

The issue also includes one of the most thought-provoking articles on drug control in sport that I have read. In his article Australian sports physician Dr Manuel Cusi poses three different scenarios that might be encountered by any doctor treating athletes. The first involves the prescription of anabolic steroids or other banned drugs by doctors appointed in an official capacity to sporting teams. Cusi argues that such doctors may not prescribe banned substances to team members. The second scenario is perhaps more common and involves the prescription of anabolic steroids for athletes involved in non competitive sports. Again the ethical position taken by Cusi is that such drugs should not be prescribed by doctors and the reasons for this position are carefully argued. His third scenario presents the problem of prescribing medication for the treatment of legitimate medical condition in an athlete who competes in a sport in which that specific drug is banned. His conclusion may seem surprising. Perhaps his most challenging statement is that his three scenarios "indicate that medical practice is more complex than the IOC's anti-doping rationale admits." Long may this debate continue.

Special thanks are due to all our authors for their diligence in sharing their knowledge and specially to our Australian colleagues, Dr Cusi and Dr Peter Brukner, former editor of SportHealth, who have given their permission for the use of Dr Cusi's article.

We wish our athletes and their medical support team all possible success in the Atlanta Olympic Games and hope that this issue of our journal will portend a favourable change in South Africa's recent achievements in Olympic competition.

Editor
Professor Tim Noakes
MRC/UCT Bioenergetics of Exercise Research Unit and Liberty Life Chair of Exercise and Sports Science, Sports Science institute of South Africa, Boundary Road, Newlands, 7700, South Africa.

REFERENCES

1. *Noakes TD. The Olympic Games and Sports Medicine. British Journal of Sports Medicine.*
2. *Noakes TD. Lore of Running. Oxford University Press. 1992.*
3. *Johnson WO. Who is the greatest? Time Magazine, June 24th, 1996.pp68-89.*

□

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

THE SOUTH AFRICAN JOURNAL OF
SPORTS MEDICINE

VOLUME 3 NUMBER 2 JULY 1996

Editor
Prof TD Noakes
Dr MP Schwellnus

Editorial Board
Dr M E Moolla
Dr P de Jager
Dr J Skowno
Dr P Schwartz
Prof R Stretch
Dr C de Ridder
Prof B C Andrews
Dr E W Derman
Mr R H Farman
Prof M Mars
Dr C A Noble

International Advisory Board
Lyle J Micheli
Associate Clinical Professor of Orthopaedic Surgery
Boston, USA

Chester R Kyle
Research Director, Sports Equipment Research Associates
California, USA

Prof HC Wildor Hollmann
Präsident des Deutschen Sportärztebundes
Koln, West Germany

Howard J Green
Professor, Department of Kinesiology
Ontario, Canada

George A Brooks
Professor, Department of Physical Education
California, USA

Neil F Gordon
Director, Exercise Physiology
Texas, USA

Edmund R Burke
Associate Professor, Biology Department, University of Colorado
Colorado, USA

Graham N Smith
Physiologist
Glasgow, Scotland

CONTENTS

The Editor,
The South African Journal of Sports Medicine
PO Box 115, Newlands 7725

PRODUCTION
Andrew Thomas
PUBLISHING
Glenbarr Publishers cc
Private Bag X14
Parklands 2196
Tel: (011) 442-9759
Fax: (011) 880-7898

ADVERTISING
Marike de Waal/Andrew Thomas
REPRODUCTION
Output Reproductions
PRINTING
Hortors

Reparil-Gel
Relieves muscular pain

The views expressed in individual articles are the personal views of the Authors and are not necessarily shared by the Editors, the Advertisers or the Publishers. No articles may be reproduced without the written consent of the Publishers.

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

ONTHULLINGS OOR SUID-AFRIKA SE GOUE MEDALJES IN ATLETIEK

FJG van der Merwe, *D Phil,* **Departement Menslike Bewegingskunde, Universiteit van Stellenbosch**

Abstract
South African sport is back in the international arena and is doing quite well lately. This year is the centenary of the modern Olympic movement. South Africa is hoping to win a gold medal in the track and field athletics. So far only five South African athletes have succeeded in winning this much sought-after trophy. They were Reggie Walker (1908), Kenneth McArthur (1912), Bevil Rudd (1920), Sid Atkinson (1928) and Esther Brand (1952). With the exception of Esther Brand, all of South Africa's gold medals were won before the Second World War. Already in 1947 Dr Ernst Jokl predicted that the African athletes would follow in the footsteps of the Scandinavian achievements. Unfortunately the SAAAU put a colour ban on athletics as early as 1931. This, and the later apartheid policy, deprived many non-white athletes of the opportunity to win a gold medal in the Olympic Games.

Keywords: South Africa, Olympic Games Track and field athletics.

Inleiding
Die Springbokke is die wêreld se rugbykampioen, die Bafana Bafana is Afrika se sokkerkampioen en die Proteas het hul voete in internasionale krieket gevind en gaan van krag tot krag. Die lang droogte wat die beleid van sportisolasie jeens Suid-Afrika meegebring het, is iets van die verlede. Vanjaar word die moderne Olimpiese Spelebeweging 100 jaar oud en Suid-Afrika neem vir die tweede keer sedert 1960 daaraan deel. Baron Pierre de Coubertin se Olimpiïsme[1] wat behels dat sport eerder karakter moet kweek as rekords najaag, was nog altyd net 'n droom. Wanneer daar van Olimpiese helde gepraat word, is die silwer- en bronsmedaljewenners van minder belang – die held(in) bly nou eenmaal dié persoon wat die hoogste plek op die rostrum ingeneem het. Hierdie prestasie het Suid-Afrika slegs tussen 1908 en 1952 te beurt geval.

Dit will tans voorkom asof Suid-Afrika 'n goeie kans op 'n goue medalje in Atlanta in atletiek sal hê. In retrospeksie het Suid-Afrika van 1908 tot 1960 en in 1992 slegs vyf atletiekprestasies opgelewer wat goed genoeg was om 'n goue medalje te verower. Daar sal in die onderhawige artikel kortliks gemotiveer word waarom hul prestasies so uitsonderlik was.

Metode
In 'n studie van dergelike aard word die histories-wetenskaplike metode gebruik met die klem op primêre bronne ten einde die verlede so noukeurig en volledig moontlik te rekonstrueer. Die primêre bronne was onder andere die notules van die Suid-Afrikaanse Olimpiese en Rykspelevereniging, notules van vergaderings van die Internasionale Olimpiese Komitee, amptelike verslae van spanbestuurders en afrigters, amptelike verslae van die Organiserende Komitees van elke Spele, en onderhoude en korrespondensie met deelnemers en ander ooggetuies.

Nadat die bronne aan interne en eksterne kritiek onderwerp was, is die inligting tot 'n sintese gevoer.

Resultate en bespreking
Alhoewel Suid-Afrikaners (waaronder twee Zoeloes) al in 1904 in St. Louis aan die Olimpiese Spele deelgeneem het, was die eerste amptelike deelname eers in 1908 toe die Spele in Londen plaasgevind het. Die 19-jarige Reggie Walker van Durban het daar 'n einde aan die Amerikaanse oorheersing in die 100 meter gemaak. Alhoewel James Rector in sy uitdun 'n Olimpiese rekord van 10,8 sek. opgestel het, het Walker dit in die semi-finaal en in die finaal geëwenaar om sodoende die Amerikaner in die finaal die loef af te steek.[2]

Afgesien van die feit dat Walker Suid-Afrika se enigste Olimpiese naelloopkampioen is, is dit van akademiese belang om hier te let op 'n historiese wanvoorstelling wat met sy geval gepaard gaan. Sedert die Amptelike Verslag van die Londense Spele in 1909 gepubliseer het dat Walker nie oorsponldik in die Suid-Afrikaanse Olimpiese span opgeneem was nie,[3] het hierdie fout herhaaldelik in verwante literatuur na vore gekom. Dit was eers toe die "verlore" notules van die Suid-Afrikaanse Amateuratletiekvereniging in die laat 1980's opgespoor is, dat die volle waarheid ontbloot is. Dit was in werklikheid HT Phillips, ook 'n naelloper, wat eers later in die span opgeneem is nadat Pretorianers sy koste betaal het. Walker was van meet af aan in die span as sesde keuse.[4]

In die daaropvolgende Spele, in Stockholm 1912, was dit die marathonatlete se beurt om roem vir Suid-Afrika te verwerf. Kennedy Kane McArthur en Christopher Gitsham het nie net eerste en tweede onderskeidelik geëindig nie, maar Suid-Afrika was ook die laaste land wat so 'n dubbel prestasie in die marathon kon vermag.

'n Persoonlike onderhoud met HB Keartland,[5] die Olimpiese atletiekafrigter van 1912, het aan die lig gebring dat daar veel meer agter "Kenneth" McArther en "Chris" Gitsham se prestasie skuil as wat die rekordboeke wil laat blyk. So byvoorbeeld was die Olimpiese marathon slegs die tweede dergelike nommer vir Gitsham. Keartland, wat die potensiaal in Gitsham raakgesien het, het hom oppad na Swede in Londen vir die Polytechnic-marathon ingeskryf. Gitsham het sy vuurdoop met vlieënde vaandels geslaag deur tweede te eindig. Hierdie marathon het ook as proewe vir die Britse Olimpiese atlete gedien.

Keartland was dit ook eens dat Gitsham meer talent as die gesoute Kenneth McArthur gehad het. Die twee Springbokke het die tweede helfte van die wedloop oor 40,200 km saam in die voortou afgelê, maar volgens hom het Gitsham sy pas ingehou om vir sy spanmaat morele ondersteuning te gee. Vyf kilometer vanaf die stadion het Gitsham die roete verlaat om by 'n fontein

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

water te gaan drink. Hy was onder die indruk dat McArthur vir hom sou wag, maar laasgenoemde het in daardie tyd sowat 200 meter gevorder. Krampe het Gitsham toe genoodsaak om 'n lang ent te stap voordat hy sy spanmaat agterna kon sit.[6] Na afloop van die wedloop het die saggeaarde Gitsham inderdaad beledigings na sy spanmaat geslinger omdat hy nie vir hom gewag het nie.[7] McArthur se tyd was 2:36:54,[8] en dié van Gitsham, 2:37:52,0.[8]

Na die Eerste Wêreldoorlog is die Spelereeks in 1920 in Antwerpen hervat. Op hierdie Spele het Bevil Gordon D'Urban Rudd die enigste Suid-Afrikaner geword om 'n volledige stel Olimpiese medaljes te verower. Alhoewel hy ten tyde van die Spele 'n Rhodesstudent aan die Universiteit van Oxford was, het hy in Springbokkleure gehardloop en teen die verwagting in die Amerikaners onttroon om die goue medalje in die 400 meter te verower met 'n tyd van 49,6 sek. Hy het in die finaal die uitgetrapte binnebaan geloot, maar desnieteenstaande sy naaste teenstander met twee meter geklop. In die 800 meter het Rudd in die laaste pylvak voorgeloop toe hy gestruikel en sy enkel beseer het. Hy kon egter daarin slaag om steeds die bronsmedalje in te palm. Hy is in die proses deur die Britse en Amerikaanse kampioene geklop. Sy derde medalje was die silwer in die 4x400 meter aflos.[9]

In 1928, in Amsterdam, het Sidney James Montford Atkinson die enigste Suid-Afrikaner geword om die 110 meter hekkietitel te verower.[10] Wat sy prestasie nog meer indrukwekkend maak is die feit dat hy by die vorige Spele, in Parys, die silwermedaljewenner in dieselfde nommer was. Hy het in die finaal 'n 0,25 meter voorsprong gehad toe hy die laaste hekkie raakgeskop en effens gestruikel het. Dit was genoeg vir sy Amerikaanse teenstander (Daniel Kinsey) om hom na die lint te klop. Alhoewel beide 'n tyd van 15,0 sek. aangeteken het, is Kinsey eerste geplaas.[11]

Vier jaar later het Sid Atkinson die nommer in 14,8 sek. gewen. Met hierdie tyd het hy die ou Olimpiese rekord van 1920 geëwenaar.[12] Dit was ook dieselfde tyd wat sy spanmaat, George C Weightman-Smith, in die uitdunne behaal het. Weightman-Smith, het in die semi-finaal egter 'n nuwe wêreld- en Olimpiese rekord van 14,6 sek. opgestel. In die finaal het hy die uitgetrapte binnebaan geloot, alhoewel dit vir die beamptes moontlik was om die hekkies só op te stel dat die binnebaan nie gebruik hóéf te geword het nie. Die uiteinde van die saak was dat hy vyfde (15,0 sek.) en Sid Atkinson eerste (14,8 sek.) geëindig het.[13]

Ira Emery, 49 jaar lank die sekretaris van die Suid-Afrikaanse Olimpiese Spelevereniging en bestuurder van verskeie Springbokspanne na die Spele, het in sy boek Springboks of the Olympiad (1956) geskryf dat dit Atkinson was wat die binnebaan geloot het en dat hulle op Weightman-Smith se aandrang bane geruil het. Atkinson sou toe in die vyfde in plaas van die binnebaan gehardloop het. Geen ander primêre bron ondersteun Emery se verhaal nie en die foto in die amptelike verslag van die Spele toon dat Atkinson in die derde baan gehardloop het.[14] Snaar Viljoen het as ooggetuie ook die verhaal van Emery ontken.[15] Op 'n vraag waarom hy nie oor die uitgetrapte binnebaan beswaar aangeteken het nie, het Weightman-Smith verklaar dat hy nooit klagtes op die sportveld sal opper nie.[16]

Suid-Afrika se laaste goue medalje in 'n Olimpiese atletieknommer (en die enigste deur 'n vroue atleet) is in Helsinki in 1952 behaal toe die 28-jarige Esther (née van Heerden) Brand die hoogspring vir vroue gewen het. Haar insluiting in die Olimpiese span het met baie kritiek gepaard gegaan, maar haar wenhoogte van 1,67 meter was goed genoeg om die wêreldrekordhouer met 0,02 meter te klop.[17] Die Olimpiese rekord op daardie tydstip was 1,68 meter.[18]

Hierdie prestasie het 11 jaar ná haar wêreldrekordsprong as 17-jarige skooldogter op Coetzenburg gekom. Toé, op 29 Maart 1941, het sy 'n hoogte van 1,65 meter behaal. Esther se rekord is egter nie destyds as 'n wêreldrekord erken nie aangesien die rekordhoogte van 1,67 meter toé agter die naam van Dora Ratjen van Duitsland gestaan het. In 1957 is Ratjen as 'n man ontbloot en sy rekord is in 1960 op 'n vergadering van die IAAF in Rome nietig verklaar. Hermann Ratjen se verweer was dat hy in die oorlogsjare deur die Nazi's gedwing was om as 'n vrou deel te neem ten einde roem en eer vir Duitse sport te verwerf. Met die skrapping van sy rekord is Esther s'n eers 19 jaar later as wêreldrekord erken.[19]

Samevatting

'n Statistiese ontleding van Suid-Afrika se prestasies op die Olimpiese Spele van 1908 tot 1960 dui aan dat die atlete ná die Tweede Wêreldoorlog nie so goed soos vóór die oorlog gevaar het nie. Die enigste goeie na-oorlogse prestasie was in 1952 toe die 13 Springbokatlete twee medaljes ingepalm het. In 1908 het Suid-Afrika se sewe atlete twee medaljes verower, in 1912 het die sewe atlete twee, in 1920 het die 13 atlete drie en in 1924 het die 12 atlete twee medaljes gewen. In 1928, 1932 en in 1960 is slegs een elk behaal. Die atleetgetalle was tien, vier en agt onderskeidelik.[20] Hierdie artikel het slegs op die goue medaljes wat in 1908, 1912, 1920, 1928 en 1952 gewen is, gekonsentreer.

In 1947 het Prof Ernst Jokl gewaarsku dat Suid-Afrika "bloedmin kans op die Olimpiade" sou hê.[21] In sy artikel het hy daarop gewys dat Suid-Afrika se atletiekprestasies gestagneer het terwyl die res van die wêreld merkwaardig verbeter het. Hy het dit beklemtoon dat Suid-Afrika voor die Eerste Wêreldoorlog 'n wêreldkrag in atletiek was, maar dat die posisie drasties versleg het. Hy het verskillende atletieklande se bevolkingsgetalle met hul prestasies vergelyk en tot die slotsom gekom dat die Skandinawiese lande op daardie tydstip die kern van wêreldatletiek gevorm het. Hy het in daardie verband die volgende opmerking gemaak:

As hulle (Skandinawiese) opperheerskappy ooit bedreig gaan word, is daar slegs een antropologiese groep wat in die nabye toekoms 'n ernstige mededinger mag word, nl. daardie lede van die swartvellige Afrikaanse (sic) rasse wat kontak met hulle bewerkstellig en hul kennis van meer ervare atletiese lande aanwend. Wat gaan Suid-Afrika met sy naturelle-atlete doen?[22]

Sedert die Olimpiese Spele van Mexiko-stad in 1968 het talle Afrikalande meteoriese opgang in die atletiekwêreld gemaak.[23] In antwoord op Jokl se vraag omtrent Suid-Afrika se "naturelle-atlete", moet die blaam op die S.A. Amateuratletiekvereniging geplaas word. Nog lank voordat die Nasionale Party aan bewind

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

gekom het, het dié beheerliggaam in 1931 besluit om die kleuskeiding toe te pas.[24] Hierdie besluit sou vir die daaropvolgende ses dekades 'n vernietigende effek op Suid-Afrika se atletiekprestasies hê. Atlete soos Sydney Maree, Mark Plaatjies en Freddie Fredericks (om net 'n paar van die mees onlangse gevalle te noem) het hul heil in die buiteland gaan soek. Daar kan slegs gespekuleer word hoeveel Reggie Walkers, Kenneth McArthurs, Bevil Rudds, Sid Atkinsons and Esther Brands in die apartheidsera nooit hul talente ten volle ontwikkel het nie.

VERWYSINGS

1. *Van der Merwe FJG. Aspiration towards Olympism. Report of the First Congress of the Olympic Academy of Southern Africa, Port Elizabeth, 26-28 June 1990. (Pretoria): Olympic Academy of Southern Africa, 1990: 63-70.*
2. *Van der Merwe FJG. Suid-Afrika se deelname aan die Olimpiese Spele, 1908-1960. Ongepubliseerde Doktorale proefskrif. Potchefstroom: PU vir CHO, 1978: 44-45.*
3. *Official Report of the Olympic Games of 1908. London: The British Olympic Association, (1909): 51.*
4. *Laubscher L. The myth about Reg Walker and the 1908 Olympic team. SA Sport Communico 1987; 8(2): 8-9.*
5. *Keartland HB. Persoonlike onderhoud. Johannesburg, 23 April 1976.*
6. *Keartland HB. Persoonlike korrespondensie, 31 Maart 1975.*
7. *Keartland HB. Persoonlike onderhoud. Johannesburg, 23 April 1976.*
8. *Kamper E. Encyclopedia of the Olympic Games. Dortmund: Harenberg, 1972: 8.*
9. *Van der Merwe FJG. Suid-Afrika se deelname aan die Olimpiese Spele, 1908-1960. Ongepubliseerde Doktorale proefskrif. Potchefstroom: PU vir CHO, 1978: 143, 145-146, 155.*
10. *Kamper E. Lexikon der 12000 Olympioniken – Who's who at the Olympics. Graz: Leykam-Verlag, 1975:10.*
11. *Zur Megede E. Die Geschichte der Olympischen Leichtathletik, Band 1. München: Bartels & Wernitz, 1968: 165.*
12. *Kamper E. Encyclopedia of the Olympic Games. Dortmund: Harenberg, 1972: 9.*
13. *Van der Merwe FJG. Suid-Afrika se deelname aan die Olimpiese Spele, 1908-1960. Ongepubliseerde Doktorale proefskrif. Potchefstroom: PU vir CHO, 1978: 250-253.*
14. *Official report of the ninth Olympiad, Amsterdam 1928. Amsterdam: Netherlands Olympic Committee, 1928: 436.*
15. *Viljoen JH. Persoonlike onderhoud, Pretoria, 10 September 1975.*
16. *Zur Megede E. Die Geschichte der Olympischen Leichtathletik, Band 1. München: Bartels & Wernitz, 1968: 198-199.*
17. *Van der Merwe FJG. Suid-Afrika se deelname aan die Olimpiese Spele, 1908-1960. Ongepubliseerde Doktorale proefskrif. Potchefstroom: PU vir CHO, 1978: 435.*
18. *Kamper E. Encyclopedia of the Olympic Games. Dortmund: Harenberg, 1972: 35.*
19. *Quercetani RL. Athletics – a history of modern track and field athletics, 1860-1990, men and women. London: IAAF, 1990: 255; Joubert A. Persoonlike korrespondensie, 1984.*
20. *Van der Merwe FJG. Suid-Afrika se deelname aan die Olimpiese Spele, 1908-1960. Ongepubliseerde Doktorale proefskrif. Potchefstroom: PU vir CHO, 1978: 629.*
21. *Jokl E. Ons atlete het bloedmin kans op die Olimpiade. Fleur 1947; 2(4): 41-43.*
22. *Jokl E. Ons atlete het bloedmin kans op die Olimpiade. Fleur 1947; 2(4): 42.*
23. *Van der Merwe FJG. Sportgeskiedenis: 'n Handleiding vir Suid-Afrikaanse studente. Stellenbosch: FJG Publikasies, 1994: 182-186.*
24. *Anderson PG. An investigation into the effect of race and politics on the development of South African sport (1970-1979). Ongepubliseerde Doktorale proefskrif Stellenbosch: Universiteit van Stellenbosch, 1979: 36.* □

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

THE LIMITS TO HUMAN PERFORMANCE: A PHYSIOLOGICAL PERSPECTIVE

JA Hawley & EJ Schabort

"Running records are still far below human physiological limits. The restraints on performance are psychological: good runners do not work as hard once they have set a record or won a medal." Ryder et al (1976)

HISTORICAL BACKGROUND

Although the purest essence of the sport of running is the competition and struggle of one athlete against another, there has always been something magical about the setting of a world record, and its constant challenge burns like an eternal flame for those individuals capable of such goals. Those athletes who have broken a world record belong to a "super elite" group, for the stretching of human capability, the breaking of barriers, and the conquest of unknown territory are positive qualities which define mankind as a whole. In athletics, world records also help to give reason and incentive to those outstanding efforts of a few athletes and ensure that the great names of the past, as well as those of the present and the future are never forgotten.[51]

But just how fast can men and women run? What are the physiological limits to human performance? Will women ever run as fast as men over any distance? These and other questions have recently been the focus of considerable scientific debate.[2,10,12,14,36]

In the past, most theories on these issues were largely irrelevant because they were seldom based upon any scientific rationale and logic but, rather, instinctive predictions centred upon personal beliefs of the time.[34,35] Lately, however, results from competitive running events have provided valuable insight for sports scientists into several key integrative areas of exercise physiology: world records offer a framework for the discussion of how various physiological factors interact as determinants of performance.[10,22,27,31,39,45] Considerable effort is now focused on the study of athletic performance.[29,33,34,39] Indeed, during the past decades many attempts have been made at providing a mathematical description of human performances based on the characteristics of the metabolic processes that provide chemical energy to power muscle contraction.[16,17,24,25,37,38,43,48,50] These models (to be discussed subsequently) often provide very accurate predictions of estimated and actual athletic performance.[32,36,45] Understandably, however, both coaches and athletes are highly suspicious of sports scientists[48] who claim from their theoretical mathematical models that "a minimum or no training is required for approximately 16 days before a competition to avoid a negative effect of training (fatigue) on competition performance!"

The purpose of this article is to investigate the evolution of human performance and, within a physiological framework, examine the 'limits' to future athletic records. Obviously, a comprehensive discussion of all running events over a wide range of distances is beyond the scope of this article. For this purpose, the men's and women's record for the one mile (1,609.36 m) has been chosen to focus on these and other questions.

THE PROGRESS OF HUMAN PERFORMANCE

At the turn of the century a famous coach of the time[1] stated of the men's world mile mark: *". . . the man who has made this record is W.G. George. His time . . . four minutes 12 seconds, and the probability is that this record will never be broken".* Almost one hundred years later, the record for the men's one mile is some 30 sec (or approximately 315 m) faster (Table 1). However, the current women's record holder, Paula Ivan of Rumania, would still be soundly beaten by Walter George. It should be noted for posterity that William Cummings, the sole competitor running against George, collapsed 70 yards from the finish of the race from 'exhaustion'.[51]

Table 1: *The evolution of the men's one mile (1,609 metre) world record since the first sub-four minute mile in 1954*

Athlete	Nationality	Performance (min:sec)	Date of record
Roger G. Bannister	Great Britain	3:59.4	06-05-1954
John M. Landy	Australia	3:58.0	21-06-1954
Derek Ibbotson	Great Britain	3:57.2	19-07-1957
Herbert J. Elliot	Australia	3:54.5	06-08-1958
Peter G. Snell	New Zealand	3:54.4	27-01-1962
Peter G. Snell	New Zealand	3:54.1	17-11-1964
Michael Jazy	France	3:53.6	09-06-1965
James R. Ryun	U.S.A.	3:51.3	17-07-1966
James R. Ryun	U.S.A.	3:51.1	23-06-1967
Filbert Bayi	Tanzania	3:51.0	17-05-1975
John G. Walker	New Zealand	3:49.4	12-08-1975
Sebastian N. Coe	Great Britain	3:49.0	17-07-1979
Steven M. Ovett	Great Britain	3:48.8	01-07-1980
Sebastian N. Coe	Great Britain	3:48.53	19-08-1981
Steven M. Ovett	Great Britain	3:48.40	26-08-1981
Sebastian N. Coe	Great Britain	3:47.33	28-08-1981
Stephen Cram	Great Britain	3:46.32	27-07-1985
Noureddine Morceli	Algeria	3:44.39	12-09-1993

Why then is the men's world mark for one mile still so far ahead of the women's? Can the differences in improvements seen in the men's and women's record over the past forty years be explained on a physiological basis?

Correspondence:

Dr John A Hawley, F.A.C.S.M.
MRC/UCT Bioenergetics of Exercise Research Unit
Sports Science Institute of South Africa
P O Box 115, Newlands 7725
Phone:(021) 686-7330 Fax:(021) 686-7530

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

Firstly, when considering the progress of human performance, it should be noted that men have participated in organised competitions over a wide range of standard distances for more than 100 years. It is only during the past 20-30 years that similar opportunities have been afforded to women. Indeed, the International Amateur Athletic Federation (IAAF) did not sanction races for women that were longer than 1,000 m until 1967 when the 1,500 m and the mile were "officially" recognised. The 10,000 m for women was not added until as recently as 1981. It is somewhat unclear when the IAAF began to acknowledge the women's marathon (42.195 km), but this event was not contested in Olympic competition until the Los Angeles Games in 1984.

Secondly, an analysis of recent race times for women show that their world records and best performances are not as consistent as those for men, particularly over the longer distances.[16] Of course, one might reasonably argue that this is as a result of the shorter history of women's middle and long distance running and the corresponding lack of competitive opportunities.

Thirdly, it is only during the past two decades that several countries, most notably China and some of the African nations, have acknowledged and belatedly encouraged women's participation in high level sport. Thus, when "pre-IAAF" times are considered, the time span available to critically and objectively analyse women's performances should probably be limited to the last quarter-century because of insufficient opportunities for women to compete at almost every level males have. Given this position of historical disadvantage, it is perhaps not surprising to find that since 1954 the rate of improvement of the women's world mile record is more than double that of the men's mark (14.7% versus 6.3%, respectively).

Finally, a closer examination of Tables 1 and 2 reveal that of the 18 men's mile world records since 1954 (achieved by 13 runners), and the 17 women's best performances (set by just 11 runners), only two records have been attained by African runners. Considering the current athletic dominance of the African nations, most notably Kenya, Ethiopia, and Morocco over a wide range of distances (3,000 m to the marathon) and events (road races, track, and cross country), this is somewhat surprising. With this vastly different background, and with reference to the evolution of the world record for the mile for the past forty years (Tables 1 and 2), one issue warrants further discussion.

Although it was not until May 6, 1954, that Roger Bannister became the first man to run under four minutes for the mile (3:59.4), it was probably one year earlier in June 1953 after running 4:02 for an invitation mile race at a schoolboys athletic meeting, that Bannister and his coach, Franz Stampfl, realised he was capable of running a 'sub four'. In contrast, John Landy from Australia, who by April 1954 had already run the mile in under 4:03 on no fewer than six different occasions, stated *"...the four minute barrier is a brick wall. I shall not attempt it again."* Yet, only two weeks after Bannister had secured fame for life as a result of his famous run at Oxford, Landy ran 3:58 for the mile and became the new world record holder. As Bannister later summarised *"... though physiology may indicate respiratory and cardiovascular limits to muscular effort, psychological and other factors beyond the ken of physiology set the razor's edge of defeat or victory and determine how closely the athlete approaches the absolute limits of performance".*[3]

In this vein, and with reference to the women's record, it was perhaps much more than pure coincidence that Diane Leather of Great Britain became the first female to break *five* minutes for the mile just three weeks after Bannister set his historic mark. This and other similar feats have led certain researchers to conclude that *"... the barrier to be overcome by the runner who wants to be a champion is psychological. The last record set and the willingness of athletes to try to break it are the determining factors for the next record."*[23] The inference is that a highly competitive situation brings out in the finest of athletes a level of performance of which even they are incapable under less challenging circumstances. The magnitude of this effect, which is almost impossible to quantify, appears to have been ignored by many researchers who have employed "mathematical equations" to predict future performance.

Table 2: *The evolution of the women's one mile (1,609 metre) world record since the first sub-five minute mile in 1954*

Athlete	Nationality	Performance (min:sec)	Date of record
Diane Leather	Great Britain	4:59.6	29-05-1954
Diane Leather	Great Britain	4:50.8	24-05-1955
Diane Leather	Great Britain	4:45.0	21-09-1955
Marise Chamberlain	New Zealand	4:41.4	08-12-1962
Anne Smith	Great Britain	4:39.2	13-05-1967
Anne Smith	Great Britain	4:37.0	03-06-1967
Maria Gommers	Holland	4:36.8	14-06-1969
Ellen Tittel	East Germany	4:35.3	20-08-1971
Paola Cacchi-Pigni	Italy	4:29.5	08-08-1973
Natalia Marasescu	Romania	4:23.8	21-05-1977
Natalia Marasescu	Romania	4:22.1	27-01-1979
Mary Decker	U.S.A.	4:21.7	26-01-1980
Lyudmila Veselkova	U.S.S.R.	4:20.89	12-09-1981
Mary Decker-Tabb	U.S.A.	4:18.08	09-07-1982
Maricica Puica	Romania	4:17.44	16-09-1982
Mary Slaney-Decker	U.S.A.	4:16.71	21-08-1985
Paula Ivan	Romania	4:15.61	10-07-1989

CAN IMPROVEMENTS IN PHYSIOLOGY EXPLAIN THE IMPROVEMENT IN PERFORMANCE?

There are a number of key physiological factors related to successful middle-distance and distance running performance. These include: (i) a high (>70 ml/kg/min) maximal aerobic power (VO_{2max}); (ii) the ability to utilise a high percentage of VO_{2max} for sustained periods; (iii) the ability to sustain high (>20 km/hr) running speeds and resist muscular fatigue; (iv) a fast running speed at the "lactate threshold"; (v) an efficient/economical running technique, and (vi) a high anaerobic (oxygen-independent) capacity. These determinants of superior performance have been extensively reviewed elsewhere.[6,8,10,18,21,30] The current issue is whether improvements in any one (or more) of these factors can explain the large improvements in human performance over the past century.

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

On-the-spot pain relief.

- For muscular pain
- Effective pain relief
- Site specific
- Non-staining
- Non-greasy

Reparil-Gel

Relieves muscular pain.

MADAUS PHARMACEUTICALS (PTY) LTD
Reg. No.: 77/00174/07 2nd Road (cnr 16th Road), Randjespark, Midrand 1685

S1 Reparil®-Gel 100 g contains: Aescin 1,0 g; Diethylamine salicylate 5,0 g. Reg. No. G/13.9/2367

Reproduced by Sabinet Gateway under licence granted

With regard to a runner's maximal aerobic power, Sid Robinson and colleagues working at the Harvard fatigue laboratory, reported very high VO_{2max} values in elite runners over fifty years ago.[41] A VO_{2max} value of 82 ml/kg/min was measured for Donald Lash, one of the first runners to run two miles in less than nine minutes. These investigators also reported several other runners with VO_{2max} values higher than 75 ml/kg/min.[40,41] As the highest VO_{2max} ever reported for a runner recorded in the modern era in a reputable laboratory is 85 ml/kg/min for Dave Bedford, ex-world record holder for 10,000 m,[5] it seems unlikely that increases in maximal aerobic power are responsible for the large improvements in the world records for varying athletic events.

Instead, it may be that the gradual improvements in performance by elite runners are more related to their improved ability to sustain a higher fraction of VO_{2max} in competition, and also to better running economy and technique.[44] This view is consistent with the evolution of training practices this past century. For example, from the early 1900's to the late 1960's, there was a steady increase in the frequency, intensity and duration of training so that by the early 1970's most track runners were undertaking several hours of training a day on a week to week basis. Since that time, the training regimens of top runners has not changed dramatically.[35,46,47]

Finally, an analysis of world records at distances from one mile to the marathon reveal that it is mainly an increase in specific endurance (i.e. the ability to resist fatigue) rather than any enhancement in basic speed or "anaerobic" power that is responsible for the gradual improvements in many events over the past fifty years.[48] The dominant effect of this improvement in specific endurance or fatigue resistance (i.e. the ability to maintain a given speed) is hidden by the tradition to time races at a constant distance, rather than to measure the distance a runner could cover in a specific time. To illustrate this point, in 1969 Derek Clayton of Australia ran a marathon in 2 hr 08:32, at an average velocity of ~328 m/min. This was slightly faster than the mean running speed for the men's one mile record some hundred years previously set by Britain's Cadet Marshall in 1852 at ~326 m/min.[43,51] In other words, Clayton demonstrated a specific endurance more than 26.2 times greater than Marshall. In physiological terms, at the same speed, Clayton was able to run 26 times further than Marshall! Perhaps more importantly, Clayton possessed a relatively modest VO_{2max} of only 69.7 ml/kg/min,[11] illustrating that it is a runner's maximal speed and economy of motion at race pace, rather than her/his VO_{2max} which predicts athletic performance.[34-36]

Apart from the physiological improvements associated with superior performance, there are, of course, other factors which may explain why world records have continued to fall. The introduction of synthetic running tracks can improve competitive performance by 2-3% compared to older traditional surfaces like grass and cinders.[29,30] Professionalism, commercialism, and more numerous competitive opportunities today compared with forty years ago mean that more potential record setters have the chance to train and compete on an almost full-time basis. It is also possible that the use of banned substances may have contributed to the improved performances of some athletes.[14,15,39,49] However, whether the modern athlete's nutritional practices have contributed to their improved training capacity and race performances is somewhat doubtful.[50]

MATHEMATICAL MODELLING OF HUMAN RUNNING PERFORMANCE

As noted previously, there have been many attempts by sports scientists to "model" or describe athletic performance based on a complex interaction of many input variables such as the upper limits of several metabolic processes involved in power production, and the input dose-effect of training interventions. Many more factors, however, remain to be specified and precisely quantified.[33] Nevertheless, several investigators have presented models that describe, with a high degree of accuracy, running performances over various distances. For example, Ward-Smith[45] proposed a model for male performances where the average absolute error between estimated and actual running times for all distances from 100 m to 10,000 m was only 0.86%. Although at first sight this model appears very accurate, it was criticised by other workers in the field[38] because it failed to take into account the well documented progressive decline in the aerobic power output that can be sustained as the distance run increases. For example, even a world-class runner is only capable of sustaining her/his VO_{2max} for ~420 sec.[12,25,28] Thereafter, the fraction of VO_{2max} that can be sustained during a race decreases linearly from 100% at time t, to 85-90% for a 60 min race, 80-85% for a 120 min race, 75-80% for a 180 min race and so on.[37,38] Taking this factor into account, Peronnet and Thibault[38] suggested a modification of Ward-Smith's[45] hyperbolic model which reduced the absolute error between actual and estimated running times for races from 60 m to the marathon for both men and women to only 0.73%. The complete model of running performances proposed by these and other workers not only provides a quantitative description of endurance capability, but also an estimation of the relative contributions of the various oxygen dependent and oxygen independent power systems to the total work output according to the duration of the race.[19,38] The theoretical considerations of such models are complex and outside the brief of the current paper.

THE LIMITS TO HUMAN PERFORMANCE: WHERE TO FROM HERE?

Perhaps of greater interest and relevance to athletes and sports scientists alike are the projected improvements in running times for various distances based on the various mathematical models. Table 3 lists the projection of both the men's and women's world record for

Table 3: *Projection of the men's and women's world mile records*

	Year			
	2000	2028	2040	Ultimate Performance
Men	3:41.96	3:33.29	3:29.84	3:18.87
Women	4:10.79	4:00.83	3:59.82	3:43.24

Data are from Peronnet and Thibault, 1989

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

the mile, along with the 'ultimate performance' for that distance.[3,4] As can be seen, a 3:30 mile is projected for men by the year 2040, even though in 1954 Roger Bannister forecast that this mark would have been accomplished by 1990.[3] In order to attain such a level of performance, the miler of the future will need a VO_{2max} of ~91 ml/kg/min while also possessing sufficient basic speed to run the quarter mile in around 44 sec and the 800 m in around 1:42. Although such a range of performances by the same runner seem somewhat unrealistic at first sight, the current world records for the 400 m and 800 m already surpass these 'hypothetical' marks (43.29 sec for 400 m by Harry 'Butch' Reynolds; 1:41.73 for 800 m by Sebastian Coe). Indeed, as discussed previously, it is likely that future improvements in world records will come not from any increase in instantaneous speed or power derived from the oxygen-independent "anaerobic" pathways, but rather an increase in fatigue resistance or specific endurance. This being the case, then one might reasonably argue that the current men's world mile mark (Table 4) is already well overdue for revision. There are presently many runners with sufficient basic speed over both 400 m and 800 m who, with the development of sufficient specific endurance, should be capable of significantly reducing the present record. Indeed, according to data derived from performance tables comparing the various running distances from 800 m to the marathon,[13] the men's world mile record ought to be around 3:42 in order to be comparable with the present 5,000 m (12:44.39 and 10,000 m (26:43.53) world best times, both held by Ethiopia's Haile Gebresilassie.

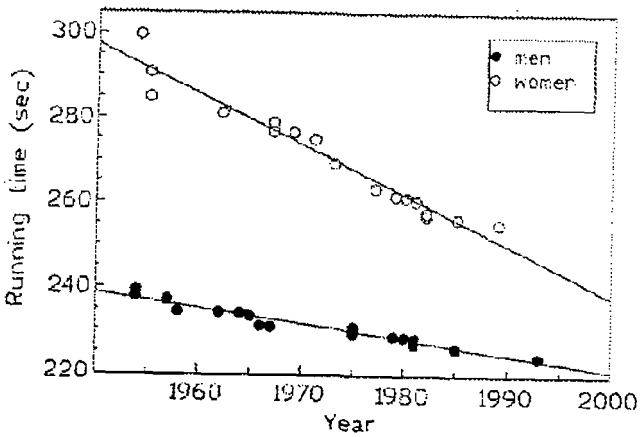
Table 4: *The fastest mile: A breakdown of Noureddine Morceli's world record*

	Distance (m)			
	400	800	1,200	1,600
Lap times (sec)	54.9	57.7	57.3	54.5
Total time (min:sec)	0:54.9	1:52.6	2:49.9	3:44.39

Set at Reiti, Italy, on 12 September 1993 @ 1838 hr. Ambient temperature 20°C, relative humidity 50%. Data are from Zur Megede and Hymans, 1995.

Finally, it has recently been proposed that for certain running distances, the performance of women may equal those of men within the next few decades.[3,4] Although this seems extremely unlikely, the results from a recent study from this laboratory[2] do suggest that for ultra-marathon events at least, women may be closing the gap. Bam *et al.*,[2] found that when male and female runners were matched for age, training history and race time over 56 km, the women outperformed the males over the ultra-marathon distance of 90 km. In fact, the "crossover" point at which the women become faster than their male counterparts was after ~ 66 km. This was in spite of the males being much faster over all distances from 5 km to 42 km. It was hypothesised that women ultra-marathon runners may have greater fatigue resistance than do equally-trained men.[2] Although the precise mechanisms for this greater specific endurance is not clear,[9] it may simply be related to the smaller sizes and lighter body mass of the females.

Figure 1: *The progression of the men's (filled circles) and women's (open circles) world record for one mile (1,609 m) since 1954. The extrapolation of the lines of best fit for the data sets would estimate that by the Sydney Olympic Games, to be held in the year 2000, the men's record will be 3:42 and the women's around 4:00.*



CONCLUSION

In conclusion, it seems likely that any future improvements in the current world records for distances from one mile to the marathon will be achieved by those athletes able to sustain high running speeds and resist the onset of muscular fatigue, rather than any significant increase in absolute running velocity *per se*. For this to happen, the runners must be in a highly competitive situation which will bring out the highest level of performance: the magnitude of this psychological effect seems to have been somewhat overlooked by those sports scientists who have employed mathematical models to describe and predict future race performances. While it seems unlikely that women will ever beat men over *any* distance until such time that they can run shorter track distances as fast as the males, one might speculate that women's performances *may* one day equal those of the leading men in very long (i.e.> 42km) distance races.

REFERENCES

1. *Andrews H. Training For Athletics and General Health. Arthur Pearson Pub. London. 1903.*
2. *Bam J, Noakes TD, Juritz J. Dennis SC. Could women outrun men in ultra-marathon races? Medicine and Science in Sports and Exercise (in review).*
3. *Bannister RG. The First Four Minutes. Putman. London. 1955.*

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

4. *Bannister RG. Muscular effort. British Medical Bulletin, 1956; 12: 222-225.*
5. *Bergh U. Physiology of Cross-Country Ski Racing. Human Kinetics, Champaign, Illinois, 1982.*
6. *Brandon LJ. Physiological factors associated with middle distance running performance. Sports Medicine, 1995; 19: 268-277.*
7. *Brandon LJ, Boileau RA. The contribution of selected variables to middle and long distance run performance. Journal of Sports Medicine and Physical Fitness, 1987; 27: 157-164.*
8. *Brandon LJ, Boileau RA. Influence of metabolic, mechanical and physique variables on middle distance running. Journal of Sports Medicine and Physical Fitness, 1992; 32: 1-9.*
9. *Coetzer P, Noakes TD, Sanders B, Lambert MI, Bosch AN, Wiggins T, Dennis SC. Superior fatigue resistance of elite black South African distance runners. Journal of Applied Physiology, 1993;75:1822-1827.*
10. *Costill DL Inside Running: Basics of Sports Physiology. Carmel, In: Benchmark Press, 1986: pp. 1-189.*
11. *Costill DL, Branam G, Eddy D, Sparks K. Determinants of marathon running success. Internationale Zeitschrift fur Angewandte Physiologies. 1971; 29: 249-254.*
12. *Costill DL. Fox EL. Energetics of marathon running. Medicine and Science in Sports, 1969; 1: 81-88.*
13. *Daniels J, Gilbert JR Oxygen power... : Performance Tables for Distance Runners. Tempe, Arizona, 1979.*
14. *Ekblom B, Berglund B. Effect of erythropoietin administration on maximal aerobic power. Scandinavian Journal of Medicine and Science in Sports, 1991;1:88-93.*
15. *Ekblom B, Goldberg AN, Gullbring B. Response of exercise after blood loss and reinfusion. Journal of Applied Physiology. 1972; 33: 175-180.*
16. *Ettema JH. Limits of human performance and energy-production. Internationale Zeitschrift fur Angewandte Physiologie, 1966; 22: 45-54.*
17. *Handelman GH, Smith DC. Comparison of running and swimming records. Sportwissenschaft, 1980; 2: 161-168.*
18. *Hawley JA. State of the art training guidelines for endurance performance. South African Journal of Sports Medicine, 1995; 2: 7-12.*
19. *Hawley JA, Hopkins WG. Aerobic glycolytic and aerobic lipolytic power systems. A new paradigm with implications for endurance and ultra-endurance events. Sports Medicine, 1995; 19: 240-250.*
20. *Hawley JA, Dennis SC, Lindsay FH, Noakes TD. Nutritional practices of athletes: Are they sub-optimal? Journal of Sports Sciences, 1995; 13: S75-S78.*
21. *Hawley JA, Myburgh KH, Noakes TD, Dennis SC. Training techniques to improve fatigue resistance and enhance endurance performance. Journal of Sports Science (Supplement), In press, 1996.*
22. *Joyner MJ. Modelling: Optimal marathon performance on the basis of physiological factors. Journal of Applied Physiology, 1991; 70: 683-687.*
23. *Joyner MJ. Physiological Limiting Factors and Distance Running: Influence of Gender and Age on Record Performances. In: Holloszy JO(Editor), Exercise and Sports Science Reviews, 1993; 21: 103-133.*
24. *Keller B. A theory of competitive running. Physician Today. 1973; 26: 43-47.*
25. *Leger D, Mercier D, Gauvin L. The relationship between : %VO_{2max} and running performance time. In: Landers DM (Editor). Sport and Elite Performers, Volume 3. Human Kineties Publishers, Champaign, Illinois, 1986; pp.113-120.*
26. *Lloyd BB. The energetics of running: an analysis of world records. Advances in Science, 1966; 22: 515-530.*
27. *Lloyd BB. World running records as maximal performances. Oxygen debt and other limiting factors. Circulation Research, 1976; XX, XXI: 218-226.*
28. *Londeree BR. The use of laboratory test results with long distance runners. Sports Medicine, 1986: 3: 201-213.*
29. *McMahon TA, Greene PR. Fast running tracks. Scientific American, 1978; 239: 148-163.*
30. *McMahon TA, Greene PR. The influence of track compliance on running. Journal of Biomechanics, 1979: 12: 893-904.*
31. *Mognoni P, Lafortuna C, Russo G, Minetti A. An analysis of world records in three types of locomotion. European Journal of Applied Physiology, 1982; 49: 287-299.*
32. *Morton RH. The supreme runner: What evidence now? Australian Journal of Sports Science, 1985; 3: 7-10.*
33. *Morton RH, Fitz-Clarke JR, Banister EW. Modelling human performance in running. Journal of Applied Physiology. 1990: 69: 1171-1177.*
34. *Noakes TD. Implications of exercise testing for prediction of athletic performance. Medicine and Science in Sports and Exercise, 1988; 20: 319-330.*
35. *Noakes TD. Lore of Running. Oxford University Press. Cape Town, 1992, pp. 266-270.*
36. *Noakes TD, Myburgh KH, Schall R. Peak treadmill running velocity during the VO_{2max} test predicts running performance. Journal of Sports Science, 1990: 8: 33-45.*
37. *Peronnet F, Thibault G. Analyse physiologique de la performance en course à pied: révision du modèle hyperbolique. Journal of Physiologie (Paris). 1987: 82: 52-60.*
38. *Peronnet F, Thibault G. Mathematical analysis of running performance and world running records. Journal of Applied Physiology, 1989; 67: 453-465.*
39. *Robertson RJ, Gilcher R, Metz KF. Hemoglobin concentration and aerobic work capacity in women following induced erthyrocythemia. Journal of Applied Physiology. 1984; 57: 568-575.*
40. *Robinson S, Dill DB, Robinson RD, Tzankoff SP, Wagner JA. Physiological ageing of champion runners. Journal of Applied Physiology, 1976; 41: 46-51.*
41. *Robinson S, Edwards HT, Dill DB. New records in human power. Science, 1937: 85: 409-410.*
42. *Rumball WM, Coleman CE. Analysis of running and the prediction of ultimate performance. Nature, 1970; 228: 184-185.*
43. *Ryder HW, Carr HJ, Herget P Future performance in footracing. Scientific American, 1976: 234: 109-119.*
44. *Saltin B, Astrand P-O. Maximal oxygen uptake in athletes. Journal of Applied Physiology. 1967; 23: 353-358.*
45. *Ward-Smith AJ. A mathematical theory of running, based on the first law of thermodynamics and its application to the performance of world-class athletes. Journal of Biomechanics, 1985; 18: 337-349.*
46. *Wells CL, Pate PR. Training for performance of prolonged exercise. In: Lamb DR, Murray R(Editors). Perspectives in Exercise Science and Sports Medicine Volume 1. Prolonged Exercise, Benchmark Press, Indianapolis, 1988: 357-391.*
47. *Wilt F. How They Train. Volume II. Long Distance (second Edition). Track and Field News, Los Altos. California. 1973; pp. 1-126.*
48. *Whipp BJ, Ward SA. Will women soon outrun men? Nature, 1992; 355: 25.*
49. *Williams MH, Wesseldine S, Somma T, Schuster R. The effect of induced erythrocythemia upon 5-mile treadmill run time. Medicine and Science in Sports and Exercise. 1981: 13: 169-175.*
50. *Wilkie DR. Equations describing power input by humans as a function of duration of exercise. In: Cerretelli P Whipp BJ. (Editors), Exercise Bioenergetics and Gas Exchange. New York: Elsevier, North Holland, 1980: 75-80.*
51. *Zur Megede E, Hymans R. Progression of World Best Performances and Official IAAF World Records. International Amateur Athletic Federation. Multiprint. Monaco, 1995.*

□

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

PSYCHOLOGICAL PREPARATION FOR OLYMPIC ATHLETES

Dr H Schomer Dept of Psychology, U.C.T

INTRODUCTION

After winning 7 gold medals at the Montreal Olympics Mark Spitz said: "At this level of physical skill, the difference between winning and losing is 99% psychological".[1] The reason is that elite athletes in a specific sporting discipline are, to a large extent, fairly equal on physiological, technical and tactical factors. When elite athletes compete the one who wins is usually the one who is mentally the strongest on that given day. Whereas physical abilities are seen as relatively stable, psychological factors primarily determine the daily variations in performance[2].Rushall goes as far as advocating sport psychology as "the key to sporting excellence and success"[3].

Current thinking and practice in applied sport psychology assumes that the athletes' level of performance is a direct consequence of the way athletes are thinking and feeling.[1] Sport scientists and athletes acknowledge that a negative psychological set, such as feelings of frustration, fear, anger and worry, negative thoughts and imagery, and task-irrelevant thoughts typically impairs performance. Sport competitions are stressful events. Athletes who overreact to the challenge experience anxiety and tension which can adversely affect physiological and cognitive processes to such an extent that they perform below their potential and expectations. The athlete displaying a palpitating heart, a dry mouth, tight or shaky muscles, rapid breathing, a tight stomach, poor concentration and unfocused negative thoughts cannot hope to perform optimally.[4,5,6]

What is needed is a positive psychological set that mobilizes the physiological reactions essential for peak performance. The likelihood of achieving peak performance increases dramatically as athletes consistently generate the mental climate that has been identified by numerous studies[1,7,8] to optimize output: Athletes do their best when relaxed and alert: The psychological ideal performance state is difficult to sustain during high-powered competition and years of tedious training.[9] To become an Olympic athlete it has to be experienced consistently and once at the Olympic Games it has to be right there.

CHARACTERISTICS OF SUCCESS

Although no set distinguishable "athletic personality"[7] has been identified in the sport psychological literature, a certain psychological profile emerges again and again when sport scientists examine successful elite athletes, regardless of the source of the data or the nature of the sport.[1]

Successful elite athletes display the following characteristics and psychological skills:

1) Consistent self-regulations of arousal (feeling energized yet relaxed)
2) Superior concentration (being appropriately focused)
3) High self-confidence (positive attitude) and
4) Determination, commitment and control (clear sense of direction, meaningfulness and awareness).

Allowing for individual variations, the above-mentioned psychological commonalities are necessary predispositions for the psychological ideal performance state to be propagated and maintained. The ideal performance state does not just happen. The mental skills needed to achieve and maintain the ideal performance state are learned through knowledge and practice just as the physical skills and strategies of the sport are learned and practised. The best preparation or countdown to competition rituals involves behavioural sequences that get the athlete physically and mentally ready for competition. The physical preparations and training has to go hand in hand with the inclusion of psychological principles and procedures if athletes are to maximise their chances of being ready to peak at competition time.[3,10]

"The ultimate goal of psychological skills training is for each athlete to learn how to create consistently at competition time the ideal performance state (thoughts, feelings, bodily responses) typically associated with his or her peak performance."[10] Psychological skills training programmes can help athletes plan effective behavioural protocols or preparation rituals that can be used regularly as pre-competition and competition readying procedures.

PSYCHOLOGICAL SKILLS TRAINING OUTLINE

Comprehensive psychological skills training programmes typically follow a set structure with three distinct phases.[8]

1. Education phase: This phase involves explaining to athletes the importance of developing and learning psychological skills and how these skills affect performance.
2. Acquisition phase: This phase focuses on strategies and techniques to learn the different psychological skills. Rather than imposing a standard package on the athlete, it is important to develop specific psychological strategies tailored to the athlete's unique needs, ability and strengths as well as the specific demands of the sport.[5,11]
3. Practice phase: This phase has three main objectives: to automate skills through overlearning, to instruct athletes to consistently integrate psychological skills into their performance situations, and to simulate skills that the athlete will draw on during the actual competition.

The most counter-productive time to implement a psychological skills training programme is after the start of the competitive season and there is concern because athletes are performing below their potential. At this time psychological skills training amounts to a quick-fix solution and is rarely effective. It can also be detrimental to make athletes aware of psychological aspects of competition that should be addressed when there is insufficient time to learn the new psychological skills needed for control.[10,12]

The most productive time to implement a psycholog-

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

ical skills training programme is during the off-season or pre-season (long before the competitions begin) when athletes are well-rested and are in a relatively pressure-free situation, and there is sufficient time to learn new skills.[13]

Mere exposure and one-off practice of psychological skills training techniques by no means prepare athletes for successful implementation of these skills in Olympic competition. Rather, they must become automatic and second-nature to be effective. Gould, Eklund and Jackson[14] reported that 1988 U.S. Olympic wrestlers who had won medals had internalized their mental strategies to the extent that they reacted automatically to adversity, whereas non-medalists did not have their coping strategies as internalised and had to make a conscious effort to use them when faced with mishaps. They even suggested that the specific coping strategy used may not be as important as the elite athlete's ability to produce that strategy in an automized mode. For psychological skills and coping strategies to become automatic and second nature, requires the long-term practice of such skills that need to be integrated with physical skills training.[5,8,10] It can take athletes several months to a year to master the new psychological skills and successfully apply them in actual competition. Orlick[16] reported that this process usually takes the highly committed athletes about three years of regular practice before things really come together mentally for them.

Leading up to the Olympics

With respect to providing the most effective service during the final months leading up to the Olympics, it is imperative not to make major changes to the athletes' routines and it is not the time to introduce new psychological, physiological or technical concepts. By this time athletes and coaches should have their plans together. Typically, the closer one gets to the Olympics themselves, the aim should be to refine and fine-tune the skills that have already been practised. An appropriate approach focuses on suggestions how athletes might handle particular concerns such as readiness, plans for distractions, preparation through simulation, familiarisation with the Olympic site, lack of personal space, dealing with media, dealing with interpersonal/personal conflicts, developing a plan for being and feeling in control in the Olympic environment, ensuring that athletes and coaches have an effective pre-event plan, especially just prior to the start of the event, how to control pre-event anxiety, guarding against overtraining, and emphasizing the need for adequate rest when faced with high levels of stress.[12,15,16]

Psychological skills training guidelines

The following psychological skills and performance enhancement strategies are structured in accordance with the psychological characteristics displayed by successful elite athletes discussed earlier in this article. Numerous sport psychology consultants have documented the application of these techniques in preparation for and during Olympic games.[17,18,19,20,21,22] It should be noted that a psychological skills training programme cannot be expected to compensate for weaknesses or deficiencies in other parts of an athlete's programme (e.g. inadequate physical capacity, training programme, coaching etc).[13] A psychological skills training programme must be viewed as a critical part of the athletic programme and the psychological input should be placed in the perspective of the athlete's life and the athlete's daily functioning. A psychological skills training programme is a significant but only one of many parts of an athlete's sport experience.[23]

The self-regulation of arousal

The inverted U-hypothesis has been a popular theory to explain the relationship between arousal or anxiety and athletic performance. Initially, performance improves with increased arousal, up to a certain point, after which further increases in arousal produce a deterioration in performance. The critical point has been referred to as the point of optimal activation.[8,24]

The optimal level of arousal varies as a function of the complexity of the task and the skill level of the athlete. For example, for activities that require precise fine motor skills involving steadiness of control of unwanted muscle activity (e.g. high-board diving), very little arousal can be tolerated without impairing performance. However, for tasks that require minimal fine motor precision (e.g. weight lifting), a higher level of arousal can be tolerated before performance is impaired.[6]

When athletes reach an optimal level of arousal they should feel highly energised but still relaxed. This high energy state has frequently been described by elite athletes as a feeling of joy, ecstasy, intensity, boldness, inspiration, challenge, and being "charged" or "hot".[25,26]

Despite the heightened arousal level, athletes should be physically relaxed with their muscles being loose and able to perform fluid movements. Athletes who find themselves in this optimum level of arousal will experience a sense of inner calm and a high degree of concentration concurrent with a time-space disorientation (usually the sense of time being slowed down). The fear of failure is completely absent.

Sport scientists generally agree that most performance errors arise not so much from under-arousal, but rather from over-arousal, when athletes experience difficulties coping with competitive anxiety.[27] Thus, athletes need to learn self-monitoring and recognize how their emotional states affect their performance during competition.

Progressive relaxation

Jacobson advanced the concept of progressive relaxation after observing that an anxious mind cannot exist within a relaxed body.[27] Relaxation of a muscle group was found to be physiologically incompatible with contraction of that same group. Therefore, relaxation training was seen to combat the anxiety response by eliminating tension in the muscles.

Progressive relaxation involves systematically contracting and then relaxing one major muscle group in the body before progressing to the next muscle group while focusing on the different sensations of tension and relaxation. With practice a person can detect tension in a specific muscle or area of the body, like the neck, and then relax that muscle.

The advantage of the method of progressive relaxation is that athletes can take full control of their level of arousal. An athlete who has mastered the technique after several months of regular practice should be able to elicit the relaxation response within seconds of encountering a stressful stimulus.

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

Autogenic training

Autogenic training consists of a series of exercises designed to produce two physical sensations: warmth and heaviness. The feeling of warmth is ascribed to the dilation of the blood vessels with a resultant increase in blood flow, while the sensation of heaviness is due to the relaxation of muscle groups.

It usually takes several months of daily practice to become proficient in the use of autogenic training. Once mastered, it is especially useful for fast relaxation in a competitive environment and can be effectively applied in the field of sport.

Concentration

Athletes must focus attention on the relevant cues in the environment and maintain the appropriate attentional foci for the duration of the competition. Concentration problems are usually caused by an inappropriate attentional focus and occur when athletes become distracted by thoughts, emotions, or other events.

The athletes should be focused on the present and be conscious only of what they are doing at that specific moment. They should have no thoughts about the past or future because these are irrelevant cues that often impair concentration and lead to reduced performance. Some athletes find it difficult to forget what has just happened, especially if it was a bad mistake. Thinking about the future usually involves focusing on the consequences of certain actions and often takes the form of "what if" questions, such as: "What if I make another mistake?" or "What if we lose the game?".[3,8] Thus athletes should have more task-oriented thoughts rather than a preoccupation with thoughts of making mistakes.

The appropriate attentional focus allows the athlete to be acutely aware of his or her own body and the surrounding athletes. The athlete also has the sensation of being completely in harmony with the environment[26].

Nideffer[28] views attentional focus along two dimensions: width (broad versus narrow) and direction (internal versus external). These combine to give four different types of attentional focus. A broad attentional focus allows athletes to attend to several occurrences simultaneously. This is essential in sports where athletes have to be aware of and sensitive to a rapidly changing environment and be able to respond to multiple cues (e.g. a hockey player leading a ball up the field). A narrow attentional focus is required when athletes have to attend to only one or two cues (e.g. pistol shooting). An external attentional focus shifts attention outward on an object, such as a ball or an opponent's movements (e.g. in a doubles tennis match). An internal attentional focus is directed inward on thoughts and feelings (e.g. monitoring calf muscle tension).

Athletes must initially control the width of their attention and decide whether to exclude or include the many environmental cues available during the competition. Further, athletes must be able to control the direction of their attention by either focussing inwards on their own feelings, thoughts and arousal level or focusing on external cues such as the opponent or ball. Athletes should ideally be able to change their focus of attention in accordance with the changing attentional demands during competition.

Self-talk

Self-verbalizations, expressed aloud or as thoughts, have a strong impact on a person's behaviour. The actual words used by athletes during self-talk influence the level of performance. Performance levels of elite athletes can be improved through thought processes and thought content alone without increased physiological efforts or energy costs.[3]

Self-talk can be positive or negative. Positive self-talk enhances the self-esteem, motivation, attentional focus and performance of athletes. Self-talk that helps athletes focus on the present and prevents their mind from wandering is viewed as positive. It usually has either a motivational component (e.g. "I can do it") or an instructional component (e.g. "Keep your eyes on the ball"). On the other hand, negative self-talk is critical and demeaning and impairs the realization of goals. Negative self-talk (e.g. "That was a stupid mistake") creates anxiety and self-doubt.[8,27]

Thoughts play a crucial role in mediating emotional reactions to situations, and these reactions influence future behaviour. Events in and of themselves do not cause negative emotional reactions (e.g. depression, anger, anxiety, hopelessness or frustration). Rather it is how athletes interpret the event that determines their response.[8]

Self-talk may be used by athletes to acquire new skills, change bad habits, initiate action (e.g. runners can increase their speed by using cue words such as "fast") and sustain effort when the athlete feels tired (e.g "keep it up", "hang in there").[8]

Several techniques can be used to improve self-talk. One strategy to deal with negative thoughts is to stop them before they impair performance. Athletes are trained to stop negative thoughts as soon as they arise by using a cue word (such as "stop") or any physical trigger (such as snapping fingers or hitting a hand against a thigh) and then focus on a task-related cue.[8,27]

It is however not possible to eliminate all negative self-talk. Another way to deal with negative self-talk when it occurs, is to change the negative thoughts into positive thoughts, which refocuses the athlete's attention to provide encouragement and motivation and which brings the athlete back into the present to take control of the event. For example, "I never play well when the wind blows" can be rephrased into "Nobody likes to play in windy conditions, but I will perform at my personal best".[8,27]

Cue words can also be used to set in motion a specific response. They can be used as an instruction (e.g. "follow-through", "watch the ball") or to motivate (e.g. "strong", "relax", "get tough"). The cue word should be simple and should automatically trigger the planned reaction. For example, gymnasts performing a floor routine can say the word "forward" to ensure that they push ahead at a specific point during their routine. Sprinters can say "explode" to ensure that they get out of the starting block quickly. Athletes must practice using these cue words so that they become habitual and well-learned before being utilized during competition. Cue words are helpful when athletes are trying to change a movement sequence or when trying to change an ingrained habit.[8]

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

High self-confidence

Athletes' performance is enhanced as their level of self-confidence increases – up to an optimal point – after which future increases in self-confidence result in impairment of performance.

Athletes lacking self-confidence doubt their capability to perform the skills under pressure during the competition. Self-doubts hinder athletes' performance by causing anxiety, reducing concentration and creating indecisiveness. Athletes lacking self-confidence focus on their weaknesses rather than on their strong points and distract their attention away from the task that has to be completed. On the other hand, the performance of athletes who are overconfident (their confidence is greater that their abilities justify) may deteriorate because they think that they do not have to prepare themselves for the event or expend the effort to complete the task.[8]

Athletes with optimal self-confidence are characterised by a positive attitude and feelings of optimism.[26] They are able to keep poise and feelings of strength and control even during adversity or potentially threatening situations. The athletes are in control of their actions and of the environment.[2] The performance seems to be automatic and effortless.

Many potential benefits for athletes arise from a feeling of high self-confidence. Confident athletes are more likely to stay calm and relaxed under pressure. Confidence facilitates concentration so that the athletes can focus on the task at hand. Confident athletes tend to set challenging goals and pursue them actively and with increased vigour. Confident athletes tend to play to win and are usually not afraid to take chances. Confidence helps athletes deal more effectively with errors and mistakes.[8]

Goal-setting

A good method to improve athletes' confidence is to set effective goals that provide direction and enhance motivation.[8] It is important that athletes understand the difference between outcome goals and performance goals. Outcome goals stress the competitive result of an event, such as winning a competition or game. Athletes with this orientation are concerned about winning or losing rather than thinking about the quality of their performance. Achieving outcome goals therefore depends not only on the athletes' own efforts but also on the abilities and performance of their opponents. Outcome goals are therefore counter-productive, because they often emphasize aspects that cannot be controlled by the athletes (especially in team sports). When athletes are too concerned about outcome goals, this causes anxiety during competition, and the athletes worry unnecessarily instead of concentrating on the task. On the other hand, performance goals focus on realizing performance objectives that are compared with the athletes' own previous performance and therefore do not focus on the outcome of the event.[8,29]

Goal setting is a very good method for improving athletes' performance if implemented correctly. In order to promote behavioural change, goals must be specified in a measurable way and in behavioural terms. In order to be effective, goals must be set difficult enough to challenge the athletes, yet realistic enough to be achievable. Short-term goals should be used as a method to achieve long-term goals and should be recorded and kept in a visible place.

Strategies or plans must be outlined to achieve the goals that have been set. Athletes must be part of the goal setting process which needs to be constantly monitored and evaluated. Regular performance feedback and support from significant others is important if goal-setting is to be effective.

Imagery

The terms mental practice, imagery, visualisation and mental rehearsal are used interchangeably to relate an athlete's mental preparation for competition. Imagery is the use of visualization to imagine situations. Internal imagery makes it possible for athletes to kinesthetically experience the correct execution of a skill, while external imagery lets them see themselves performing the skill.[29]

Athletes can use imagery to recreate past experiences or visualize future new events to ready themselves mentally for performance. When using imagery, the athlete needs to involve as many senses as possible in order to create life-like images. It is also important to generate the emotions or moods associated with specific tasks or skills that are being imagined.

Athletes should pay attention to environmental detail (e.g. layout of the facilities, closeness to spectators) and recreate the atmosphere of the actual competition. Many Olympic teams visit the actual competition sites months in advance to familiarize themselves with the surroundings so that they can visualize themselves performing in that exact setting, with its specific colour, layout, lighting and construction.

Athletes can use imagery to improve both physical and psychological skills. Concentration may be enhanced by athletes imagining themselves in situations where they generally lose concentration and then visualizing themselves remaining composed and focused. Imagery can be used to build confidence in athletes. They can imagine situations that have caused problems in the past and then picture themselves coping positively with these events. The best-known use of imagery is practising particular sport skills in detail (e.g. throwing a javelin) repetitively to fine tune them or identify weaknesses and visualize correcting them.

For imagery to be incisive, it needs to be practised as part and parcel of an athlete's daily routine. At the beginning, it is best to practise in a setting with no distractions. With practice, athletes learn to use imagery amid distractions and even in actual competitions. The time spent imagining a particular skill should eventually be equal to the time the skill actually takes to occur in order to improve the transfer from imagery to real life situations.

DETERMINATION, COMMITMENT AND CONTROL

Determination, commitment and self-control have been recognized as key psychological ingredients for sporting excellence.[30] Few athletes can achieve high levels of excellence without complementary high levels of per-

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

sonal determination and commitment. Achieving the ultimate standard possible requires an athlete to make sacrifices: to train harder and longer, to expend more time and effort during practices.[1] Orlick and Partington[31] stated that for the most successful Canadian Olympic athletes at the 1984 Olympics excellence in sport was the top priority in their lives: everything revolved around their sport. They were completely committed athletes with clearly defined success goals. The emphasis was on quality training, bolstered by pre-set individualized training goals and a clear commitment to follow their plans.

To achieve real athletic success, maturity and self-control are essential. Being able to react effectively in big games and tight situations as well as in normal games requires confidence and composure.

CONCLUSION

Refining and perfecting mental skills takes life-long practice.[16] It is a tedious, time-consuming effort. Just as physical training is. Only a select few will bring all components together consistently. They are the elite. Yet each and every athlete can learn, apply and grow through the inclusion of psychological skills training in their athletic life, at whichever level they choose to compete. For those at the top the choice is clear. Psychological skills training is a must to be part of the Olympic experience. To be part of the experience of excellence.

Reflecting on the sport psychology services provided to the US team at the 1988 Summer Olympics in Seoul, Murphy and Ferrante[32] concluded: "At a moment when the whole world seemed focused on winning versus losing, we became even more committed to our basic philosophy of helping each individual learn and grow as a function of his/her Olympic experience".

REFERENCES

1. *Williams JM. Psychological characteristics of peak performance.In: Williams JM, ed., Applied Sport Psychology: Personal Growth to Peak Performance. Palo Alto, California:Mayfield Publishing Company, 1986: 123-132.*
2. *Van-den Auweele Y, De Cuyper B, Van Mele V, Rzewnicki R. Elite performance and personality: From description and prediction to diagnosis and intervention. In: Singer, RN., Murphey, M., Tennant, LK., eds., Handbook of Research on Sport Psychology. New York: MacMillan Publishing Company, 1993:257-289.*
3. *Rushall, BS. Sport psychology: The key to sporting excellence. International Journal of Sport Psychology, 1989; 20(3): 165-190.*
4. *Gould D. Eklund RC, Jackson SA. 1988 US. Olympic wrestling excellence: I. Mental preparation, precompetitive cognition, and affect. The Sport Psychologist, 1992; 6: 358 -382.*
5. *Gould D, Eklund RC, Jackson, SA. 1988 U.S. Olympic wrestling excellence: II. Thoughts and affect occurring during competition. The Sport Psychologist, 1992;6:383 -402.*
6. *Landers, DM., Boutcher, SH. Arousal-performance relationships. In: Williams, JM., ed., Applied Sport Psychology: Personal Growth to Peak Performance. Palo Alto, California:Mayfield Publishing Company, 1986: 163-184.*
7. *Vealey RS. Personality and sport: A comprehensive view. In: Horn TS., ed. Advances in Sport Psychology. Champaign, Illinois: Human Kinetics Publishers, 1992: 25-60.*
8. *Weinberg RS, Gould D. Foundations of Sport and Exercise Psychology. Champaign. Illinois:Human Kinetics, 1995.*
9. *Toufexis A. Engineering the perfect athlete. Time 1992; July: 46-51.*
10. *Williams JM. Integrating and implementing a psychological skills training programme. In: Williams JM., ed. Applied Sport Psychology: Personal Growth to Peak Performance. Palo Alto, California: Mayfield Publishing Company, 1986, 301-324.*
11. *Gould D, Murphy S, Tammen V, May J. An evaluation of US Olympic sport psychology consultant effectiveness. The Sport Psychologist 1991; 5: 111-127.*
12. *Nideffer RM. Psychological services for the US track and field team. The Sport Psychologist 1989; 3: 350-357.*
13. *Partington J, Orlick T. An analysis of Olympic sport psychology consultants' best-ever consulting experiences. The Sport Psychologist 1991; 5: 183-193.*
14. *Gould D, Eklund RC, Jackson SA. Coping strategies used by US Olympic wrestlers. Research Quarterly for Exercise and Sport 1993; 64(1): 83-93.*
15. *Nowicki D. Using mental training during residential squad training in combat sports: A Polish experience. The Sport Psychologist 1995; 9: 164-168.*
16. *Orlick T. Reflections on sportpsych consulting with individual and team sport athletes at Summer and Winter Olympic Games. The Sport Psychologist 1989, 3: 358-365.*
17. *Gipson M, McKenzie T, Lowe S. The sport psychology programme of the USA women's national volleyball team. The Sport Psychologist 1989;3:330-339.*
18. *Gordin RD, Henschen KP. Preparing the USA women's artistic gymnastics team for the 1988 Olympics: A multimodal approach. The Sport Psychologist 1989; 3: 366-373.*
19. *Halliwell W. Delivering sport psychology services to the Canadian sailing team at the 1988 Summer Olympic Games. The Sport Psychologist 1989; 3: 313-319.*
20. *Kirschenbaum DS, Parham WD, Murphy SM. Provision of sport psychology services at Olympic events: The 1991 US Olympic festival and beyond. The Sport Psychologist 1993; 7: 419-440.*
21. *Suinn RM. The 1984 Olympics and sport psychology. Journal of Sport Psychology 1985; 7: 321-329.*
22. *Salmela JH. Long-term intervention with the Canadian men's Olympic gymnastic team. The Sport Psychologist 1989; 3: 340-349.*
23. *May JR, Brown L. Delivery of psychological services to the US alpine ski team prior to and during the Olympics in Calgary. The Sport Psychologist 1989; 3: 320-329.*
24. *Gould D, Krane V. The arousal-athletic performance relationship: Current status and future directions. In: Horn TS, ed. Advances in Sport Psychology. Champaign. Illinois: Human Kinetics Publishers, 1992: 119-142.*
25. *Loehr JE. How to overcome stress and play at your peak all the time. Tennis 1984; March: 66-76.*
26. *Garfield CA, Bennett HZ. Peak Performance:Mental Training Techniques of the World's Greatest Athletes. Los Angeles: Tarcher, 1984.*
27. *Schomer HH. Psychological training techniques for athletes. In: Potgieter JR. ed. Readings in Sport Psychology. University of Stellenbosch:Institute for Sport and Movement Studies, 1992; 1-11.*
28. *Nideffer RM. Athletes' Guide to Mental Training. Champaign, Illinois: Human Kinetics Publishers, 1985.*
29. *Cox RH. Sport Psychology: Concepts and Applications. 3rd Edition: Dubuque, Iowa: Brown & Benchmark, 1994.*
30. *Orlick T. In Pursuit of Excellence. Champaign. Illinois:Human Kinetics, 1980.*
31. *Orlick T, Partington J. Mental links to excellence. The Sport Psychologist 1988; 2: 105-130.*
32. *Murphy SM, Ferrante AP. Provision of sport psychology services to the US team at the 1988 Summer Olympic Games. The Sport Psychologist 1989: 3: 374-385.* □

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

National Olympic Committee of South Africa (NOCSA) Anti-doping Policy April 1996

Dr G Ruijsch van Dugteren MB ChB FCP

1. INTERPRETATION

In this policy, the following words have the following respective meanings:

"NOCSA" the National Olympic Committee of South Africa.

"IDS" the Institute for Drug-Free Sport

"Agency" any agency throughout the world recognised by NOCSA as conducting sampling or testing, or both, of athletes for the detection of doping and in accordance with the IOC Medical Code;

"NSC" the National Sports Council

"Athlete" (a) a member or potential member of a South African Olympic Team;

(b) a member of a NOCSA Affiliate or person competing in any competition under the control or auspices of a NOCSA Affiliate;

(c) a person competing in any competition in South Africa contested in the framework of the Olympic Movement, in particular those competitions organised under the authority, whether direct or delegated, of an International Federation, NOCSA or a NOCSA Affiliate.

"Doping" is defined as:

(a) the administration of substances belonging to prohibited classes of pharmacological agents; and/or

(b) the use of various prohibited methods

as described in Chapter II of the IOC Medical Code (as in force from time to time).

"IF" an International Federation being a body controlling a branch of sport and recognised as such by the IOC.

"IOC" the International Olympic Committee, being an association created by the Congress of Paris of 23 June 1984 and which is entrusted with the control and development of the modern Olympic Games pursuant to the Olympic Charter.

"IOC Medical Code" the Medical Code provided for under Rule 48 of the Olympic Charter.

"Affiliate" any Body which is affiliated to NOCSA.

"Olympic Charter" the Olympic Charter of the IOC or any amendment, modification or replacement thereof.

"Responsible Authority" the IOC, IFs, NOCSA, NSC, IDS, NFs and NOCSA Affiliates.

Trafficking occurs when any person:

(a) manufactures, extracts, transforms, prepares, stores, expedites, transports, imports, transits, offers (subject to payment or free of charge), distributes, sells, exchanges, brokers, obtains in any form, prescribes, commercialises, makes over, accepts, possesses, holds, buys or acquires in any manner products or substances which are prohibited under the IOC Medical Code;

(b) acts in this respect, finances or serves as an intermediary for the financing of the latter, provokes in any way the consumption or use of such products or prohibited substances or establishes means of procuring or consuming such substances; or

(c) is concerned or involved in methods which are prohibited by the IOC Medical Code, other than in the course of the legal exercise of professional activities.

Any words when used in the plural shall have a corresponding meaning in the singular.
Any words used in the masculine gender shall have a corresponding meaning in the feminine gender.

Words not defined in this policy shall have the meaning ascribed to them in the Constitution of NOCSA unless a contrary meaning appears from the context.

2. POSITION STATEMENT

2.1 The IOC's Medical Code (Olympic Charter Rule 48) (i) provides for the prohibition of doping, (ii) determines the classes of prohibited substances and prohibited methods, (iii) establishes the list of accredited laboratories, (iv) pro-

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

vides for the obligation of competitors to submit themselves to medical controls and examinations, (v) lays down testing procedures, including procedures for selection of athletes, sample collection and sample analysis, (vi) provides for appeals to the Court of Arbitration for Sports, (vii) determines sanctions to be applied in the event of a doping violation and (viii) prohibits the trafficking in prohibited substances.

2.2 On 13 January 1994 representatives of the IOC, the Association of Summer Olympic International Federations, the Association of International Winter Federations, IFs, the Association of National Olympic Committees, the continental associations of NOCs and athletes agreed, among other things:

(1) to unify their anti-doping rules and procedures for the doping controls performed both during and out of competition;

(2) to adopt, each year, as a basic document the list of prohibited classes and methods of doping established by the IOC Medical Commission and to undertake the necessary controls for each sport;

(3) to accelerate unification of the minimum sanctions provided for by the IOC Medical Commission for violations of the anti-doping regulations and to ensure their application at both international and national level;

(4) to recognise the sanctions imposed by an IF;

(5) to use laboratories accredited by the IOC for all international competitions and out of competition testing; and

(6) to develop co-operation between the IOC, IFs, NOCs, National Federations and governments or other organisations concerned in order to organise and carry out doping controls and to combat the trafficking of prohibited substances in sport.

2.3 The IOC Medical Code and this policy are essentially intended to safeguard the health of athletes and to ensure respect for the ethical concepts implicit in Fair Play, the Olympic Spirit and medical practice.

2.4 Doping is prohibited

2.5 All athletes must provide samples for testing at the request of a Responsible Authority or Agency.

2.6 The counselling of the use of, permitting the use of, or condoning the use of any substance or method contrary to the IOC Medical Code is prohibited.

3. APPLICATION OF ANTI-DOPING POLICY

3.1 This policy applies to:

(1) athletes, whether in or out of competition;

(2) coaches, trainers, officials, and medical and paramedical personnel working with or treating athletes;

(3) NOCSA Affiliates; and

(4) all persons involved in trafficking.

3.2 Sanctions are applicable in the event of any breach of the provisions of this policy.

4. DOPE TESTING

4.1 NOCSA or an Agency may conduct sampling and testing or both of athletes for the detection of doping.

4.2 A Responsible Authority may select an athlete to provide any number of samples for dope testing in a year, whether in or out of competition.

4.3 Sampling and testing of athletes must be conducted in conformity with the IOC Medical Code.

4.4 Minor irregularities which cannot reasonably be considered to affect the results of otherwise valid tests, will not invalidate such results. However, tests may be invalidated in the case of serious irregularities such as a break in the chain of custody of the sample, improper sealing of the container in which the sample is stored, failure to request the signature of the athlete, or failure to provide the athlete with an opportunity to be present or be represented at the opening and analysis of the "B" sample.

4.5 Every NOCSA Affiliate must:

(1) permit NOCSA or an Agency to attend competitions conducted by it, or under it's auspices, in order to obtain samples for dope testing;

(2) permit NOCSA or an Agency to obtain samples for testing from athletes out of competition and provide reasonable assistance for this purpose.

(3) inform athletes that they are liable for selection to provide samples for dope testing whether in South Africa or overseas;

(4) arrange for completion and return of forms required for dope testing purposes at the request of NOCSA, an Agency or a Responsible Authority;

(5) require and cause athletes and officials to permit NOCSA or an Agency to collect samples for testing out of competition and provide reasonable assistance for this purpose;

(6) use NOCSA or an Agency to conduct any additional test required by the NOCSA Affiliate

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

in South Africa at its own expense;

(7) submit its anti-doping policy to NOCSA for approval of consistency with its policy and thereafter not alter or amend its approved anti-doping policy without first obtaining the approval of NOCSA.

5. OTHER DOPING OFFENCES

5.1 Should an athlete fail or refuse to provide a sample upon request, then this will be an infraction of this policy and for which the athlete is subject to the same penalty as if the athlete had committed doping.

5.2 Where an athlete has made a statement admitting doping such statement will be prima facie evidence of an infraction of this policy. Upon notification of such a statement, the Secretary -General may conduct enquiries as he or she deems appropriate to determine whether there is sufficient evidence that the statement of admission of doping was made. In conducting these enquiries, NOCSA will not be obliged to conduct any hearing or to receive any evidence or statements by or on behalf of the athlete concerned.

5.3 Should a NOCSA Affiliate fail to adopt and implement an anti-doping policy consistent with this policy, it will be in breach of NOCSA's Constitution and this policy and liable for the penalties described therein for a breach of the Constitution or By-Laws made thereunder.

5.4 Trafficking is prohibited and any person (including any body, corporate or unincorporate) involved in trafficking is liable to sanction under this policy.

5.5 Any person will be deemed to be involved in trafficking if that person:

(1) has aided, abetted, counselled or procured the trafficking;

(2) has induced, whether by threats or promises or otherwise, the trafficking;

(3) has been in any way, directly or indirectly, knowingly concerned in, or party to, the trafficking; or

(4) has conspired with others to effect the trafficking.

5.6 Clauses 5.4 and 5.5 do not apply to doctors, pharmacists and other members of the medical profession or holders of analogous diplomas recognised by the public authorities concerned, when one or other of the above clauses is necessary for them within the strict limits of exercising the art of healing.

6. ADVICE OF ALLEGED BREACH

6.1 Where NOCSA has requested an Agency or Agencies to conduct sampling or testing or both of athletes, that Agency or Agencies will notify NOCSA of the names and results of any athlete who returned a positive test result or who failed to comply with the requirement to provide a sample for testing.

6.2 Affiliates must notify NOCSA of the names and result of any athlete who returned a positive test result or who failed to comply with a requirement to provide a sample for testing. Other Responsible Authorities may so notify NOCSA.

6.3 Athletes and Affiliates must notify NOCSA of the names of any person who they know or reasonably suspect of being involved in trafficking, and must provide NOCSA with all such information and assistance as they are able to give to enable NOCSA to conduct an investigation into the circumstances surrounding the suspected trafficking. Failure to do so will be considered trafficking by the athlete or NOCSA Affiliate concerned.

6.4 NOCSA will maintain confidentiality of information provided under clauses 6.1, 6.2, and 6.3 until after a decision (if any) to impose a sanction for a breach of this policy has been determined except as is necessary to conduct or prosecute any hearing under this policy or to notify the relevant Responsible Authorities.

7. NOTIFICATION OF ALLEGED BREACH BY AN ATHLETE OR OTHER PERSON

7.1 Where NOCSA receives notification from an Agency or a Responsible Authority that an athlete has returned a positive test result or has failed to comply with a request to provide a sample or for another reason believes that a person to whom this policy applies has committed an infraction of this policy, NOCSA will give to the athlete or person concerned notice of the alleged infraction.

7.2 This notice of alleged infraction (clause 7.1 above) must:

(1) be in writing and be delivered to the athlete or person;

(2) set out the nature and particulars of the alleged infraction;

(3) set out or enclose an extract of this policy relating to the sanctions that may be imposed if it is determined that the alleged infraction has occurred, and

(4) state that a Hearing to decide whether an infraction of this policy has occurred and what penalty to impose will be determined by a

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

Committee appointed by the IDS according to the procedures described in clause 9.

8. OLYMPIC GAMES

8.1 The IOC Executive Board is the only body competent to rule on the effects of a positive test result during the Olympic Games.

8.2 Should an athlete be found by the IOC Executive Board to have committed doping during the Olympic Games, any hearing by a Committee appointed by NOCSA or any appeal therefrom to the Court of Arbitration for Sport will be bound by that finding and the hearing or appeal will be limited to the sanction to be imposed for the breach of this policy.

9. PROCEDURE FOR THE CONDUCT OF HEARING INTO DOPING

9.1 Where NOCSA gives an athlete or person a notice pursuant to clause 7, NOCSA will consult with the Affiliate of the athlete or person concerned with a view to there being a joint hearing on behalf of NOCSA and the Affiliate to determine:

(1) whether the athlete or person has committed an infraction of this policy and/or the anti-doping policy of the NOCSA Affiliate;

(2) what sanction consistent with this policy should be applied to the athlete or person who was found to have committed an infraction of this policy.

9.2 Should it not be possible or feasible to conduct a joint hearing pursuant to clause 9.1, the hearing will be on behalf of NOCSA alone.

9.3 The NOCSA Executive will appoint a Committee of up to three persons to conduct a hearing.

9.4 The Committee may conduct a hearing in such a manner as it determines. Hearings may be conducted by telephone or other conference facilities.

9.5 Hearings are to be conducted with as little formality and technicality, and with as much expedition, as proper consideration of the matter before the Committee permits.

9.6 At a hearing of the Committee:

(1) the Committee may examine and cross examine witnesses and may appoint a legal representative or other person to assist it;

(2) NOCSA and, if the hearing is a joint hearing on behalf of NOCSA and an Affiliate, that Affiliate, may separately or jointly examine and cross-examine witnesses and be assisted by legal representation or other person;

(3) the athlete or person concerned may examine and cross-examine witnesses and may be assisted by a legal representative or other person; and

(4) where an athlete contends that sampling or testing or both of him or her is not substantially in conformity with the IOC Medical Code, the onus shall be on the athlete to show on the balance of probabilities that his or her contention is correct and that as a result thereof the results of the sampling and testing have been so affected as to not record doping.

9.7 The Committee will make a statement in writing stating its findings of fact and its decision and will send the statement to NOCSA. The Committee is not bound to give a statement of its reasons for its decision.

9.8 NOCSA will send a copy of the statement to:

(1) the IOC

(2) the IDS

(3) the NSC

(4) the Affiliate of which the athlete or person is a member; and

(5) any other person or organisation that NOCSA believes should be informed.

9.9 The Committee will send to the athlete or person concerned a copy of the statement so far as it relates to the athlete or person, but the athlete or person is not entitled to a copy of the Committee's statement of its reasons (if any).

10. APPEALS

10.1 An athlete or person who is dissatisfied with a decision made in relation to him or her under this policy may, within 14 days of receiving written notification of the sanction imposed, appeal to the Court of Arbitration for Sport and request that an appeal be conducted in relation to:

(1) the determination that an infraction of this policy has occurred and the imposition of the sanction; or

(2) the sanction that has been imposed.

10.2 Any such appeal will be conducted according to the Code of Sports-Related Arbitration.

10.3 An appeal deals only with the original matters appealed against.

10.4 Upon receiving notice of the outcome of an appeal from the Court of Arbitration for Sport, NOCSA will give written notice of the outcome to:

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

(1) the athlete or person making the appeal; and

(2) the persons and/or organisations provided with the statement pursuant to clause 9.7.

10.5 An appeal conducted in accordance with this policy is the sole form of appeal from the decision under this policy. No appeal may be made to a court or other tribunal.

11. SANCTIONS

11.1 Any athlete who is found to have committed doping will be ineligible for membership of or selection in any South African Olympic Team, or to receive funding from or to hold any position on NOCSA as follows:

(1) for a first infraction other than cases provided for in paragraph (2) - suspension for two years.

(2) for a first infraction in cases of a positive result for ephedrine, phenylpropanolamine, pseudo-ephedrine, caffeine, strychnine and related compounds - suspension for a maximum period of three months;

(3) for the second offence other than in the cases provided in paragraph (4) - suspension for his or her lifetime;

(4) for a second infraction in cases of a positive result for ephedrine, phenylpropanolamine, pseudo-ephedrine, caffeine, strychnine and related compounds - suspension for two years.

(5) for a subsequent infraction in cases of a positive result for ephedrine, phenyl-propanolamine, pseudo-ephedrine, caffeine, strychnine and related compounds - suspension for his or her lifetime.

11.2 Where an athlete or other person to whom this policy applies is found to have committed an infraction of this policy other than doping he or she will be subject to at least the same penalties as described in clause 11.1, provided that such penalties are a minimum only and may be increased according to the circumstances and culpability involved.

11.3 The above sanctions may be applied to a person regardless of any sanction or penalty, its duration or timing or whether current or past, imposed by any Responsible Authority PROVIDED THAT NOCSA will recognise previous sanctions imposed by any Responsible Authority to determine whether the breach is a first or second offence.

11.4 NOCSA will, however, recognise sanctions imposed by a relevant IF if its sanctions extend for a longer period than that imposed by NOCSA.

11.5 Failure by an invited athlete or person to attend to be heard by the Committee in accordance with clause 9 for whatever reason will not invalidate the right of NOCSA to impose a sanction in accordance with this policy.

12. PRESS RELEASE

A press release may be issued by NOCSA in relation to any sanction imposed under this policy.

13. REVIEW OF SANCTION

13.1 Where an athlete or person to whom a sanction has been applied under this policy has new and relevant information concerning the infraction, he or she or it may make written application to NOCSA setting out the grounds for a possible review of that sanction. The Executive of NOCSA may consider the application and determine in its sole and absolute discretion to either:

(a) itself review any sanction imposed under this policy and whether to alter a decision made previously including a reduction or withdrawal of the sanction; or

(b) refer the matter to the Court of Arbitration for Sport for that Court to determine whether to review any sanction imposed under this policy and whether to alter a decision made previously including a reduction or withdrawal of the sanction.

13.2 NOCSA will not alter any decision under clause 13.1 without first consulting with any other sports organisation which it knows has a current sanction over the athlete or person and obtains its agreement to the alteration.

13.3 Notification of any change to the previous decision will be made in accordance with clause 11.

14. EDUCATION AND OTHER INITIATIVES

NOCSA will undertake the following anti-doping initiatives:

(1) Support the anti-doping policies of the Government through the Institute for Drug-Free Sport.

(2) Encourage the development and implementation by Responsible Authorities of drug education programmes for athletes and officials.

(3) Support the information and educational initiatives of Responsible Authorities. □

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

South African Institute for Drug-Free Sport

INTERNATIONAL OLYMPIC COMMITTEE MEDICAL COMMISSION

Prohibited Classes of Substances and Prohibited Methods
January 1996

Doping contravenes the ethics of sport and medical science.

Doping consists of:

1. the administration of substances belonging to selected classes of pharmacological agents, and/or
2. The use of various prohibited methods.

I. PROHIBITED CLASSES OF SUBSTANCES

A. Stimulants
B. Narcotics
C. Anabolic Agents
D. Diuretics
E. Peptide and glycoprotein hormones and analogues

II. PROHIBITED METHODS

A. Blood doping
B. Pharmacological, chemical and physical manipulation

III. CLASSES OF DRUGS SUBJECT TO CERTAIN RESTRICTIONS

A. Alcohol
B. Marijuana
C. Local anaesthetics
D. Corticosteroids
E. Beta-blockers

EXAMPLES AND EXPLANATIONS

This document lists examples representing different doping classes to illustrate the doping definition. No substances belonging to the banned classes may be used even if they are not listed as examples. For this reason, the term "and related substances" is introduced. This term describes drugs that are related to the class by their pharmacological actions or chemical structure. A longer list of examples belonging to different pharmacological classes of banned substances can be found in annex 1.

If substances of the banned classes are identified by an IOC accredited laboratory the relevant authority will act.

I. PROHIBITED CLASSES OF SUBSTANCES

A. Stimulants

Stimulants comprise various types of substances which increase alertness, reduce fatigue and may increase competitiveness and hostility. Their use can also produce loss of judgement, which may lead to accidents to others in some sports. Amfetamine and related compounds have the most notorious reputation in producing problems in sport. Some deaths of sportsmen have resulted even when normal doses have been used under conditions of maximum physical activity. There is no medical justification for the use of "amphetamines" in sport.

One group of stimulants is the sympathomimetic amines of which ephedrine, pseudoephedrine, phenylpropanolamine and norpseudoephedrine are examples. In high doses, this type of compound produces mental stimulation and increased blood flow. Adverse effects include elevated blood pressure and headache, increased and irregular heart beat, anxiety and tremor. These compounds are often present in cold and hay fever preparations which can be purchased "over the counter" from pharmacies and sometimes from other retail outlets without medical prescription.

Another group of stimulants is the beta-2 agonists. These drugs are unusual because they are classified as both stimulants and anabolic agents. When taken by mouth or by injection they may exert powerful stimulatory and anabolic effects. Oral and injectable administration of beta-2 agonists is banned.

Of the beta-2 agonists only Salbutamol, Salmeterol and Terbutaline are permitted and only by inhalation. Any physician wishing to administer beta-2 agonists by inhalation must give written notification to the relevant medical authority prior to the competition.

The choice of medications to treat asthma and other common respiratory disorders poses a problem because some of the more commonly prescribed substances are powerful stimulants. Furthermore, because these drugs have many different product names, the status of a drug may be confusing. The most prudent approach is never to take or prescribe a product for colds, sore throats, and flu without first checking with a physician or pharmacist who has special expertise in this area.

Prohibited substances in class (A) include the following examples:

amiphenazole	amphetamines
amineptine	caffeine *
cocaine	ephedrines
fencamfamine	mesocarb
pentylentetrazol	pipradol
salbutamol**	terbutaline **
salmeterol **	

. . . and related substances.

* Caffeine: The definition of a positive depends on the concentration of caffeine in the urine. The concentration in urine may not exceed 12 micrograms per milliliter.

** Salbutamol, salmeterol and terbutaline are permitted by inhaler only and must be declared in writing, prior to the competition to the relevant medical authority.

NOTE: All imidazole preparations are acceptable for topical use, e.g. oxymetazoline. Vasoconstrictors (e.g. adrenaline) may be administered with local anaesthet-

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

ic agents. Topical preparations (e.g. nasal, ophthalmological) of phenylephrine are permitted.

B. Narcotics

Morphine and other compounds of this class are powerful analgesics and are mainly used for the management of severe pain. These substances have major side effects, including respiratory depression, and they carry a high risk of physical and psychological dependence. Evidence reveals that narcotic analgesics have been abused in sports. Therefore the IOC Medical Commission has issued and maintained a ban on their use. The ban is consistent with international restrictions and with the regulations and recommendations of the World Health Organisation regarding narcotics.

Prohibited substances in class (B) include the following examples:

dextromoramide	dextropropoxyphene
diamorphine (heroin)	methadone
morphine	pentazocine
pethidine	

. . . and related substances

NOTE: Codeine, dextromethorphan, dihydrocodeine, diphenoxylate and pholcodine are permitted.

C. Anabolic agents

The Anabolic class includes anabolic androgenic steroids (AAS) and Beta-2 agonists.

1. Anabolic androgenic steroids (AAS)

The AAS class includes testosterone and substances that are related in structure and activity to it. They have been misused in sport to increase muscle strength and bulk, and to promote aggressiveness. The use of AAS is associated with adverse effects on the liver, skin, cardiovascular and endocrine systems. They can promote the growth of tumours and induce psychiatric syndromes.

In males AAS decrease the size of the testes and diminish sperm production. Females experience masculinization, loss of breast tissue and diminished menstruation. The use of AAS by teenagers can stunt growth.

Prohibited substances in class (C1) include the following examples:

clostebol	fluoxymesterone
metandienone	metenolone
nandrolone	oxandrolone
stanozolol	testosterone *

. . . and related substances

* The administration of testosterone is banned.The presence of testosterone (T) to epitestosterone (E) ratio greater than six (6) to one (1) in the urine of a competitor constitutes an offence unless there is evidence that this ratio is due to a physiological or pathological condition, e.g. low epitestestosterone excretion, androgen production by tumour, enzyme deficiencies.
In the case of a T/E ratio higher than 6, it is mandatory that the responsible authority conduct an investigation before the sample is declared positive. A full report will be written and will include a review of previous tests, subsequent tests and any results of endocrine investigations. In the event that previous tests are not available, the athlete should be tested unannounced at least once per month for three months. The results of these investigations should be included in the report. Failure to cooperate in the investigations will result in declaring the sample positive.

2. Beta-2 agonists

When given systemically, beta-2 agonists may have powerful anabolic effects, and their use is therefore banned. (See also section IA)

Prohibited substances in class (C 2) include the following examples:

clenbuterol
salbutamol
terbutaline
salmeterol
fenoterol
. . . and related substances

D. Diuretics

Diuretics have important therapeutic indications for the elimination of fluids from the tissues in certain pathological conditions and for management of high blood pressure. Diuretics are sometimes misused by competitors for two main reasons, namely:
- to reduce weight quickly in sports where weight categories are involved, and
- to reduce the concentration of substances by diluting the urine.

Rapid reduction of weight in sport cannot be justified medically. Health risks are involved in such misuse because of serious side-effects which might occur. Furthermore, deliberate attempts to reduce weight artificially in order to compete in lower weight classes or to dilute urine constitute clear manipulations which are unacceptable on ethical grounds.

For sports involving weight classes, the responsible authorities reserve the right to obtain urine samples from the competitor at the time of the weigh-in.

Prohibited substances in class (D) include the following examples:

acetazolamide	bumetanide
chlorthalidone	ethacrynic acid
furosemide	hydrochlorothiazide
mannitol	mersalyl
spironolactone	triamterene

. . . and related substances

E. Peptide and glycoprotein hormones and analogues

Prohibited substances in class (E) include the following examples:

1. Chorionic Gonadotrophin (HCG-human chorionic gonadotrophin):

It is well known that the administration to males of human chorionic ganodotrophin (HCG) and other compounds with related activity, leads to an increased rate of production of endogenous androgenic steroids and is considered equivalent to the exogenous administration of testosterone.

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

2. Corticotrophin (ACTH):
Corticotrophin has been misused to increase the blood levels of endogenous corticosteroids notably to obtain the euphoric effect of corticosteroids. The application of corticotrophin is considered to be equivalent to the oral, intra-muscular or intravenous administration of corticosteroids. (See section III. D).

3. Growth hormone (HGH, somatotrophin):
The misuse of growth hormone in sport is unethical and dangerous because of various adverse effects, for example cardiomyopathy, hypertension, diabetes mellitus, and acromegaly when given in high doses for a long period of time. Contamination of some growth hormone preparations of human origin can cause Creutzfeldt Jacob disease (a fatal neurological condition).
NOTE: All the respective releasing factors of the above-mentioned substances are also banned.

4. Erythropoietin (EPO):
This naturally occurring hormone is produced in the kidney and regulates red blood cell production. Synthetic EPO is currently available and has been demonstrated to induce changes similar to blood doping (see IIA).

II. PROHIBITED METHODS
The following procedures are prohibited:

A. Blood doping
Blood doping is the administration of blood, red blood cells or related products to an athlete. This procedure may be preceded by withdrawal of blood from the athlete who continues to train in this blood depleted state.

These procedures contravene the ethics of medicine and of sport. There are also risks involved in the transfusion of blood and related blood products. These include the development of allergic reactions (rash, fever etc.) and acute haemolytic reaction with kidney damage if incorrectly typed blood is used, as well as delayed transfusion reaction resulting in fever and jaundice, transmission of infectious diseases (viral hepatitis and AIDS), overload of the circulation and metabolic shock.

B. Pharmacological, chemical and physical manipulation
Pharmacological, chemical and physical manipulation is the use of substances or of methods which alter, attempt to alter or may reasonably be expected to alter the integrity and validity of urine samples used in doping controls. Examples of banned methods include, without limitation, catheterisation, urine substitution and/or tampering, inhibition of renal excretion such as by probenecid and related compounds, and epitestosterone administration.

The IOC Medical Commission bans the use of substances and of methods which alter the integrity and validity of urine samples used in doping controls.

If the epitestosterone concentration is greater than 200 ng/ml, the laboratories should notify the appropriate authorities. The IOC Medical Commission recommends that under these circumstances further investigations be conducted.

III. CLASSES OF DRUGS SUBJECT TO CERTAIN RESTRICTIONS

A. Alcohol
In agreement with the International Sports Federations and the responsible authorities, tests may be conducted for ethanol. The results may lead to sanctions.

B. Marijuana
In agreement with the International Sports Federations and the responsible authorities, tests may be conducted for cannabinoids (Marijuana, Dagga, Hashish . . .). The results may lead to sanctions.

C. Local anaesthetics
Injectable local anaesthetics are permitted under the following conditions:

a) that bupivacaine, lidocaine, mepivacaine, procaine etc. are used but not cocaine. Vasoconstrictor agents (e.g. adrenaline) may be used in conjunction with local anaesthetics.
b) only local or intra-articular injections may be administered;
c) only when medically justified (i.e. the details including diagnosis, dose and route of administration must be submitted prior to the competition or immediately, if administered during the competition, in writing to the relevant medical authority).

D. Corticosteroids
Because of their anti-inflammatory properties, the naturally occurring and synthetic corticosteroids are widely used in medicine to treat many diseases. When administered systemically, they influence the natural production of corticosteroids by the body. Corticosteroids may produce mood changes including euphoria and other side-effects such that their medical use, except when administered topically, demands medical control.

Because it was known that corticosteroids were being used non-therapeutically in certain sports by the oral, rectal, intramuscular and even the intravenous routes, the IOC Medical Commission attempted to restrict their use during competitions by requiring a declaration by doctors. However, as such restrictions failed to solve the problem, stronger measures, designed not to interfere with the appropriate medical use of corticosteroids, became necessary.

The use of corticosteroids is banned except
a) for topical use (aural, opthalmological and dermatological, but not rectal;
b) by inhalation;
c) by intra-articular or local injection
The IOC has introduced mandatory reporting of athletes requiring corticosteroids by inhalation during competitions.

ANY TEAM DOCTOR WISHING TO ADMINISTER CORTICOSTEROIDS BY LOCAL OR INTRA-ARTICULAR INJECTION, OR BY INHALATION, TO A COMPETITOR MUST GIVE WRITTEN NOTIFICATION

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

PRIOR TO THE COMPETITION TO THE RELEVANT MEDICAL AUTHORITY.

E. Beta-blockers

Due to the continued misuse of beta-blockers in some sports the IOC Medical Commission reserves the right, at the Olympic Games, to test those sports which it deems appropriate. These are unlikely to include endurance events which necessitate prolonged periods of high cardiac output and large stores of metabolic substrates in which beta-blockers would severely decrease performance capacity.

In agreement with the rules of the International Sports Federations, tests will be conducted in some sports at the discretion of the responsible authorities.

Some examples of beta-blockers are:

acebutalol
alprenolol
atenolol
labetalol
metoprolol
nadolol
oxprenolol
propranolol
sotalol
. . . and related substances.

EXPANDED LIST OF EXAMPLES: ANNEX I

Caution: This is not an exhaustive list of banned substances. It is provided only to give the reader a more comprehensive list of banned substances. Many substances that do not appear on this expanded list are considered banned under the term "and related substances".

A. STIMULANTS

amfepramone
amineptine
amfetamine
caffeine
cathine
cocaine
cropropamide
crotetamide
ephedrine
etamivan
etilamfetamine
etilefrine
fencamfamin
fenetylline
fenfluramine
heptaminol
medea
mefenorex
mephentermine
mesocarb
metamfetamine
methoxyphenamine
methylephedrine
methylphenidate
nikethamide
norphenfluramine
parahydroxyamfetamine
pemoline
phendimetrazine
phentermine
phenylephedrine
phenylpropanolamine
pholedrine
prolintane
propylhexedrine
pseudoephedrine
salbutamol
strychnine

B. NARCOTICS

dextropropoxyphene
ethylmorphine
hydrocodone
morphine
pentazocine
pethidine
propoxyphene

C. ANABOLIC AGENTS

(1) Anabolic steroids
(2) Beta2-agonists
boldenone
clenbuterol
clostebol
danazol
dehydrochlormethyl-testosterone
dihydrotestosterone
drostanolone
fluoxymesterone
formebolone
mesterolone
metandienone
metenolone
methandriol
methyltestosterone
nandrolone
norethandrolone
oxandrolone
oxymesterone
oxymetholone
stanozolol
testosterone
trenbolone

D. BETABLOCKERS

acebutolol
alprenolol
atenolol
betaxolol
bisoprolol
bunolol
metoprolol
oxprenolol
propranolol
sotalol

E. DIURETICS

acetazolamide
bendroflumethiazide
bumetanide
canrenone
chlortalidone
furosemide
hydrochlorothiazide
indapamide
spironolactone
triamterene

F. MASKING AGENTS

epitestosterone
probenecid

G. PEPTIDE HORMONES

HCG
hGH
erythropoietin
ACTH

This information was kindly provided by the National Olympic Committee of South Africa □

Some important points about over-the-counter medications and prescription drugs

1. Many athletes purchase from their local pharmacy over-the-counter medications for the treatment of e.g.headaches, sinusitis, hayfever, asthma, colds, influenza etc.
2. It is a known fact that the majority of the branded medications for treatment of the above ailments contain banned substances, notably phenylpropanolamine and ephedrine.
3. An athlete should ask his/her pharmacist or medical practitioner if a medication contains any banned substances before taking it.
4. An athlete should request his medical practitioner to complete a medical notification form whenever any drug is prescribed for treatment.
5. Remember that the accredited Drug Testing Laboratory uses the most modern and sensitive testing methods, and any athlete taking a banned substance will most certainly test positive even some time after taking the substance.

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

DOPING AND CLINICAL PRACTICE: ETHICAL PERSPECTIVES

Dr MF Cusi, *MB, BS, Cert. Sports Med.*

The use of performance enhancing agents has been present in Olympic sport since the Greek Games, and throughout the modern Olympics.[1] The term "Doping" has been borrowed from the horse racing fraternity. The word derives from Dop, a stimulant used by the Kafirs in Southeast Africa.

Definitions of doping have been based on the ability to detect forbidden substances and practices.[2,3,4] A more philosophical definition, *artificial performance enhancing,* was proposed by the IOC Medical Commission Chairman.

The IOC has declared war on three accounts:

a) To protect the health of athletes
b) To uphold Sports Ethics, which is contrary to scientific manipulation
c) To ensure fair competition[5]

The official position in Australian sport is quite clear:

"1. Doping is forbidden. The ASC condemns the use of performance enhancing substances as both dangerous and contrary to the ethics of sport. It recognises the need to take strong and positive action to eliminate doping." [6]

The means to implement this policy have been to test for banned drugs and to impose heavy penalties on those found "positive". Education has been advocated, but no clear goals and guidelines have been set. Knowing athletes' motives for drug use could also point to possible solutions.

Much remains unknown in this area. Surveys on the extent of doping are plagued by underreporting.[7,8] The severe attitude that prevails at present will preclude controlled studies in future.[9]

The interest of doping for a medical practitioner is threefold.

1. Knowledge of drug intake is part of a good medical history.
2. Doctors' attitudes bear important consequences, as athletes regard doctors as reliable sources of information on drugs.[10] Attitudes can vary from assisting athletes to use drugs, to reporting them to the relevant sporting authorities, or simply ignoring the matter.
3. The extent of doctors' responsibility in advising and prescribing in these matters. These difficult issues will be discussed in the context of three scenarios that medical practitioners may have to face.

SCENARIO 1. THE OFFICIAL TEAM DOCTOR

May the doctor of a sports team prescribe banned substances?

The answer is simple: Doctors officially involved in competition sport may not ethically prescribe banned substances by virtue of the rules that govern that particular sport. Any exception to the rules must be authorised by the appropriate authorities in advance.

SCENARIO 2. ANABOLIC STEROIDS IN A NON-COMPETITIVE ATHLETE

A young man wants to improve his body image lifting weights, and feels that the anabolic steroids (A.S.) will help him achieve his goal. Competition rules cannot be broken because there is no competition. The doctor needs to ask four questions to decide whether it would be ethical to write a prescription for anabolic steroids.

1. Are Anabolic Steroids Effective?
   The scientific literature has been inconsistent and at times at odds with empirical wisdom of the athletic community regarding the ergogenic effects of A.S. However, the answer would have to be YES.[11]
2. Are there any contraindications?
   The answer is also YES, but we need not consider this point any further in our argument.
3. Are there side effects and how serious are they?
   The answer is again YES: there are changes in organ function, energy metabolism and also signs of psychological dependence.[12] Side effects should be compared to potential benefits before making a clinical decision to prescribe.
4. Can we prevent, cure or alleviate a clinical condition with this prescription?
   The answer is a definite NO.

Therefore the ethical response to a request of this kind is to decline the prescription. The reaction of the athlete can be either.

a) to accept the advice and not take the A.S.
b) to threaten the doctor with taking low quality black market Steroids "because they were not made available by prescription." There are three possible courses of action open to the medical practitioner who faces this kind of blackmail.

The Damage-Control Approach

Presented with a "Fait Accompli" some Doctors feel inclined to prescribe the desired drug, in an attempt to prevent patients from taking "street drugs" (with no quality control), and to provide some form of medical monitoring. Maintaining contact with the patient may also give a chance to wean them off for good.

This position is well-intentioned, but flawed for the following reasons:

a) The lesser evil approach is never the right choice. If an action is considered to be wrong, this action should not be taken.
b) There is no guarantee that the athlete will abide by the conditions that the prescriber may set. Anecdotal experience confirms that athletes easily get whatever drugs they want.
c) The prescribing doctor becomes a known source of steroids, and eventually a willing instrument in the spread of their abuse: the very opposite of the original intention.

The Damage-Control Approach is therefore clinically unsound and ethically unwise.

Paternalistic Platitudes

It is easy to dismiss these athletes with paternalistic platitudes such as "drugs are no good for you". Lack of time or distaste for these matters are not valid reasons for dismissal, because they do not provide the athlete with an answer or a solution to his problem.

Counselling

Help in these cases requires a mixture of firmness and gentleness in the right dose. Commitment is related to the "bottom line position". I will NOT prescribe A.S. Gentleness refers to the counselling required: simple, logical arguments, to make the potential drug-user think twice. A conversation of this kind may have to cover personal problems, attitudes and misconceptions that the athlete may have about himself and his social

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)

environment. Counselling is difficult, time-consuming, and often frustrating as the final decision remains with the individual.

SCENARIO 3. A DESPERATE DECISION

The third scenario involves an elite female shooter. A drop in forms leads to the diagnosis of an essential-familial tremor. The treatment of choice is Propranolol, a beta-blocker banned by the IOC.

She wants to perform well at her next meet to secure a long term sponsorship. This puts her in a no-win situation, and her increasing anxiety makes her condition worse. She finally makes a desperate decision: to take Propranolol and give herself a chance to live normally and train as well as she can.

When she talks with her family doctor, a distinction needs to be made between her actions and the actions of the doctor. Both face different ethical decisions. If she competes whilst taking beta-blockers she is in breach of the competition rules.

The prescription of a beta-blocker in this case is good medical practice. In the absence of contraindications it is the drug of choice. The ethical position of the doctor depends on the circumstances:

a) If he is involved in the sport in an official capacity he cannot ethically prescribe a banned drug without official permission, as we saw in Scenario 1.
b) If he is not involved in an official capacity he is not bound by those rules. Thus, provided that he does not approve of rule-breaking and says so, his prescription of the banned drug will be ethical. The primary effect is good: the appropriate treatment of a medical condition.

There is also a bad secondary effect: the doctor will cooperate in the shooter's breach of competition rules if she competes whilst on a banned drug. Both effects are independent of each other: the therapeutic effect is not the result of the doctor's cooperation with the breach of doping regulations.

The proportion between these two effects will determine the ethical legitimacy of the prescription. It is ethical if there is due proportion between the good intended (treatment of a medical condition) and the secondary wrongful effect (cooperation with possible breach of anti-doping regulations).

DISCUSSION

The three scenarios presented indicate that medical practice is more complex than the IOC's anti-doping rationale admits. Both the rationale and a perceived inconsistency in its application have been criticised in some quarters. A summary of these criticisms would include:

1. The concept of doping being bad per se has not been proved.[13]
2. The ban on drugs for the sake of athlete's health is derived from a paternalistic attitude that denies athletes of the principle of autonomy.
3. If fair competition means that all athletes can compete on equal terms, most competitions are unfair. Training facilities, coaches, sports physicians and physiology laboratories are not equally available to all athletes.
4. The ban and stigma attached to drugs readily available in everyday medical practice leads athletes to the perception that they can only receive second-class treatment for a variety of illnesses.
5. The policy of protecting athlete's health will ring hollow as long as boxing continues to be a part of Olympic and Commonwealth Games Programmes.[14] All the precautions designed to protect boxers only confirm that the purpose of boxing is to punch the opposition to defeat.

As there is some merit in these criticisms, wide and frank debate of these issues is required to provide the IOC with a sound rationale for its ethical stand on doping and for a fair implementation of its policy.

The conflicts that arise need to be addressed both by doctors and sporting authorities, as competitive athletes look to their family doctor as a reliable source of information on drugs.[15] Four basic points can be highlighted.

1. Doctors who treat athletes need to be aware of doping rules, and to be familiar with the clinical and ethical issues involved in the treatment of these patients.
2. The need to maintain independence of one's medical practice. Should there be a conflict of interests, the first loyalty of a treating physician is to the individual patient's welfare above all other considerations.[16]
3. It is important to realise that the patient (athlete) must take the ultimate responsibility for his or her actions, whilst bearing in mind the weight of a doctor's advice.
4. Doping charges often carry strong emotional overtones, which do not help in finding solutions. A good working knowledge of the facts – clinical, historical, personal and ethical – will assist greatly to think clearly, to remain objective and to make fair decisions.

Acknowledgement

This article was first published in SportHealth (Volume 13 No 1), an official publication of the Australian Sports Medicine Federation Ltd. It is reprinted here with the kind permission of the author and of the editor of SportHealth, Dr Peter Brukner.

REFERENCES

1. *Haynes S., "Doping". ASDA Update. Canberra, 7 May 1991.*
2. *Haynes S., "Doping". ASDA Update. Canberra, 7 May 1991.*
3. *Merode A., in "La Vanguardia" (Barcelona, Spain), 3 November 1991.*
4. *Australian Sports Commission (ASC). "Doping Policy". Canberra. August 1990.*
5. *Merode A., in "La Vanguardia" (Barcelona, Spain), 3 November 1991.*
6. *Australian Sports Commission (ASC). "Doping Policy", Canberra. August 1990.*
7. *Nicholson A. et al. "Drug use in Sport. A study of the Knowledge and Attitudes of a Section of the Australian Sporting Community". ASDA, 1991.*
8. *Martin MB and Anshel MK. "Attitudes of elite Australian athletes towards drug Implications for effective drug prevention programmes". Department of Human Movement Science, University of Wollongong, Australia. 1990.*
9. *Frankle M and Leffers D. "Athletes on Anabolic-Androgenic Steroids". The Physician and Sportsmedicine. 20, 6: 75-87. (1992).*
10. *Martin MB, Anshel MK., op. cit.*
11. *Yessalis CE, Wright JE and Lombardo JA. "Anabolic-androgenic steroids: a Synthesis of existing data and recommendations for future research" Clinical Sports Medicine 1. 109-134 (1989).*
12. *Yessalis CE, Wright JE and Lombardo JA. op. cit.*
13. *Institute of Medical Ethics. "A Reappraisal". London, October 1987.*
14. *Australian Medical Association Policies 4/73, 68/90, 69/90.*
15. *Nicholson A. et al. Op. Cit.*
16. *World Medicine Association. International code of Ethics.*□

Reproduced by Sabinet Gateway under licence granted by the Publisher (dated 2012.)