

Doping in Sport: the Extent of the Problem

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1. INTRODUCTION

Descriptions of the use of substances to enhance athletic performance have been reported for at least two millennia. Early references to the use of doping agents in sport are anecdotal. Unfortunately, many of the contemporary reports are likewise anecdotal. Accurate data on the extent of drug misuse in sport are extremely difficult to acquire. There are many reasons for this, not least of which is the reluctance, by those who misuse drugs, to reveal details of their drug taking activities. It is possible to assess the extent of the problem of doping in sport by reviewing the information from three sources: (i) statistics on laboratory testing for doping control (ii) evaluation of surveys on drug misuse (iii) published research into drug misuse in sport.

2. STATISTICS ON LABORATORY TESTING

Statistical data from the International Olympic Committee (IOC) Accredited Laboratories are shown in Table 1. This covers the period 1986 to 1991.

Table 1
Positive test results from IOC laboratories 1986-1991 (Source: IOC Laboratory Statistics)

	1986	1987	1988	1989	1990	1991
Stimulants	177	299	420	508	340	221
Diuretics	2	9	57	45	37	47
Anabolic steroids	439	521	791	611	579	552
Narcotic analgesics	23	55	58	76	62	72
Beta blockers	31	32	8	6	8	10
Masking agents	n/a	24	19	10	6	1
Peptide hormones	n/a	n/a	n/a	n/a	1	1

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It is clear from these figures that stimulants and anabolic steroids have been the drugs with the highest levels of misuse in sport. The incidence of positive results for beta blockers tailed off over this period, whilst the results for narcotic analgesics are consistent. Around half of the positive results for narcotic analgesics were for codeine, a drug which is widely available over-the-counter (OTC) for self-medication. Such cases may not have constituted a deliberate attempt at performance enhancement. Indeed, in 1994 the IOC removed codeine, and similar OTC narcotic analgesics, from the list of banned substances. Tests for masking agents, notably probenecid, were introduced in 1987, since when the numbers of positive cases have diminished. Peptide hormones were banned from 1990. The low level of positive results is probably indicative of the difficulties associated with testing for these substances rather than a measure of the incidence of their misuse.

The percentage of positive tests results from the IOC-accredited laboratories, compared with the total number of samples tested, is around 2.0 to 2.5% per annum. How accurate these figures are as an indicator of the extent of drug misuse in sport is open to question. Unfortunately, IOC statistics on the positive test results have not been published since 1991. Looking at the statistics for the U.K. from 1991 (Table 2) a similar trend can be seen. The percentage of positive tests in the UK over this period is around 1.0 to 1.5% per annum.

Table 2

Summary of positive test results from the UK Sports Council testing programme 1991-1995

	1991/92	1992/93	1993/94	1994/95
Stimulants	16	17	11	30
Diuretics	1	1	0	2
Anabolic agents	21	20	20	23
Narcotic analgesics	11	7	5	4
Peptide hormones	0	0	2	0
Hallucinogens	2	2	2	10
Alcohol	0	0	1	0
Beta blockers	1	1	0	1

Source: Reports on the UK Sports Council Doping Control Service 1991-1995

Statistics from IOC-accredited laboratories simply record the number of positive tests for the identification of prohibited substances in the biological fluids from athletes. These statistics do not disclose:

- (i) The reason for that substance being present within the sample. Was it an attempt at performance enhancement? Was the substance present as a result of "social" or "recreational" use? Was the substance present as a result of self-medication for a legitimate therapeutic purpose?
- (ii) The fact that an athlete may have been taking a potential performance enhancing substance which is difficult to detect.
- (iii) Whether an athlete is a regular user of banned substances but was "clean" at the time of testing.

Clearly, the use of statistical data on the number of positive tests provides some indication on the extent of drug misuse in sport. However, as Benzi [1] has reported, "although the misuse of doping is debated throughout the world, about 86% of countries who participate in the Olympic Games are unable to perform domestic antidoping control. Further, in the countries provided with IOC accredited laboratories, the mean of the samples analysed each week per country is about 80, in spite of the fact that sports are practised by millions of athletes a week." These statistics may therefore represent the tip of the iceberg.

3. SURVEYS ON PREVALENCE OF DRUG MISUSE

Surveys on the prevalence of drug misuse have tended to concentrate on high school and college students in North America. Many studies relate to the period of the late nineteen eighties including that of Buckley *et al.* [2] who showed that in 150 high schools, 6.6% of male seniors used or had used anabolic steroids, of whom 35% were not involved in interscholastic sports. Other studies [3,4] have shown that between 5% and 11% of males in high school have used anabolic steroids at some time. Similarly, at collegiate level, Schuckit [5] reported that approximately 20% inter-collegiate athletes used anabolic steroids compared with around 1% in non-athletes. The use of steroids was, not surprisingly, particularly high in weight-lifters and body builders.

A more recent study [6], in the UK, has shown a rate of current or previous use of steroids in college students of 4.4% in males and 1% in females. The male users were more likely to be participating in body building, weight-lifting or rugby union. A major study by Melia *et al.* [7] who surveyed 16,000 young Canadians, showed that 2.8% of respondents were estimated to have used anabolic steroids in the year before the study. Significant numbers of respondents reported using other substances (caffeine, 27%; extra protein, 27%; alcohol, 8.6%; painkillers, 9%; stimulants, 3.1%; "doping methods", 2.3%; beta blockers, 1%) in attempts to improve sport performance. Tanner *et al.* [8], surveying adolescents in Denver, Colorado, showed a prevalence of steroid use of 4% in males and 1.3% in females. Prevalence of use by sport participants was only slightly higher than by non-sport participants.

Studies such as these are highly selective in their target population and in the scope of questions asked. It is difficult to draw firm conclusions on the extent of drug misuse in sport from such studies, particularly concerning the misuse of drugs, other than anabolic steroids, in sport in general.

4. REVIEW OF RESEARCH INTO DRUG MISUSE IN SPORT

The results in this section are taken from a study which was undertaken on behalf of the U.K. Sports Council [9]. The research brief was: (i) to conduct a full scale review to identify and categorise research which has taken place and is taking place nationally and internationally (ii) to provide an indication of where research deficiencies might exist with regard to the effects of drugs on sport performance, detection methods and the social aspects of doping in sport.

The study included two major components; (i) a review of the literature from which a database on all relevant publications relating to drug misuse in sport was created and (ii)

individual and focus group interviews with key personnel in sport, using semi-structured quantitative and qualitative questionnaires. Interviewees included sports administrators, coaches, elite athletes, medical practitioners and researchers.

From the results of the research it was possible to assess attitudes towards drug misuse in sport and to identify key centres for research. Conclusions and recommendations regarding future focus for research were then provided. In this paper, results on the literature review and analysis of the data recorded on the database are presented.

4.1. Methods

A literature search was conducted using on-line library searches, such as Medline, Sports Discus, BIDS and Biosis and other literature sources, as appropriate. Details on all relevant research papers were entered on a database, using Microsoft Access (v 2.0) under the field headings:

- title of the paper
- author(s)
- journal reference (title, volume, pages, year)
- country of origin of the paper
- subject area of research (drug effects, drug testing, social/ethical issues)
- sport involved (if appropriate)
- drug(s) involved
- type of paper (experimental, scientific review, non-scientific review, comment).

The subject areas of the research were defined as follows:

Drug effects: Papers concerned with the effects of drugs on exercise performance and the psychological/physiological health implications of drug use.

Drug testing: Papers concerned with the techniques for identifying and detecting drug use in urine, plasma or other body fluids.

Social/ethical issues: Papers concerned with the rules and regulations of drug use in sport. Also under this heading were papers concerned with the usage and prevalence of drug misuse in sport.

Where appropriate, research papers were categorised according to the sport(s) and/or drug(s) to which the papers related. Drug groups were, in general, categorised according to the IOC classification. Whilst the majority of papers related to one or more drug groups, relatively few referred to specific sports.

The type of research paper was defined as follows:

Experimental: Papers that scientifically assessed a problem associated with drug misuse in sport, normally through the generation of new data.

Scientific review: Papers in which there is a review of previously published scientific literature with the aim of improving the scientific understanding of a particular area of research.

Non-scientific review: Papers in which there is a review of previously published research without reference to scientific literature and that may include personal opinion.

Comments: Papers that include editorials or letters to the editor.

In general, publications related to sports medicine, non-human sports and food supplements were excluded from the database.

4.2. Key findings

The literature review identified 1831 publications from 1985 to 1995. A breakdown of the number of publications per year is shown in Table 3.

Table 3
Number of publications relating to drug misuse in sport per year, 1985-1995

1985	67	1989	174	1993	225
1986	62	1990	220	1994	224
1987	103	1991	224	1995	166
1988	142	1992	206		

The output of research has been consistent over the period, with an increase in activity after the Seoul Olympic Games of 1988. The number of publications for 1995 appears to be relatively low; this is explained by the lag period between the publication of research and its appearance in the on-line search databases.

The numbers of papers relating to drug misuse in sport categorised by subject area were: drug effects 941 (51.4%), drug testing 670 (36.6%) and social/ethical issues 220 (12.0%). Emphasis for research has been placed on the effects of drugs on performance and health. The correlation between the subject area and the output of papers per year (Table 4) was examined. Output of papers relating to drug effects and social/ethical issues has been consistent throughout the period whilst papers relating to drug testing have significantly increased in the more recent years.

Table 4
The relation between subject area and research output (1985-1995)

	1985 to 1990	1991 to 1995
Drug Testing	30.2%	69.8%
Drug Effects	48.4%	41.6%
Social/ethical Issues	53.4%	46.6%

Many research papers referred to specific drugs or groups of drugs. A breakdown of the number of papers relating to specific groups of drugs is shown in Table 5.

Table 5
Numbers of research publications relating to specific groups of drugs

Anabolic steroids	663	Diuretics	60
Stimulants	360	Non-banned (biological)	55
Drugs (general)	261	Non-banned (pharmaceutical)	49
Beta blockers	167	Alcohol	42
Narcotic analgesics	106	Anabolic agents	26
Peptide hormones	93	Blood doping	20
Drugs subject to restriction	69		

Some research papers were very selective for particular drug groups, others related to more than one group and some referred to drugs in general. The number of studies relating to anabolic steroids and stimulants reflects the statistics on the positive results associated with these groups of drugs (Table 1). The relation between these two major groups of drugs and the subject area of the publication is shown in Table 6.

Table 6
The relation between subject area and papers concerning anabolic steroids and stimulants

	Anabolic Steroids	Stimulants
Drug Testing	23.3%	47.1%
Drug Effects	57.9%	50.4%
Social/ethical Issues	18.8%	2.5%

Over half the published papers on both stimulants and anabolic steroids were concerned with the performance and health effects of the drugs. A high percentage of papers focusing on stimulants were concerned with testing. Social/ethical issues have been reported for anabolic steroids to a far higher degree than for stimulants.

Analysis of the specific sport to which papers were related showed that 38.7% did not mention a specific sport at all and 43.2% referred to sport in general. Only 18.1% of papers described research related to a specific sport. Of these, just over a half (52.1%) related to power events and around a quarter (23.5%) related to athletics. Clearly, little of the research into drug misuse in sport is based on specific sports.

The final category under which papers were categorised was the type of publication (Table 7). This categorisation may be used as an indicator of quality of research.

Table 7
Categorisation of research papers by type of publication

Experimental	71.8%
Scientific Review	17.3%
Non-scientific Review	4.3%
Comments	6.6%

The relation between this categorisation of publication and the subject area of the research is shown in Table 8. It is evident that the majority of papers relating to drug effects and especially drug testing are experimental in nature whilst the majority of papers on social and ethical issues are the subject of non-experimental review and comment.

Table 8

The relation between this categorisation of publication and the subject area of the research

	Drug effects	Drug testing	Social/ethical
Experimental	60.0%	78.9%	23.9%
Scientific Review	27.3%	10.9%	9.1%
Non-scientific Review	2.8%	2.3%	26.3%
Comments	9.9%	7.9%	40.7%

4.3 Discussion

There has been a significant output of published research into drug misuse in sport, which was stimulated by events, in Seoul, in 1988. The emphasis for this research has been in the area of drug effects on performance and health, although, in recent years, research into drug testing has increased significantly. There has been relatively little published research into social/ethical issues, although this may be perceived as a key area for study.

Anabolic steroids and stimulants have been the principle drug groups into which research has been targeted. This reflects their pre-eminence as drugs of choice for misusers. Of these two classes of drugs, research into anabolic steroids has concentrated on drug effects. Under this heading, the bulk of the research for anabolic steroids has been concerned with their physiological and psychological effects on health. There is a deficiency in research into the effects of anabolic steroids on performance, probably due to the problems of obtaining ethical approval for such research. Research into drug testing and the social/ethical issues surrounding the use of anabolic steroids has not been neglected. On the other hand, research into stimulants has concentrated on performance and testing with little emphasis on social/ethical issues. The effects of caffeine on metabolism and exercise performance have been studied extensively. The lack of research into social/ethical issues of stimulant use may change in the future with the increase in the use of drugs within this class in a "recreational" context. This pattern of use may have a significant impact on sport. Likewise there is limited research into the effects on performance of stimulant drugs commonly found in "over-the-counter" medicines. Research into beta blockers, which peaked around 1988-1991, and diuretics, which peaked around 1990-1991, is decreasing. This output of research into these two groups of drugs correlates well with the decrease in the incidence of their use (Table 1). It is interesting to note that most of the published research on beta blockers is concerned with their effect on dynamic exercise performance, not on their use as anxiolytic agents.

For the future, research into peptide hormones, including growth hormone, erythropoietin and human chorionic gonadotrophin, must increase as their use in sport increases. The GH2000 research project was established during 1996, to develop a detection method for human growth hormone before the Olympic Games in the year 2000. The project aims are i) to define limits of acceptable physiological ranges of growth hormone in general and in elite athletes; ii) to perform controlled studies in the administration of growth hormone and iii) to produce criteria for the detection of growth hormone administration.

To date, there is little published research into the impact of education on drug misuse. This is another key area for which good quality research is needed. The quality of research output is, in general, of a high standard, particularly in the area of drug testing. A more scientific approach to research on social/ethical issues may be required in order to provide a deeper insight into this increasingly important aspect of drug misuse in sport.

5. OVERALL CONCLUSION

With our current level of knowledge and understanding it is impossible to gauge the true extent of drug misuse in sport. Analysis of published work provides some insight into the problem but still leaves the issue open to speculation. Whilst testing remains an important tool in the control, deterrence and monitoring of drug misuse in sport, we need to achieve a much deeper understanding of the motivating factors surrounding drug misuse both in sport and in the wider social context. This can only be achieved through high quality research.

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Discussion: Doping in Sport: the Extent of the Problem

J.B. Leiper:

In your research brief, how did you define misuse of a drug?

D.R. Mottram:

Very broadly. We looked at any papers in which there was a connection between drugs and sport. That is, we considered drugs even if they were not clearly and unequivocally shown to be involved as misuse. Having done that, we eliminated those papers that dealt with exercise in normal individuals and had very little to do with the sporting context.

J.B. Leiper:

But did you cover items such as aspirin?

D.R. Mottram:

We looked at papers where aspirin was mentioned, but again, because these are drugs which are not banned, we did not include them in the study unless we felt there was some specific reason, maybe if it was to do with a testing procedure or something like that which had been shown to be important in a sporting context. But in general, no. We included drugs that were not specifically IOC prohibited substances only if they did have an interest within a sporting context.

J.P. Clarys:

In one of your slides I understood that there is a serious decrease over the years of the use of beta-blockers. Is there an explanation for that?

D.R. Mottram:

It is difficult to say. These drugs are only of importance in certain sports. It is quite interesting that the papers concerned with beta-blockers were mainly to do with their effects on performance and how their side effects might lead to deterioration in performance. There was very little published in the way of their anxiolytic effect, which is often the reason why beta-blockers are actually taken by performers for calming themselves down. In 1988-1989 there were many papers on beta-blockers in sports like snooker and shooting events but I do not have an answer to your question specifically as to why there is a decrease in the numbers of papers published.

A.J.M. Wagenmakers:

When I read the reviews on ergogenic aids, then I can hardly find reviews without a personal comment or personal interpretation of the literature. So I am curious to know which criteria you have used to qualify a paper as a scientific or as nonscientific review. The figure you came up with that 95% of the published reviews can be qualified as scientific reviews seems very high to me.

D.R. Mottram:

It is very difficult to go through the criteria that we adopted on this. Obviously each paper was open to interpretation and you have to assess it on your general view as to whether you put it in one category or another. Maybe our way of categorising them is more strict, or alternatively a more relaxed method than that you might have adopted.

T.D. Fahey:

I think that most studies on anabolic steroid use in high school athletes do not reflect the true use in elite athletes, and I do not know if we are ever going to uncover the true patterns. In the 1970s, when I was an active athlete, the use of anabolic steroids was almost universal in elite athletes. Now, as a coach, I do not think things have changed that much. It has become more covert. Athletes typically take the drugs until it is time to be tested and, very often, the athletes who are detected are the unfortunate ones who are picked up by random drug tests.

D.R. Mottram:

I concur entirely with the statement you have made. The problem is that these drugs are being used so widely now in a non-sporting context and, therefore, we are perhaps missing some of the more important issues with regards to the misuse of these drugs in sport. It not only applies to anabolic steroids but, I think, to a lot of the other drugs which are readily available, especially these days in terms of drugs such as the amphetamines, for example ecstasy and cocaine which are widely used. It is much larger issue, I think, in society than just with regard to sport. It worries me now that drugs are becoming such a norm within society that kids will come through into the sporting arena thinking that drug-taking is the natural thing to do, that there is nothing wrong with it.

J.B. Leiper:

There is a lot of time, effort and money being spent on identifying athletes who are taking drugs, on the understanding that they are cheating. Should we perhaps rid ourselves of the idea of cheating and instead legalise the use of performance enhancing drugs. We could then let athletes perform the best they can with whatever drugs they wish to use, forget about the ethical position, and concentrate more on the health issues and the prevention of illness caused by the use of drugs.

D.R. Mottram:

This is a very important issue and it is often debated. It is difficult to answer that sort of question. Ethics is an important aspect to this whole thing and when you talk to athletes themselves, the majority of them are very hawkish about the issue of drug misuse in sport. They would rather see life bans for the first offence in many instances, whereas the administrators have a much more relaxed attitude, should we say, because they have to deal with the litigation side of the consequences of drug misuse in sport. So, certainly the competitors themselves would like to see drug misuse in sport abolished, at least the majority of them.