Performance Profiling: A Role for Sport Science in the Fight Against Doping?

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In recent years, antidoping strategies underwent a significant development, from purely biochemical analyses and the detection of substances in urine samples to a biological approach, using blood samples, longitudinal monitoring, and probabilistic techniques. Nowadays, the appropriate timing of testing and the targeting of the athletes to be tested with antidoping tests is a major issue. A new strategy to improve the targeting of suspicious athletes might be the longitudinal monitoring of individual performances. By these means, suspect athletes might be identified, as doping will not only alter their blood or steroid profiles, but ultimately boost their performance, as well. Through the proposed approach, the effectiveness in the fight against doping might be improved considerably.

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Despite all efforts, doping remains a major problem in sports. The fight against doping has evolved considerably over the years. In the 1960s, the first antidoping tests were urine tests that screened for certain classes of substances abused during competition. Two decades later, the abuse of anabolic steroids during training periods in certain sports stimulated the introduction of out-of-competition urine tests. Subsequently, the development of recombinant doping substances, such as recombinant erythropoietin (EPO), that are difficult to detect in urine led to the examination of blood as an additional matrix for antidoping purposes. Blood tests are mainly used as a tool to screen for suspicious athletes through longitudinal profiling or as so-called health tests, which exclude athletes from competition if they exceed limits in certain variables, such as hematocrit or hemoglobin concentration.1,2

Through these measures, antidoping has made a significant step forward, from the purely biochemical detection of forbidden substances to a more biological, probabilistic approach.

Because resources are limited, another major issue in the successful fight against doping is not only the timing of the testing and the choice of the appropriate testing method or matrix, but also the selection of the athletes to be tested (“intelligent testing”). Blood tests or steroid profiles are currently used to detect athletes who are attempting to evade doping regulations.

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Figure 1 — Male 5000-m (top) and 10,000-m (bottom) season’s best performances (-□-) and the average of the 20 best performances (○-) for each year from 1975 to 2000. The arrow indicates the commercial introduction of recombinant erythropoietin (EPO; adapted from Berthelot et al4).
Figure 2 — Female discus throw season’s best performances (-□-) and the average of the 20 best performances (-○-) for each year from 1960 to 2000. The arrow indicates the introduction of out-of-competition doping tests (adapted from Berthelot et al).
However, a major source of information has not been used to the present time. In fact, the influence of doping could substantially alter both the doper’s blood values or steroid profile, and the performance in the event he or she is competing in. Because many of the sporting disciplines that are highly affected by doping are held as timed or measured events (eg, track and field, swimming, and certain cycling disciplines), the effect of doping might be identified through the development of benchmark rates of progression in the evolution of performances of an athlete or athletes. As an example, data from the former East German doping protocols clearly demonstrate that a significant effect of doping can be identified and quantified in athletes through the monitoring of their performance (see Franke and Berendonk for details). From a more general perspective, it appears that middle- and long-distance running seasons’ best performances have markedly improved after 1990 (Figure 1a, Figure 1b). Interestingly, EPO became commercially available in most countries in 1989. This sudden improvement in performance in the 1990s can be observed in most other endurance sport disciplines as well, and, although a direct proof of doping as a cause for this surprising development is a subject for speculation, the coincidence of these performances and the market introduction of EPO remains striking. In the same context, most strength-oriented sports faced massively increased performances from the mid-1960s onward. Remarkably, the opposite pattern (decrease of performances) was visible after the introduction of regular out-of-competition controls in 1988, probably reducing the abuse of anabolic steroids in these disciplines (Figure 2).

A new approach could involve monitoring the rate of improvements in competition performance of an athlete from an early age, in combination with monitoring of blood values or steroid profiles once an appropriate level of competition is reached. Although sudden increases of performance can be induced by many reasons other than doping (improved training strategies, nutrition, growth in young athletes, etc), such observations are nevertheless worthwhile to trigger target testing of the athlete. In connection with data from blood and/or urine profiling, such “performance profiling” might improve the identification of suspicious athletes’ behaviors. In a similar context, mathematical analyses of winning patterns of gamblers are used with success to identify cheaters in casinos.

In times of ever more innovative dopers, the fight against them should expand its boundaries once again and extend the pure biochemical/biological horizon to a more global framework, considering all available information. The analysis of readily available competition performance data and race results could be an important step in this direction. Hopefully, scientific studies will provide practicable algorithms for this approach in the near future.

References

