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## **New research supports ‘biological passport’ for growth hormone doping in sport**

A new study showing that biomarkers of growth hormone doping are not subject to the same natural fluctuations as growth hormone itself could help sporting authorities worldwide to catch athletes that use it illegally to boost their performance. The study is published in the journal *Clinical Endocrinology*. Led by Professor Richard Holt from the University of Southampton, UK, the study’s findings show that growth hormone testing might be viable for inclusion in the “*athlete biological passport*”, which logs an athlete’s blood test results over the athletic season.

Building on their previous work in this area, the researchers in this Anglo-Italian study compared data from four separate studies that measured blood serum levels of insulin-like growth factor-1 (IGF-1) and type III procollagen (P-III-P) in 303 elite and 78 amateur athletes at intervals across the athletic season. IGF-1 and P-III-P have been identified by the GH-2000 and GH-2004 studies<sup>(1)</sup> as good biomarkers of growth hormone doping, as the blood levels of these substances change significantly when growth hormone is injected, but not after exercise. They found that whilst the levels of IGF-1 and P-III-P and the ‘GH-2000 score’ (calculated from the levels of IGF-1 and P-III-P) varied dramatically between athletes (inter-individual variability of IGF-1: 44-71%; P-III-P: 31-58%; GH-2000 scores: over 3 units), these values differed relatively little in a single individual across the season (intra-individual variability of IGF-1: 14-16%; P-III-P: 7-18%; mean intra-individual variability of GH-2000 scores: under 0.6 units in all studies).

These results are the first to prove that the ‘within-athlete’ (i.e. intra-individual) levels of the growth hormone-dependent biomarkers IGF-1 and P-III-P remain relatively constant over the athletic season. The GH-2000 test may therefore be a useful addition to the “*athlete biological passport*” which was introduced by the World Anti-Doping Agency to detect certain other illegal substances<sup>(2)</sup>. The results presented here show that a significant deviation from an individual athlete’s normal GH-2000 score would indicate doping. Further research now needs to establish a concrete method of calculating an ‘abuse’ GH-2000 score from an individual athlete’s normal GH-2000 score.

Growth hormone is a naturally occurring hormone that acts to build muscle mass and improve exercise capacity. Its levels in the blood vary widely with exercise, and it is broken down very quickly in the body. An effective test for growth hormone abuse that will stand up to legal challenge must therefore ensure that a ‘false-positive’ result is not achieved through

normal fluctuations of the hormone in the body, and that doping with growth hormone can be detected even after the injected growth hormone has left the body.

**Lead researcher, Professor Richard Holt of the Developmental Origins of Health and Disease Division, the University of Southampton's School of Medicine said:**

*"Blood levels of growth hormone vary a great deal over time, and it disappears from the blood very quickly. This means that it is difficult to test athletes directly for growth hormone abuse by measuring growth hormone.*

*"Our results show that the levels of the growth hormone-dependent biomarkers IGF-I and P-III-P within any individual remain relatively constant over time regardless of whether that person is an amateur or professional athlete. This means that they might be logged into an individual "athlete biological passport" to establish an individual's normal GH-2000 score, against which future test results can be compared. The principle of the athlete biological passport is that the athlete is his or her own benchmark, which increases the specificity of the test and helps us to catch more cheaters."*

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Notes for editors:

This paper appears in the April edition of *Clinical Endocrinology*, **72**, 520–526 DOI: [10.1111/j.1365-2265.2009.03668.x](https://doi.org/10.1111/j.1365-2265.2009.03668.x). It is available to download [here](#). *Clinical Endocrinology* is the official clinical journal of the Society for Endocrinology. Visit *Clinical Endocrinology* online [here](#).

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References:

<sup>1</sup> Sönksen, P *et al.* (1999), *GH-2000 Final Report*. ([www.gh2004.soton.ac.uk/GH-2000%20Final%20Report.pdf](http://www.gh2004.soton.ac.uk/GH-2000%20Final%20Report.pdf))

<sup>2</sup> Athlete biological passport page of World Anti-Doping Agency website - <http://www.wada-ama.org/en/Science-Medicine/Athlete-Biological-Passport/>

**ABSTRACT**

**The use of growth hormone (GH)-dependent markers in the detection of GH abuse in sport: Physiological intra-individual variation of IGF-I, type 3 pro-collagen (P-III-P) and the GH-2000 detection score**

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**Background** Growth Hormone is abused by athletes for its lipolytic and anabolic properties. Its use is prohibited by the World Anti-Doping Agency. The GH-2000 project developed a methodology to detect its abuse using the concentrations of two GH-dependent biomarkers, IGF-I and type 3 procollagen (P-III-P). The sensitivity of this method may be improved by considering intra-individual variability.

**Aim** The aim of this study was to examine the intra-individual variability of IGF-I, P-III-P and the GH-2000 score.

**Subjects and methods** IGF-I, P-III-P and GH-2000 score were evaluated in four longitudinal studies involving 303 elite and 78 amateur athletes. Samples were collected over a period of up to 12 months from a total of 238 men and 143 women aged between 17 and 53 years (mean 24.2).

**Results** The four studies showed good agreement with no apparent difference in within-individual variation between amateur and elite athletes. The intra-individual variability for IGF-I ranged between 14–16% while the variability for P-III-P was 7–18%. No athlete tested positive for growth hormone during any of the studies. The overall mean intra-individual variability of the GH-2000 score was less than 0.6 units in all studies.

**Conclusions** The high stability of marker levels suggests that concentrations are largely genetically determined. Adopting a test based on the concept of an athlete's 'passport' or 'profiling' would take advantage of this and most likely increase the sensitivity of the test. These data also provide strong evidence that a positive test result for GH abuse would not occur as a result of chance variability.