

# Bibliometric and social network analysis on the abuse of anabolic steroids in athletes

Rafael Aleixandre Agulló<sup>1</sup> Francisco Bueno Cañigral<sup>2</sup> Juan Carlos Valderrama Zurián<sup>3</sup> David Melero Fuentes<sup>4</sup>  
Rafael Aleixandre Benavent<sup>5</sup>

<sup>1</sup>*averafa4@hotmail.com*

Instituto de Documentación y Tecnologías de la Información. Universidad Católica de Valencia “San Vicente Mártir” Av. Guillem de Castro, 106. CP 46006 Valencia. Spain

<sup>2</sup>*fjbueno@valencia.es*

Plan Municipal de Drogodependencias. Ayuntamiento de Valencia. Spain

<sup>3</sup>*juan.valderrama@seap.minhap.es*

Departamento de Historia de la Ciencia y Documentación. Universidad de Valencia. Av. Blasco Ibáñez, 15. CP 46010 Valencia. Spain

<sup>4</sup>*davidmf@mail.ucv.es*

Departamento de Ciencias de la Educación. Universidad Católica de Valencia “San Vicente Mártir”. Av. Guillem de Castro, 106. CP 46006 Valencia. Spain

<sup>5</sup>*rafael.aleixandre@uv.es*

Ingenio (CSIC-UPV) UISYS-Universidad de Valencia. Plaza Cisneros, 4. 46004 Valencia. Spain

## Introduction

Anabolic steroids are substances synthesized in laboratories that mimic the effects of testosterone, producing androgenic actions (National Institute on Drug Abuse, 2007). Its use in sports activities aims to increase muscle mass, physical strength and resistance to fatigue to improve athletic performance (Laure and Bisinger, 2005). Its use is a serious problem of public health, which requires handling all the information necessary to know the state of research in this field. The aim of this work is to identify bibliometric characteristics and the network of international scientific collaboration on the abuse of anabolic steroids in athletes.

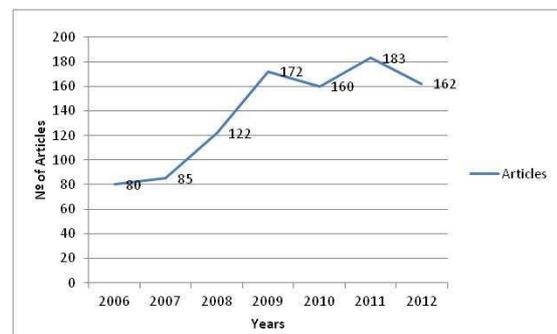
## Method

1,011 original articles published in the 2006-2012 period in Web of Science combining 36 terms related to physical activity and 61 terms related to steroid use in different sports were retrieved.

## Results and discussion

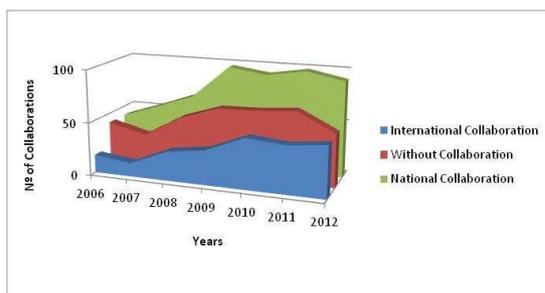
The number of published articles has grown over the analysed period (Figure 1). 2,436 authors from 771 institutions and 49 countries published the 1,011 articles. By applying a threshold of 3 coauthored articles, 24 groups were identified. The core of the main group of 30 authors is composed of authors affiliated with the Center for Preventive Doping Research Institute of Biochemistry from German Sport University de Colonia. National and international collaboration has increased, while

domestic collaboration has decreased in recent years (figure 2). The network of collaboration between countries shows higher degrees of collaboration between Germany and Switzerland (n=59), followed by Italy and Spain (n=33), France and Switzerland (n=26) and Australia and Germany (n=21) (figure 3).

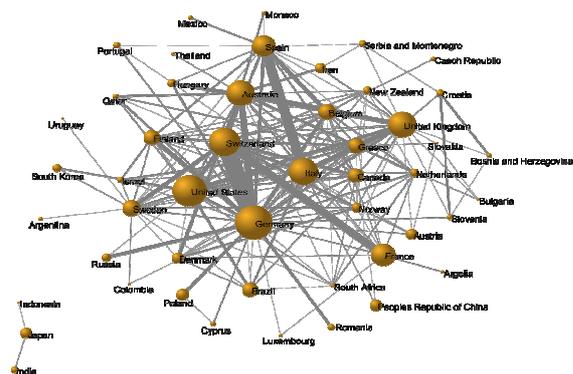


**Figure 1. Annual evolution of published articles**

Table 1 shows most productive subject areas with most used key words and journals with most published articles. The first place is for Sports Science, with 245 articles and the keywords: doping (n=65), sport (n=17) and athletes (n=14). The journals with most published articles were *International Journal of Sports Medicine* (n=35), *British Journal of Sports Medicine* (n=27) and *Scandinavian Journal Medicine & Science in Sports* (n=20).



**Figure 2. Papers published in collaboration**



**Figure 3. Network of collaboration between countries**

The second place is for Analytical Chemistry with 175 articles and the following key words: doping (n=44), urine (n=26) and doping control (n=21). The most important journal in this area were the same that in the previous. Other important subject areas were Biochemical Research Methods, Endocrinology and Metabolism, Pharmacy and Pharmacology.

### Conclusions

The number of published articles and international collaboration has increased. The largest number of collaborations has taken place between institutions

from Germany, USA, Switzerland, UK, Italy and Spain. These countries have also the highest number of published papers and citations. Most productive journals belong to subject categories related with Sport Sciences, Chemistry, Endocrinology and Pharmacology.

### Acknowledgments

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**Table 1. Subject categories, most frequent key words and most productive journals**

Thematic area	Articles	Keywords	Articles	Journals	Articles
Sport Sciences	245	Doping	65	INTERNATIONAL JOURNAL OF SPORTS MEDICINE	35
		Sport	17	BRITISH JOURNAL OF SPORTS MEDICINE	27
		Athletes	14	SCANDINAVIAN JOURNAL OF MEDICINE & SCIENCE IN SPORTS	20
Chemistry, Analytical	175	Doping	44	INTERNATIONAL JOURNAL OF SPORTS MEDICINE	35
		Urine	26	BRITISH JOURNAL OF SPORTS MEDICINE	27
		doping control	21	SCANDINAVIAN JOURNAL OF MEDICINE & SCIENCE IN SPORTS	20
Biochemical Research Methods	141	Doping	30	ANALYTICAL AND BIOANALYTICAL CHEMISTRY	36
		doping control	19	JOURNAL OF CHROMATOGRAPHY A	31
		mass spectrometry	16	RAPID COMMUNICATIONS IN MASS SPECTROMETRY	19
Endocrinology & Metabolism	109	Doping	29	STEROIDS	32
		growth hormone	13	GROWTH HORMONE & IGF RESEARCH	21
		Testosterone	11	GROWTH HORMONE & IGF RESEARCH	21
Pharmacy	89	Doping	25	DRUG TESTING AND ANALYSIS	88
		doping control	17	ARCHIV DER PHARMAZIE	1
		Sport	9	BIOMEDICAL CHROMATOGRAPHY	8
Pharmacology & Pharmacy	66	Doping	19	JOURNAL OF PHARMACEUTICAL AND BIOMEDICAL ANALYSIS	20
		Anabolic steroids	10	BIOMEDICAL CHROMATOGRAPHY	8
		Urine	9	DRUG METABOLISM AND DISPOSITION	4