



# Scientific Research Report

Overview of Scientific Research funded by the World  
Anti-Doping Agency and Partnership for Clean  
Competition in the last 20 years

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## 1. Introduction

This report, an outcome of the [iNADO Capability Register 2018-2020](#), responds to a specific area of the Register - the high number of NADOs who, at least one topic of research, currently engage (47%) or intend to (42%)<sup>1</sup>.

In this report, we hope to draw a clear picture of the evolution of research through time, identify trends in current research and provide hints to members on future developments, potential collaboration partners and opportunities to fund their research to support the research initiatives of members.

iNADO would like to thank Nelson Morales Páez, freshly graduated from a multidisciplinary program delivered by six European Universities with a Master of Arts in Sports Ethics and Integrity, for his valuable contribution to the report in all its stages.

This report is divided into four sections corresponding to the main findings:

- a) The historical evolution of funding for research projects by the World Anti-Doping Agency (WADA) and Partnership for Clean Competition (PCC).
- b) The distribution of financial resources for scientific research on doping by region and country.
- c) The main thematic areas investigated in the last 20 years.
- d) The type of organizations involved and the most prominent institutions in doping research.

Scientific research has accompanied the anti-doping fight since its beginnings. Since the International Olympic Committee (IOC) established the Medical Commission to examine doping in 1962, science has been a fundamental part of the advances in controlling the use of performance-enhancing substances and methods. The contributions of the scientific community have:

- Helped to develop and implement tests for the detection of banned substances and methods.
- Provided the scientific basis for the elaboration of the list of prohibited substances and methods from 2004.
- Incorporated new technologies into anti-doping practices.

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<sup>1</sup> Source: iNADO Capability Register 2018-2020: Answers provided by 53 members: 44 NADOs and 9 RADOs.

- Recently brought new perspectives on anti-doping from the social sciences, which are very useful for understanding factors that influence doping and underpin the development of education and prevention programs.

This report, in addition to highlighting the importance of scientific research for Anti-Doping Organizations, seeks to give an overview of the evolution of doping research since 2001 when the World Anti-doping Agency (WADA) started to implement the Agency's scientific research grants. To date, WADA reports having invested approximately \$83 million in research grants over the past 20 years. Next to WADA, the second organization that has played a visible role in the funding of scientific research in anti-doping is the Partnership for Clean Competition (PCC), which has funded projects to the tune of \$29 million since 2008.

In order to follow this evolution, we have compiled the research projects funded by WADA and PCC into a database. Although we recognize that the universe of scientific research in the anti-doping field is broader, the mapping of the work done by these two organizations is a good sample of the current situation and gives an idea of the destination of the funds devoted to scientific research in anti-doping. While WADA awarded 584 research grants between 2001 and 2020, PCC reported 206, for a total of 790 research studies analyzed in this report.

In this process of diagnosing the current state of scientific research, interesting findings have emerged:

- The progressive increase of funded projects in the last few years. From 2001 to 2010, 307 projects were funded by WADA and PCC. Between 2011 and 2020 that number increased significantly by 55%, to 476. PCC has reported 7 funded research projects so far in 2021.
- Research funding is mainly concentrated in organizations based in Europe, North America, and Oceania. More than 80% of the research funded was carried out in these regions.
- Although the funds have been diversified to various research areas, most of the resources are allocated to research on new testing mechanisms and improving the existing ones. In particular projects for the detection of anabolic agents, peptide hormones and growth factors.
- Universities and academic institutions conduct a large proportion of the projects funded. Almost 70% of the total.

But let's take a closer look at the numbers in detail.

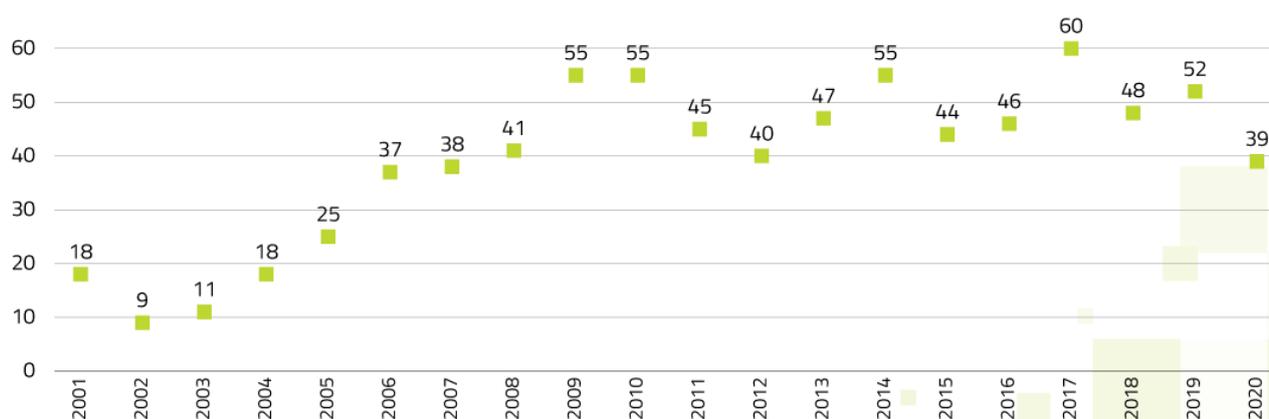
## 2. Evolution of Scientific Research on Doping

The earliest scientific research in anti-doping dates back to 1910, as a result of concerns about the use of performance-enhancing drugs in racehorses. Alfons Bukowski is considered as the pioneer of anti-doping research, who developed a method for detecting alkaloids in horse saliva<sup>2</sup>. While it is true that the initial research initiatives preceded the establishment of the first known anti-doping body, the IOC Medical Commission in 1961, it was not until 2001 that a systematic funding program was created to promote anti-doping research.

These early years were characterized by research of a technoscientific nature and aimed at developing and improving detection methods, especially for anabolic agents and peptide substances. In 2008 the Partnership for Clean Competition (PCC) was founded, a non-profit organization whose purpose is to protect the integrity of sport and public health by supporting top scientists and innovators in high-quality anti-doping research and development. Together with WADA, they are the two main funders of anti-doping research with a global reach.

From 2001 to the present day, the number of research projects supported by these organizations has increased progressively to more than 40 funded research projects per year, except in 2020 when the number of funded initiatives decreased to 39. It seems that the effects of the pandemic may have also impacted on doping research.

Research Projects Funded by WADA and PCC 2001-2020

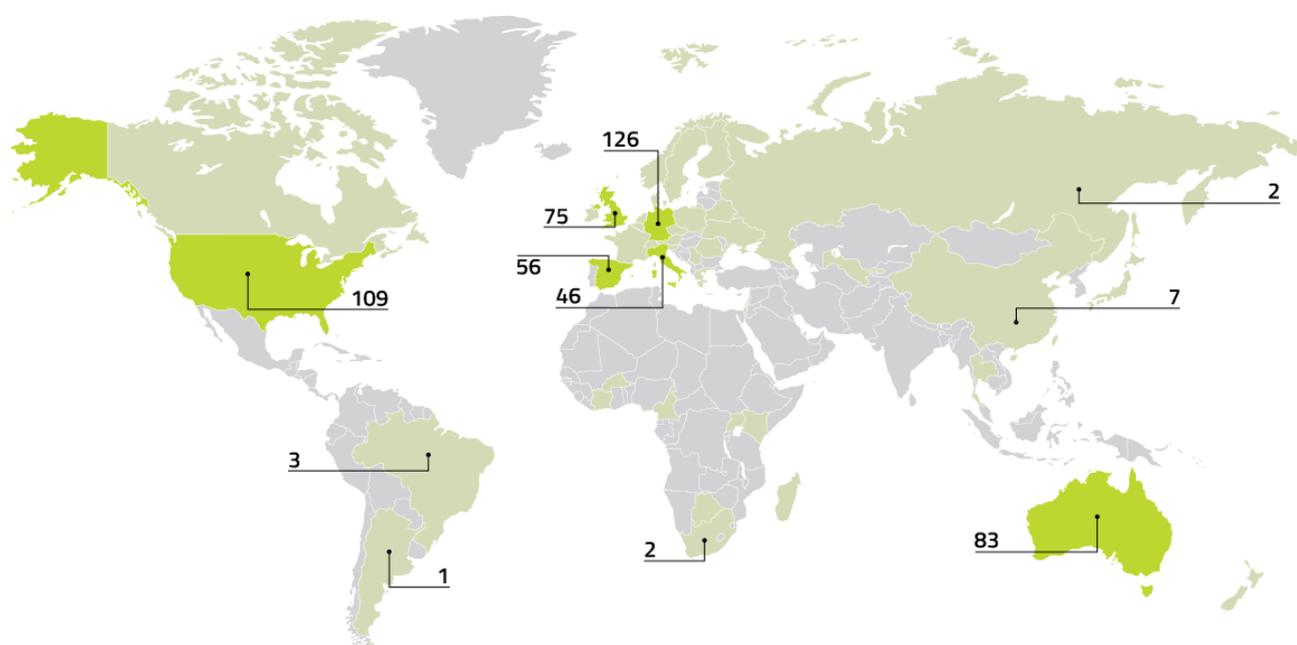


<sup>2</sup> Andrén-Sandberg, A. (2016). *The History of Doping and Anti-Doping*.

### 3. Funded Research Projects per Region and Country

The second notable finding is the evident concentration of resources for research projects developed in organizations located in Europe, North America, and Oceania. 82.65% of the projects were developed in these three regions and 56.83% in the top countries on the list, namely: Germany, the United States, Australia, United Kingdom and Spain.

**Research Projects Funded by WADA and PCC by Countries**



Country of the main funded organization	Number of research projects	%
Europe	526	66.58%
North America	141	17.85%
Oceania	86	10.89%
Asia	22	2.78%
Africa	11	1.39%
South America, Central America, and the Caribbean	4	0.51%
<b>TOTAL</b>	<b>790</b>	<b>100%</b>

Table 1: Research projects per region

## 4. Funded Research Projects per Research Area

When analyzing the research projects funded by WADA and PCC over the last 20 years, three main thematic groups can be identified:

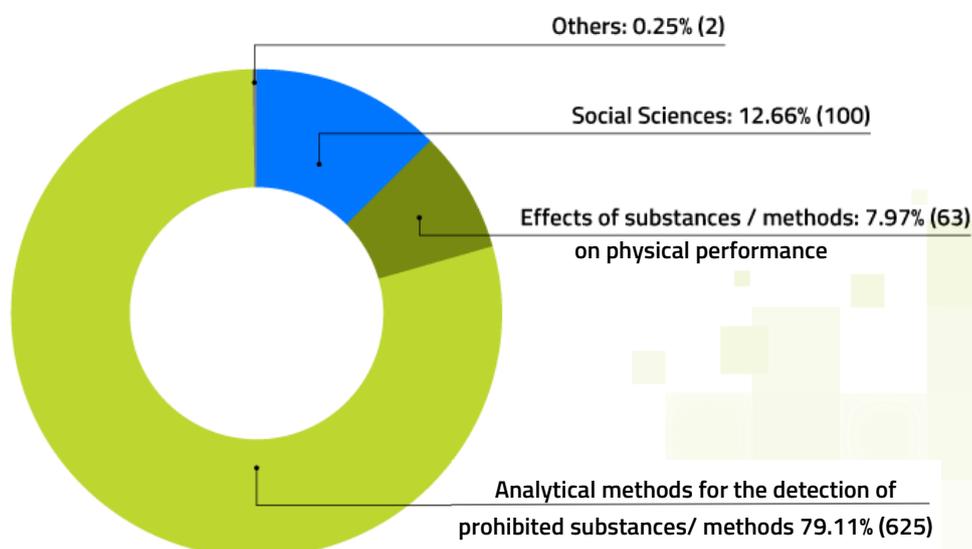
1. Analytical methods for the detection of prohibited substances/ methods
2. Effects of substances and methods on physical performance
3. Social sciences.

**Nearly 80% of the research analyzed is related to the development and implementation of new methods for the detection of prohibited substances and methods, as well as the improvement of existing techniques.**

Social sciences, second field of research but far behind, got its first impetus in 2005 when WADA implemented the Social Science Research Grant Program to ensure that preventive anti-doping education programs were designed using an evidence-based approach. A social science perspective allows an approach to the anti-doping issue from a lens that is oriented towards human behaviors.

Research on the effect of substances and methods on physical performance accounted for 8% of the universe of research analyzed. These projects were oriented to analyze the enhancing effect of substances and methods in- and out- of competition, regardless of their classification by WADA: prohibited, monitored or permitted. It is notable that despite the constant debates on the inclusion and exclusion of substances and methods on the prohibited list, research on the effect of these methods and substances does not exceed 10%.

**Number of Research Projects Funded: 790**



If we contrast these results with the answers given by the NADOs and RADOs in the iNADO Capability Register, we note that 47%<sup>3</sup> of the respondents report to be developing research in social sciences. An additional 37% of respondents said that they intend to expand their social science research in the future. The expanding WADA program and the recent inclusion of social sciences in PCC research priorities may represent an opportunity for NADOs to access the necessary funding.

Areas of research	Currently conducting (%)	Would like to conduct in the future (%)	Not planning to conduct in the future (%)
Social Science	47	37	12
Drug Detection	40	29	26
Policies & Procedures	40	33	23
Supplements / Food Medications	30	42	23
AI & IT Innovations	26	38	31
WADA Monitored Substances	17	41	37
Physiological / Clinical Effects	15	32	49

Table 2: Capability Register Table 5.1: Top seven research fields in which scientifically active ADOs are doing research

Considering that 37%<sup>3</sup> of the members who responded to the iNADO Capability Register survey expressed their willingness to conduct research on monitored substances in the future<sup>4</sup>, and that only 17% of them are currently conducting such research, it may be also pertinent for WADA and PCC as well as other organizations to dedicate a larger share of their funding to research on these topics. The inclusion or exclusion of these substances and methods on the prohibited list based on scientific criteria does not seem to be a settled issue for many stakeholders in sport. This is the case of tramadol, a substance banned in competition by L'Union Cycliste Internationale, but only included in the monitoring program of WADA<sup>5</sup>. Scientific research can contribute to clarify these ethical debates based on evidence demonstrating the effect of these substances and methods on sport performance.

The three sections below provide more details on these three areas of research:

<sup>3</sup> Source: iNADO Capability Register 2018-2020: Answers provided by 53 members: 44 NADOs and 9 RADOs

<sup>4</sup> Watch iNADO webinar from 27 July 2021: *Best Practices in Social and Scientific Research with Guest Speakers from PCC and UKAD*: <https://www.gotostage.com/channel/29f37e17800c461f81c149b9a47d550f/recording/4d52bd628d394bc7adba84beaafe29ab/watch>

<sup>5</sup> Holgado, D., Zandonai, T., & Sanabria, D. (2019). Comment on “review of WADA prohibited substances: limited evidence for performance-enhancing effects”. *Sports Medicine*, 49(7), 1135-1136.

#### 4.1 Funded Research on Analytical Methods for the Detection of Prohibited Substances/ Methods

The WADA and PCC funding programs have mainly benefited those projects researching the detection of two types of substances: on the one hand anabolic agents (e.g., testosterone) and on the other hand pethidine hormones and growth factors (e.g., EPO). Almost two thirds of the funded projects focused on these two categories.

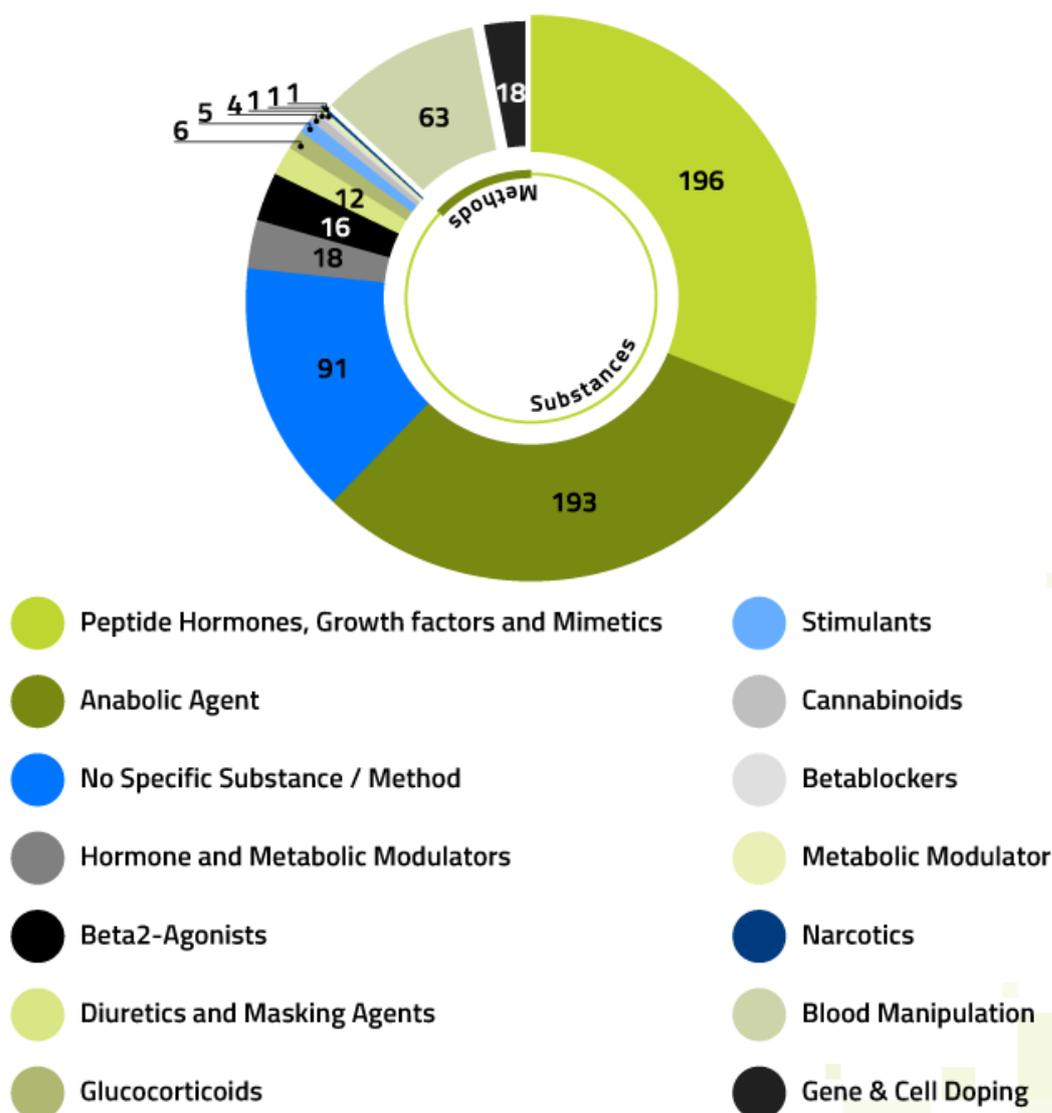
There are other categories of substances, some of which have been used as complements to growth hormones and steroids but have not received sufficient attention from the scientific community and funding organizations, such as metabolic modulators, diuretics, masking agents, Beta-2-agonists, among others. All these substances combined account for barely more than 10% of the research funded by WADA and PCC.

Research Projects	Number of funded research projects	%
<b>Substances</b>	<b>544</b>	<b>87.04%</b>
Peptide Hormones, Growth factors and Mimetics	196	31.36%
Anabolic Agent	193	30.88%
No Specific Substance / Method	91	14.56%
Hormone and Metabolic Modulators	18	2.88%
Beta2-Agonists	16	2.56%
Diuretics and Masking Agents	12	1.92%
Glucocorticoids	6	0.96%
Stimulants	5	0.80%
Cannabinoids	4	0.64%
Betablockers	1	0.16%
Metabolic Modulator	1	0.16%
Narcotics	1	0.16%
<b>Methods</b>	<b>81</b>	<b>12.96%</b>
Blood Manipulation	63	10.08%
Gene & Cell Doping	18	2.88%
<b>TOTAL</b>	<b>625</b>	<b>100%</b>

Table 3: Research Projects on doping detection per substance / method

When it comes to the detection of prohibited methods such as blood and gene doping, almost 13% of the research projects were devoted to this scourge. The underfunding of research into cell and gene doping, a problem that is seen as crucial in the sport of the future<sup>6</sup>, may indicate that researchers, universities, and Anti-Doping Organizations are still focusing on the prevalent substances of the present. This should be a point to be considered by all anti-doping stakeholders, and in particular researchers.

### Detection of substances and methods



<sup>6</sup> Additional information available on iNADO member-only library: Excel database: [iNADO Research WADA and PCC Funding](#). Open Tab “Effects of Subs and Methods” – Click on categories: “Gene & Cell Doping” to open all relevant research projects.

## 4.2 Funded Research on the Effect of Substances and Methods on Physical Performance

When it comes to the study of the effect of substances and methods on sports performance, attention has historically been focused on Beta-2-agonists, which are commonly prescribed for the treatment of asthma and for the majority are prohibited in sport.<sup>7</sup>

Considering the frequent cases of anti-doping rule violations<sup>8</sup> for the detection of narcotics (1%) and cannabinoids (3%) out of all the substances identified as Advert Analytical Findings (AAF) in each drug class in ADAMS, and the scarce conclusions on their effect on performance<sup>9</sup>, the lack of research funded by WADA or PCC on these substances is striking.

Although these topics are indeed the subject of scientific research, little funding has been devoted to them by these two funding organizations, whether this is due to a lack of applications or low prioritization for PCC or WADA is not clear.

The effect of cellular and gene doping on sporting performance also does not seem to have been a priority in recent years of research. As a threat to the integrity of sport, it seems necessary to better understand the effect of these practices in the future.

Research projects: effect of substances/ methods	Number of funded research projects	%
<b>Substances</b>	<b>61</b>	<b>96.83%</b>
Beta2-Agonists	13	20.63%
Anabolic Agent	11	17.46%
Peptide Hormones, Growth factors and Mimetics	10	15.87%
Glucocorticoids	9	14.29%
Other Substances - Anxiolytics, Inhibitors	5	7.94%
Monitored Substances - Stimulants	4	6.35%
Monitored Substances - Narcotics	3	4.76%
Hormone and Metabolic Modulators	2	3.17%
Betablockers	1	1.59%
Stimulants	1	1.59%
No Specific Substances	2	3.17%

<sup>7</sup> [https://www.wada-ama.org/sites/default/files/resources/files/2021list\\_en.pdf](https://www.wada-ama.org/sites/default/files/resources/files/2021list_en.pdf)

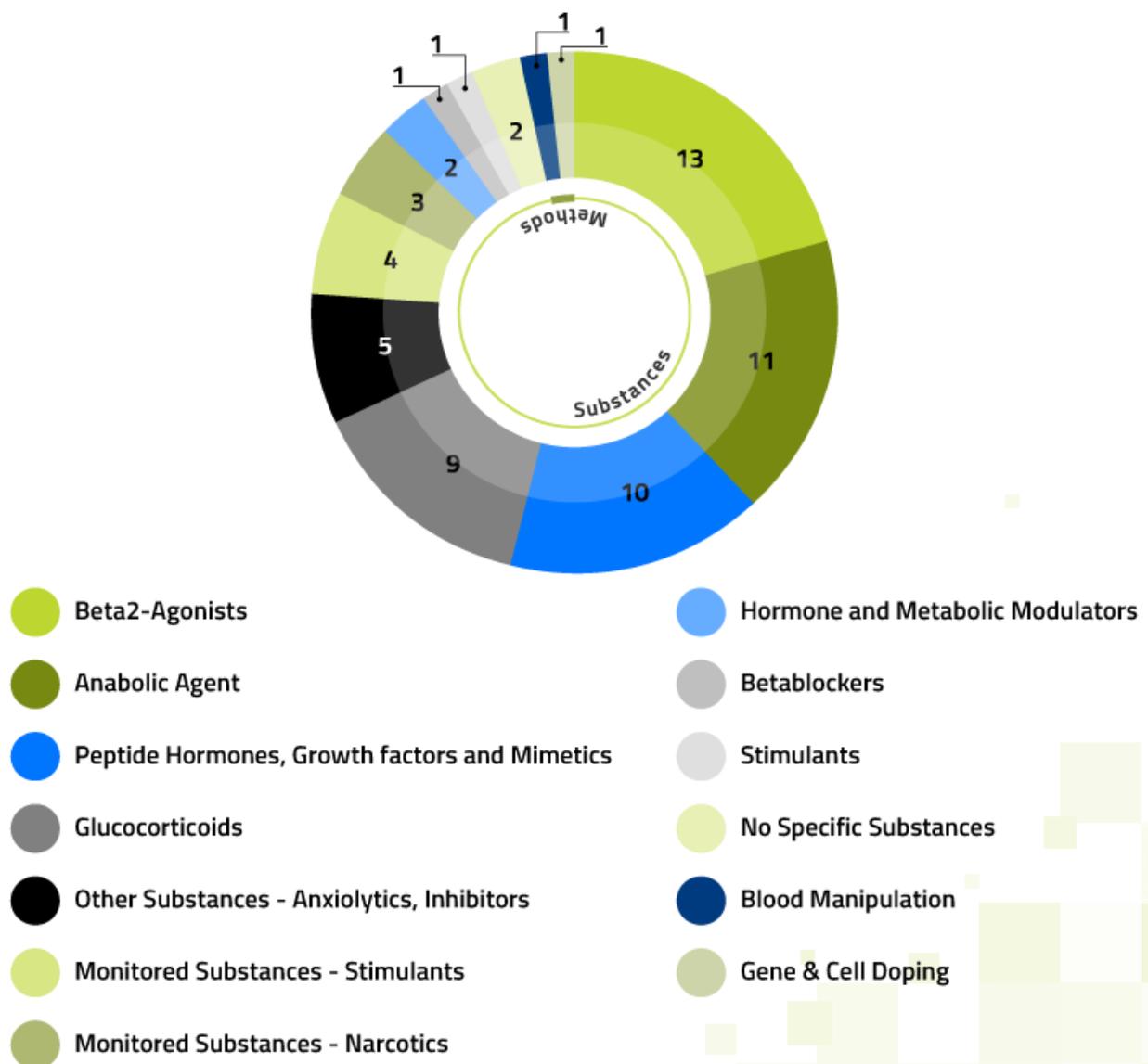
<sup>8</sup> As per WADA 2019 Testing figures: <https://www.wada-ama.org/en/media/news/2020-12/wada-publishes-2019-testing-figures-report>

<sup>9</sup> Heuberger, J. A., & Cohen, A. F. (2019). *Review of WADA prohibited substances: limited evidence for performance-enhancing effects. Sports Medicine, 49(4), 525-539.*

Methods	2	3.17%
Blood Manipulation	1	1.59%
Gene & Cell Doping	1	1.59%
<b>TOTAL</b>	<b>63</b>	<b>100%</b>

Table 4: Research projects on the effect of substances / methods on sporting performance.

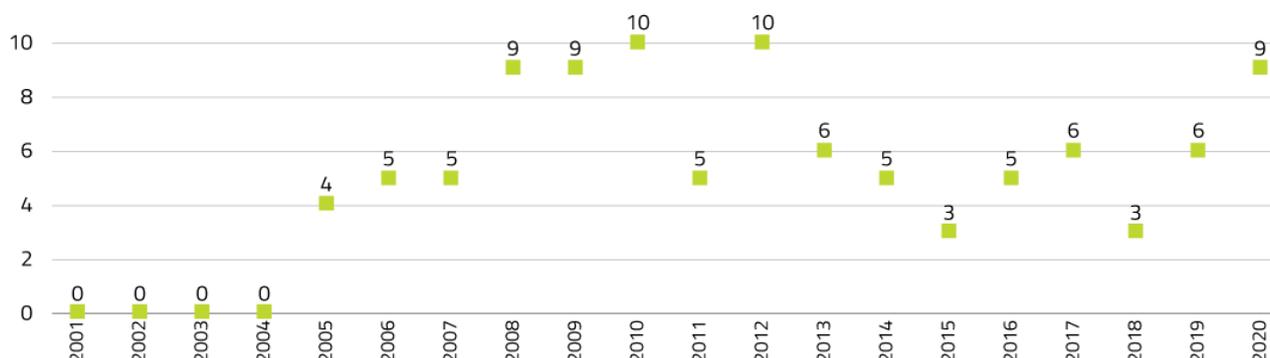
Research on the effect of substances / methods on sporting performance



### 4.3 Funded Research on Social Sciences

The WADA and PCC approach to the study of doping from a social science point of view seems to be increasingly prevalent. As mentioned above, the number of projects funded by WADA and PCC decreased during 2020, (most probably) due to the effects of the COVID-19 pandemic. Contrary to this general trend, social science research has been increasing in the last two years.

Social sciences research projects per year



This new approach is not only evident in the numbers but also in the communication strategies of WADA and PCC on the funding of social science projects. In fact, WADA announced in 2020 its Social Science Research Strategy (SSR Strategy) for 2020-2024<sup>10</sup>, which was approved by WADA's Executive Committee during its meeting in September 2020. In 2020, PCC announced that it would include social sciences in its priority research areas, since a social science perspective may offer human aspects of doping that complement the techno-scientific findings of the laboratories.

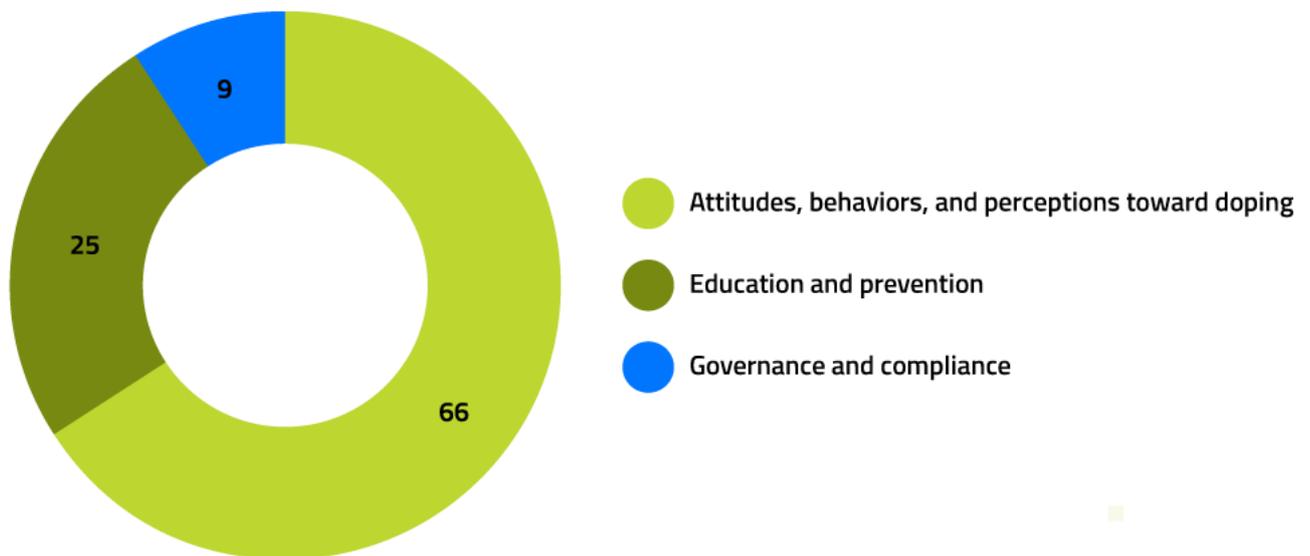
The main focus of the projects funded by WADA and PCC in the social sciences realm were the perception of doping by the different stakeholders in sport, studies of the effectiveness of prevention and education programs and to a lesser extent the analysis of the governance and compliance of anti-doping organizations.

<sup>10</sup> <https://www.wada-ama.org/en/media/news/2020-10/wada-strengthens-approach-to-social-science-research-with-new-strategy-for-2020>

Social sciences areas	Number of research projects
Attitudes, behaviors, and perceptions toward doping	66
Education and prevention	25
Governance and compliance	9
<b>TOTAL</b>	<b>63</b>

Table 5: Research on social sciences per field of study

### Funded social sciences research projects



It is also worth noting that 32% of doping research in the social sciences was carried out in the UK, mostly through the combined efforts of universities and research centers (e.g., University of Birmingham, University of Stirling).

## 5. Organizations that have conducted research projects funded by WADA and PCC

In the 20 years analyzed, a total of 296 organizations have received funding for research from WADA and/or PCC. The majority of organizations leading these research projects were universities and academic institutions. Almost 70% of the projects allocated funding were led by such educational intuitions. The second most significant group are laboratories accredited by WADA to conduct research. To a lesser extent, government organizations, individual researchers, private companies, NADOs and sports government bodies also benefited from these research grants.

It should be noted that it is common in research cooperation agreements that include a university/academic institution they are likely to be the partner applying for funding as grant applications would be within their area of expertise.

This is the case of some NADOs that have outsourced their research work or universities and laboratories that work together with companies and sport governing bodies, etc.

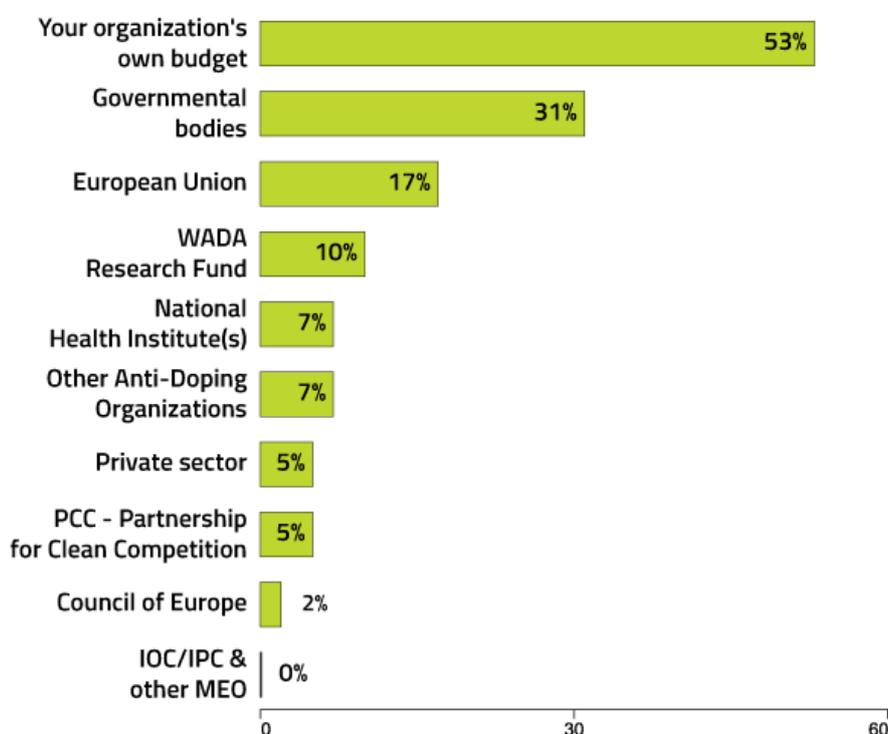
Type of organizations	Number of research projects	%
Universities and Academic Institutions	539	68%
Laboratory	137	17%
Government Organization	44	6%
Individual	28	4%
Company	23	3%
NADO	15	2%
Sport Governing Body	4	1%

Table 6: Types of organizations that conducted projects funded by WADA and PCC

A not insignificant fact for our members is that only 2% of the research funded by WADA or the PCC was carried out by NADOs. This is in line with the Capability Register, where 25% of respondent members reported in-house research<sup>11</sup> unit and some research activities have been outsourced to academic institutions and accredited laboratories. When we asked the ADOs where the research funding came from, more than half reported that it came from their own budgets and only 15% reported receiving funding from WADA or PCC for research.

<sup>11</sup> Source: iNADO Capability Register 2018-2020: 53 answers received from 44 NADOs and 9 RADOs.

### Origins of anti-doping research fund used by NADOs and RADOs in percentage<sup>12</sup>



Considering that the vast majority of WADA and PCC funded projects have been developed by universities, academic institutions, and accredited laboratories, and that NADOs have reported using their own funds for research, we consider that there is still great potential for cooperation with these organizations to access resources for scientific research. To this end, greater cooperation between academic institutions and NADOs<sup>13</sup> could be useful in identifying joint needs and funding opportunities in organizations such as WADA and PCC.

**Of the nearly 300 organisations that have benefited from WADA and PCC research grants, we have listed the top 10 in terms of number of projects funded. In addition, we have highlighted the research areas of emphasis of these organizations over the last 20 years.<sup>14</sup>**

<sup>12</sup> Source: iNADO Capability Register 2018-2020: 53 answers received from 44 NADOs and 9 RADOs

<sup>13</sup> Podcast with Catherine Ordway, PhD, University of Canberra in which she advocated for greater collaboration with between her program students and NADOs. Listen to episode iNADO Live Chat episode here: <https://www.podbean.com/site/EpisodeDownload/PB1093B273W98Z>

<sup>14</sup> Additional information available on iNADO member-only library: Excel database: [iNADO Research WADA and PCC Funding](#). Open Tab "Type of Organization" – Click on categories: "Organization Name" you are interested in to open all relevant research projects."

Organization	Country	Research projects	Research areas of emphasis
<a href="#"><u>German Sport University Cologne</u></a>	Germany	83	Detection of anabolic agents and peptide hormones, detection of metabolic modulators, diuretics, and masking agents.
<a href="#"><u>Mar Institute of Medical Research Foundation - IMIM</u></a>	Spain	47	Detection of anabolic agents and peptide hormones, effects of glucocorticoids and detection of blood manipulation.
<a href="#"><u>National Measurement Institute</u></a>	Australia	36	Detection of anabolic agents and peptide hormones.
<a href="#"><u>Federazione Medico Sportiva Italiana</u></a>	Italy	30	Detection of anabolic agents and peptide hormones, detection of metabolic modulators, diuretics, and masking agents
<a href="#"><u>University of Ghent</u></a>	Belgium	28	Detection of anabolic agents and peptide hormones
<a href="#"><u>Seibersdorf Labor GmbH, Austrian Research Centers</u></a>	Austria	26	Detection and effects of anabolic agents and peptide hormones
<a href="#"><u>Sports Medicine Research &amp; Testing Laboratory</u></a>	United States	23	Detection and effects of anabolic agents and peptide hormones
<a href="#"><u>University of Copenhagen</u></a>	Denmark	16	Detection and effects of anabolic agents and peptide hormones, effect of Beta2-Agonists
<a href="#"><u>National Institute of Scientific Research (INRS)</u></a>	Canada	12	Detection and effects of anabolic agents and peptide hormones.
<a href="#"><u>Karolinska Institutet</u></a>	Sweden	9	Detection and effects of anabolic agents and peptide hormones.

Table 7: Top 10 organizations in number of projects funded.

Along the same lines as the entire universe of the projects analyzed, the focus of these top ten organizations has been on the detection and effect of anabolic agents and peptide hormones. In addition to these predominant lines of research, some outstanding areas are, for example, the study

of metabolic modulators, diuretics and masking agents at the German Sport University Cologne and the Italian Medical Sports Federation. We can also mention several studies on the effect of glucocorticoids and the detection of blood doping at the Mar Institute of Medical Research Foundation in Barcelona, Spain. Or for instance, the development of several studies on the effect of Beta-2-agonists on sports performance by the University of Copenhagen.

Aside from the serious problem that growth hormones and steroids represent for the integrity of sport and the health of athletes, there seems to be a marked concentration of effort in the same areas of research. Increased cooperation among stakeholders in doping research may result in less duplication of effort and greater diversity of studies to address the many challenges of doping in sports organizations.

## 6. Conclusions

The progressive increase in resources dedicated to scientific research by WADA and PCC is promising for ADOs and stakeholders. As the organizations that fund anti-doping studies globally, their grant programs are a representative sample of the current state of scientific research in the field. This report also represents a tool for understanding the management of financial resources dedicated to scientific research in anti-doping, resources that normally come from public organizations such as national governments.

The increase in research funding does not always have an impact on the diversity of areas and organizations involved. Such is the case for the funding of doping research projects. In this sense, a greater participation in anti-doping research by organizations in Asia, Africa, South America, Central America and the Caribbean is needed, not only to ensure diversity of actors but also diversity of areas according to the local realities of anti-doping around the world.

Extensive research into the implementation of new detection methods and the improvement of existing ones reflects the needs of ADOs, as testing and results management are at the heart of their operations. However, the recent inclusion of social sciences in the PCC priority areas as well as the social science research grants program that WADA has been developing since 2005 are a great opportunity for NADOs who want to explore prevention programs or anti-doping governance and compliance research. Another area to develop seems to be the study of the enhancing properties of substances monitored by WADA, or those banned but widely debated such as cannabinoids and narcotics. This would contribute to more solid International Standards, further supported by scientific evidence and the participation of NADOs and anti-doping stakeholders.

We acknowledge that the widespread prevalence of traditional substances such as steroids, peptides or growth hormones determine much of the day-to-day operations of ADOs. However, when it comes to research, we encourage NADOs to explore new areas of study and avoid duplication of efforts. This is only possible in collaboration with institutions already well versed in research such as universities and accredited laboratories.

Venturing into new areas of research will not only contribute to solving current threats to the integrity of sport but will also be useful in tackling emerging problems such as cell and gene doping, or the increasingly innovative methods of blood manipulation. The mapping of leading anti-doping research organizations provides NADOs with a preliminary idea of the types of organizations with which they could collaborate with to expand their research capabilities and access WADA and PCC funding. We encourage our members to consider areas of cooperation in anti-doping research with these and other stakeholder organizations.