

1 **Outcomes of adverse analytical findings in individual and team sports**

2

3 **Running Head:** Anti-doping rule violations in sport

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5

6 **ABSTRACT**

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8 The aim of this investigation was to describe the outcomes of the adverse analytical  
9 findings in different Olympic sports. The data included were gathered from the WADA  
10 Anti-doping Rule Violations Reports (from 2013-2017). Weightlifting (78.1±9.4%),  
11 wrestling (73.2±18.5%) and volleyball (68.3±18.7%) were the sports with the highest  
12 proportion of cases that ended in an anti-doping sanction. Gymnastics (45.1±10.1%),  
13 triathlon (32.6±11.9%) and shooting (29.9 ± 14.1%) were the sports with a higher  
14 frequency of cases that were not sanctioned due to medical reasons. Gymnastics (22.4±  
15 18.4%), boxing (23.2±16.0%) and taekwondo (17.3.1±16.4%) presented the highest  
16 proportion of cases that are still pending resolution. The proportion of cases that ended in  
17 no sanction was higher in fencing (26.2 ± 22.7%), skating (23.6 ± 35.1%) and tennis (18.6  
18 ± 26.5%). These results indicate that the sanctions derived from ADRVs were not uniform  
19 in all sports disciplines.

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22 **Keywords:** elite athlete, sports performance, anti-doping rule violations, type of sport

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24           1. **INTRODUCTION**

25  
26           According to the World Anti-Doping Agency (WADA), the international and  
27 independent agency that harmonises anti-doping policies worldwide, a doping case is  
28 produced when an athlete or his/her support personnel breaks one or more of the anti-  
29 doping rules set out in the World Anti-Doping Code [1]. Due to the diverse behaviours  
30 that can be considered as doping in modern sport, Article 2 of The Code includes 10  
31 circumstances that can be constitutive of an anti-doping rule violation. The presence of a  
32 prohibited substance in an athlete’s bodily specimens as well as the use of a prohibited  
33 method are the most common violations of The Code, but evading doping controls,  
34 Whereabout failures, tampering with a doping control, possession of a prohibited  
35 substance or a prohibited method, selling a banned substance to another athlete, or  
36 complicity and prohibited association are also considered anti-doping rule violations.

37           If the violation is related to the presence of a prohibited substance, or its  
38 metabolites or marker, in a urine or blood sample, WADA-accredited laboratories  
39 endorse the presence of this substance by establishing an adverse analytical finding.  
40 However, there are other non-analytical anti-doping rule violations that can be certified  
41 by doping control officers (e.g., refusing to submit to a sample collection or a  
42 Whereabouts failure), or even police forces (e.g. possession or trafficking of a substance  
43 or a prohibited method). When an athlete commits a doping offence, the anti-doping  
44 organisations initiate legal actions against the potential offender to deliver a sanction or  
45 to investigate the circumstances that produced the violation of The Code. Interestingly,  
46 WADA is never involved in the management of the results of the doping control tests,  
47 instead the process is managed by the International Sports Federation in which the athlete  
48 is registered or by the national anti-doping organisation where the control was performed.  
49 Thus, although WADA monitors anti-doping activities worldwide and accredited

50 laboratories to guarantee that the presence of a substance in a bodily specimen is the result  
51 of the misuse of a doping substance, the international federations and the national anti-  
52 doping organisations are responsible for presenting the cases against the doped athletes.  
53 Although the configuration of this anti-doping system has received criticism in the last  
54 years [2,3] the current anti-doping programme has effectively responded to the dynamic  
55 changes associated to doping [4]. However, there are still problems to be solved in the  
56 current anti-doping programme, such as the low deterrent effect of the punishment  
57 established for an anti-doping rule violation, the inclusion of substances on the banned  
58 list without proper scrutiny of their effects on physical performance, and the  
59 imperfections in the Therapeutic Use Exemption protocol, among others [5,6].

60         Although each doping offence has its own legal process, the outcomes of an anti-  
61 doping rule is common or all cases. The case against the athlete can: (a) be closed with  
62 a sanction; (b) can be dropped if the athlete has a therapeutic use exemption; (c) can be  
63 closed at the results management level; (d) can be closed with the athlete being exonerated  
64 if the disciplinary proceedings concludes that the athlete committed no infraction of The  
65 Code. Still, some cases need several months or even years to be closed and are pending a  
66 final decision. A recent analysis [7] has revealed that the prevalence of adverse analytical  
67 findings found by WADA-accredited laboratories has remained relatively stable at ~2%  
68 since the creation of WADA. However, the prevalence of adverse findings is not uniform  
69 across all sports disciplines. Individual sports such as cycling, weightlifting and boxing  
70 present a higher prevalence of adverse findings than team sports such as ice hockey, rugby  
71 and basketball [8]. Previous research has shown that more than 11% of the athletes who  
72 tested positive in a doping control test received no sanction, indicating that the specific  
73 circumstances of the case, or lack of available evidence, are important factors leading to  
74 a sanction [9]. However, to date, there is no information about how the adverse analytical

75 finding that constituted a potential doping case evolved until an outcome was obtained.  
76 Thus, the aim of this investigation was to describe the final consequences of adverse  
77 analytical findings in sport and to establish differences among sports disciplines.

78

## 79 2. MATERIAL & METHODS

80 The data included in this investigation have been gathered from the Anti-Doping  
81 Rule Violations Reports made available annually from 2013 to 2017 by WADA [10].  
82 Only the outcomes of anti-doping rule violations associated to adverse analytical findings  
83 were analysed in this investigation. The anti-doping rule violations that resulted from  
84 non-analytical findings were discarded as it was unfeasible to determine its nature from  
85 the information contained in the Reports. Hence, the current analysis presents the  
86 outcomes of adverse analytical findings in individual and team sports. In 2013, it was the  
87 first time that WADA published the information about the number of adverse analytical  
88 findings per sport in a public report. Thus, the information for establishing anti-doping  
89 rule violations, respect to the total number of adverse analytical findings in each sport,  
90 has only been available in the last five Anti-Doping Rule Violations Reports (2013, 2014,  
91 2015, 2016 and 2017) and the present investigation represents an analysis of this period.  
92 To date, no Anti-Doping Rule Violations Report for 2018 has been released by WADA.  
93 These reports offered a complete analysis of all doping cases established during one year  
94 by compiling the legal decisions received by WADA. Although they contain information  
95 about the outcomes of analytical and non-analytical anti-doping rule violations, we have  
96 only used the information about the outcomes of adverse analytical findings because we  
97 aimed to associate these data on sanctioning per sport with the available data about the  
98 prevalence of adverse analytical findings per sport [8]. According to the reports, the  
99 outcomes of a doping case can be classified into five categories:

- 100 - Medical Reasons: Therapeutic Use Exemption granted to an athlete, which  
101 permits the presence of a prohibited substance and/or the use or attempted use,  
102 possession and/or administration or attempted administration of prohibited  
103 substances or methods for therapeutic purposes.
- 104 - No Case to Answer: Cases closed at the results management level, excluding  
105 medical reasons, or cases outside of WADA's jurisdiction.
- 106 - No sanction: Cases in which the athlete was exonerated following the conclusion  
107 of disciplinary proceedings.
- 108 - Pending: Cases that have not yet been finalised following either the conclusion of  
109 disciplinary proceedings or at the results management level.
- 110 - Anti-doping rule violation (ADRV): Cases for which a final decision has been  
111 rendered and a sanction was imposed against the athlete.

112 To fulfil the aim of this investigation, the analysis included the outcomes of adverse  
113 analytical findings of 25 Olympic sports (18 individual sports and 7 team sports). Sports  
114 with less than 1,400 samples analysed per year in all the years examined were excluded  
115 to guarantee that the distribution of adverse analytical finding outcomes was  
116 representative of each sport, as previously suggested [11]. In addition, for increase the  
117 statistical power of the analysis, we use the aggregate data of the 5 available reports. This  
118 analysis followed a similar pattern to a previous publication in which the differences in  
119 the frequency of adverse analytical findings were established per sport [8].

## 120 **2.1. Statistical analysis**

121 The data in the present study are presented as mean and standard deviation (SD)  
122 for each outcome ruled from 2013 to 2017. Briefly, in each year, the proportion of  
123 outcomes were calculated for by dividing the number of each outcome (i.e.,  
124 ADRV/Medical Reasons/Therapeutic Use Exemption/No Case to Answer/No sanction)

125 between the total number of outcomes. Then, the data per year were averaged for the 5  
 126 years under scrutiny. The proportion of the outcomes of the adverse analytical findings  
 127 was subsequently calculated in each sport by dividing the number of cases that ended in  
 128 any specific outcome by the total number of adverse findings in the sport. The differences  
 129 in distribution of outcomes among sports were tested with crosstabs and Chi Square test,  
 130 including adjusted standardised residuals. Briefly, it was considered that a sport had a  
 131 distribution of adverse analytical finding outcomes statistically different from the  
 132 expected value when its distribution of adverse analytical finding outcomes was > or <  
 133 the critical Z-score value (i.e., 1.96). As the Z-score is a measure of standard deviation,  
 134 the sports that surpassed the above-mentioned threshold contained data that were 1.96  
 135 standard deviations higher and lower than the mean value. The significance level was set  
 136 at  $p < 0.05$ .

137 **Table 1.** Adverse analytical finding outcomes in Olympic sports from 2013 to 2017.

138 Data are absolute values for each year.

139

<b>Sport</b>	<b>Samples</b>	<b>Total AAFs</b>	<b>Medical reasons</b>	<b>No case to answer</b>	<b>No sanction</b>	<b>Pending</b>	<b>ADRV</b>
2013	180740	1714	158†(9%)	225*(13%)	78†(5%)	98†(6%)	1155†(67%)
2014	186723	1439	157† (11%)	187*(13%)	102†(7%)	77†(5%)	916†(64%)
2015	196579	1633	212(13%)	101†(6%)	147†(9%)	109†(7%)	1064†(65%)
2015	193345	1926	215† (11%)	76†(4%)	510*(26%)	271(14%)	854†(44%)
2017	205405	1575	152† (10%)	89† (6%)	103† (7%)	343*(22%)	886†(56%)

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141 (\*) Higher than expected  $P < 0.05$ . (†) Lower than expected  $P < 0.05$ .

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145        3. **RESULTS AND DISCUSSION**

146            Between 2013 and 2017, a total of 8,287 adverse findings were reported for the  
147 sports included in this investigation. During this period, the number of samples analysed  
148 increased, while the number of adverse findings per year has remained relatively constant  
149 (Table 1). Specifically, the percentage of adverse findings in the reports included in this  
150 investigation has remained relatively stable below 1% (0.95% in 2013, 0.77% in 2014,  
151 0.83% in 2015, 1.00% in 2016 and 0.77 in 2017). These results coincide with previous  
152 research that included information on all the samples and findings reported by WADA  
153 for 13 years [7]. These data suggest a stable proportion of adverse analytical findings in  
154 the last years despite the increasing number of samples analysed by WADA-accredited  
155 laboratories. The current investigation is innovative because, in addition to the above  
156 conclusion, this is the first investigation to show that the evolution of the disciplinary  
157 outcomes of adverse analytical findings has also remained constant since 2013 (Table 1).  
158 Overall, the percentage of adverse findings that ended in ADRV was 58.8%. The  
159 remaining cases are still pending (10.8%), have been closed due to medical reasons  
160 (10.8%) or because there was no case to answer (8.2%). From the total, 10.4% of the  
161 cases were closed without any sanction for the athlete. The current analysis reflects that  
162 only a moderate proportion of doping cases initiated by anti-doping authorities ended in  
163 a sanction for the offender with question the deterrent effect of the anti-doping  
164 programme for athletes. To this, it is necessary to add that only ~2% of doping control  
165 tests report the presence of a banned substance [7,8] despite the prevalence of doping  
166 measured with other techniques such as questionnaires is between 14%–57% [12,13].  
167 Together, this information suggests the inefficacy of the anti-doping system to  
168 successfully prove that the presence of this substance is the result of a violation of The  
169 Code.

170           Some of the substances included in the banned list, such as  $\beta$ -2 agonists and  
171 glucocorticoids, might have a therapeutic use for athletes with a clinical condition and  
172 thus, some athletes are allowed to use prohibited medications in sport after their need is  
173 certified by a medical court (i.e., Therapeutic Use Exemption (TUE)) [14]. As a result of  
174 these exemptions, about 10% of adverse atypical findings are closed for medical reasons,  
175 a number higher than the frequency of Olympic athletes that compete under a TUE (0.9%)  
176 [15]. Thus, the TUE is an international standard with high utility to allow sports  
177 participation for those athletes with conditions that require the use of banned substances.  
178 However, the TUE is probably misused by healthy athletes as a “permissive” doping  
179 passport alongside the current antidoping methods [12,13]. The current system of TUEs  
180 allows athletes with clinical conditions to use some banned substances while competing  
181 in official events but there has been some argument against it [18]. The high number of  
182 TUEs conceded in particular sports, the high proportion of Olympic athletes that suffer  
183 from asthma [5], and the use of stimulants to treat athletes with attention-  
184 deficit/hyperactivity disorder has also been questioned [19,20]. These concerns are  
185 aggravated in the light of the current data, because gymnastics, triathlon, shooting,  
186 aquatics, tennis, ice hockey, skiing, and cycling, with percentages varying from 45 to  
187 12%, presented a higher proportion of exoneration after adverse findings due to medical  
188 reasons (Figure 1 and 2).

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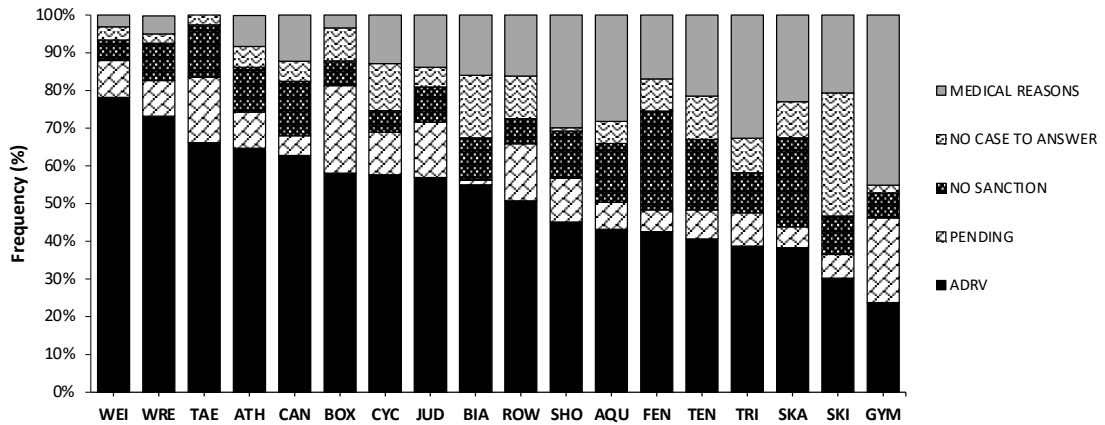
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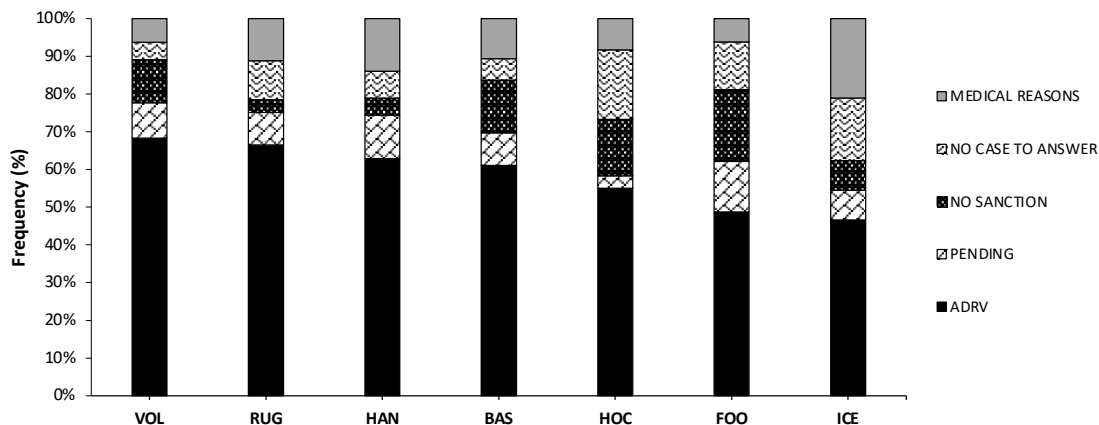
193



194 **Figure 1.** Mean frequency of adverse analytical findings outcomes between 2013 and  
 195 2017 in individual sports



196  
 197 **Figure 2.** Mean frequency of adverse analytical findings outcomes between 2013 and  
 198 2017 in team sports.



199

200            Interestingly, subtle changes have been present in the last few years when  
 201 referring to the outcomes of the adverse analytical findings. For example, the proportion  
 202 of “no case to answer” has been reduced to half since 2015 (Table 1), likely due to the  
 203 improvement in the management of the results in national anti-doping authorities and  
 204 international federations. In 2016, the proportion of adverse analytical findings that  
 205 ended with athletes being exonerated of culpability increased to 26% while this outcome  
 206 did not exceed 9% in the remaining years. Likely, this significant increase in “no  
 207 sanction” cases in 2016 is related to the prohibition of meldonium which was added to  
 208 the 2016 Prohibited List [21]. Many of the athletes who were sanctioned for having  
 209 committed an anti-doping rule violation due to the use of meldonium denied that they  
 210 consciously breached anti-doping regulations. In fact, a previous report suggested that  
 211 up to 40% of sanctioned athletes with an anti-doping rule violation did not intentionally

212 violate the regulations [9]. In any case, The Code clearly certifies that, although the  
213 athlete has the right to a hearing after a doping case has been initiated, the anti-doping  
214 authority does not need to demonstrate intent, conscious use, fault or negligence on the  
215 athlete's part.

216         Regarding adverse analytical findings that ended in "no sanction", the distribution  
217 was similar in individual ( $12.2 \pm 0.1\%$ ) and team sports ( $10.8 \pm 0.1\%$ ) during the  
218 examined period. These findings coincide with previous research that reported that 11%  
219 of athletes who tested 'positive' after a doping control received a sanction of zero months  
220 ineligibility [9]. This means that around 11% of athletes notified with an adverse  
221 analytical finding were either regarded as having no fault or negligence because of the  
222 circumstances of the case, or the available evidence was insufficient to justify a ban.  
223 Fencing, skating, football, tennis, aquatics, canoe/kayaking and athletics, with  
224 proportions between 26% and 12%, presented higher than expected proportions of cases  
225 that ended with no sanction. Despite reporting the percentage of doping cases that do not  
226 end with a sanction, WADA does not indicate why these cases were closed with no  
227 sanction.

228         A total of 633,884 samples were analysed from the individual sports selected for  
229 this investigation between 2013 and 2017 with an overall frequency of adverse findings  
230 of  $0.9 \pm 0.5\%$ . Figure 1 depicts the distribution of the outcomes of the adverse analytical  
231 findings reported in each sport. In weightlifting, wrestling and athletics, the proportion of  
232 cases that ended in ADRV was higher than expected ( $p < 0.05$ ). In contrast, the proportion  
233 of cases closed due to medical reasons was higher than expected in gymnastics, triathlon,  
234 shooting, aquatics, tennis, skiing, and cycling ( $p < 0.05$ ). In skiing, biathlon and cycling,  
235 the outcomes classified as "no case to answer" were higher than expected ( $p < 0.05$ ). The  
236 adverse analytical findings that ended in "no sanction" were higher than expected in

237 fencing, skating, tennis, aquatics, canoe/kayaking, and athletics ( $p < 0.05$ ). Finally, the  
238 proportion of cases that are still "pending" resolution were higher than expected in boxing  
239 and gymnastics ( $p < 0.05$ ). In team sports, the number of samples analysed was 291,587  
240 while the frequency of adverse findings was lower than in individual sports (overall,  $0.7$   
241  $\pm 0.3\%$ ;  $p < 0.05$ ). The distribution of the outcomes of the adverse analytical findings per  
242 sport are presented in Figure 2. Volleyball and rugby were the sports with a higher  
243 proportion than expected of adverse analytical findings that ended in ADRV ( $p < 0.05$ ).  
244 The proportion of cases closed due to medical reasons and the cases classified as "no case  
245 to answer" was higher than expected in ice hockey ( $p < 0.05$ ). Adverse analytical findings  
246 that ended in "no sanction" or the ones that are still pending a final decision were higher  
247 than expected in football ( $p < 0.05$ ). These data indicate that the outcomes of the doping  
248 cases initiated by the anti-doping authorities present some sport-specific differences. In  
249 some sports, a higher proportion of cases ended in ADRV which may indicate that  
250 athletes in these sports were using substances and methods in a context that facilitated  
251 detection first and sanction later (i.e., in terms of type of substance, dose administered,  
252 method of administration). In this regard, the highest frequency of ADRVs were within  
253 the sports with a high proportion of adverse analytical findings associated with anabolic  
254 agents [11]. As this is an innovative finding of this investigation, further studies should  
255 be aimed at determining why some sports receive a higher proportion of sanctions.

256         The current study has some limitations that should be discussed to correctly  
257 understand its outcomes. First, the 2016 ADRV Report covered decisions received by  
258 WADA until 31 December 2017, whereas in previous reports the period of decisions was  
259 longer. However, the 2017 ADRV Report covered decisions received by WADA before  
260 31 May 2019. The increase in the load of adverse findings could have led to  
261 corresponding delays in finalising decisions. In addition, unequivocally determining an

262 anti-doping rule violation in anti-doping cases has become more and more complex due  
263 to the meticulous processes necessary to certify the correct implementation of the protocol  
264 for the obtaining of anti-doping samples, the intricate laboratory methods employed to  
265 detect substances and the existence of national anti-doping regulations that tackle the  
266 determination of a final sanction, which often affects their duration. All of these causes  
267 might have affected the progressively higher proportion of pending cases reported in  
268 Table 1. Secondly, this analysis does not include sanctions of non-analytical anti-doping  
269 rule infractions. Additionally, the current investigation will never be totally complete due  
270 to the 10-year window permitted for retrospective analysis. The use of retrospective  
271 testing is a deterrent strategy against doping [1] which allows anti-doping authorities to  
272 analyse an athlete's sample retrospectively for 10 years to look for a possible violation of  
273 The Code. To date, there is a gap between WADA becoming aware of a new  
274 performance-enhancing substance and the development of a valid and reliable laboratory  
275 test. Because of this, the International Olympic Committee has allowed retrospective  
276 testing since the Athens Olympics in 2004; where 5 athletes were caught retrospectively,  
277 while 90% of ADRVs in 2008 and 87% in 2012 were granted from retrospective testing  
278 [22]. In addition, as mentioned in other research [9], there are various reasons why a  
279 sanction could be mitigated according to the anti-doping rules, such as collaboration with  
280 anti-doping organisations to detect other athletes or an athlete's support person who are  
281 committing anti-doping rule violations.

282

#### 283 4. CONCLUSIONS

284 In conclusion, the analysis of the WADA Anti-Doping Rule Violations Reports  
285 suggests that most of the adverse analytical findings detected by WADA-accredited  
286 laboratories ended with the certification that an antidoping rule violation had occurred.

287 However, the conversion of adverse analytical findings into violations of The Code was  
288 not uniform in all sports disciplines. The current analysis reveals that some sports had a  
289 higher proportion of anti-doping rule violations for a given number of adverse findings  
290 than others.

## 291 5. **FUTURE PERSPECTIVE**

292 Because WADA is not involved in the first steps of the management of the results of  
293 the doping control tests, the analysis presented here recommends national anti-doping  
294 authorities and international federations to use the information about the doping  
295 characteristics of each sport (banned substances more commonly found in doping control  
296 tests, proportion of medical exemptions, schedule of international events, etc.) to increase  
297 the efficacy of the deterrent and punitive policies. However, WADA should perform a  
298 further examination to understand why some adverse analytical findings do not end in a  
299 sanction. Finally, WADA should reconsider the international standard that regulates the  
300 concession of TUEs, particularly in some sports, due to the abnormal number of doping  
301 cases exonerated for medical reasons.

302

## 6. EXECUTIVE SUMMARY

### **Background**

- The use of prohibited substances and methods is the most common infraction of the anti-doping rules. However, other behaviours such as evading doping controls, tampering with a doping control or possession of a prohibited substance are also catalogued as anti-doping rule violations.
- While there is ample information about the prevalence in the use of banned substances, there is no information about the consequences of adverse analytical findings in sport.

### **Results**

- Weightlifting, wrestling and volleyball were the sports with the highest proportion of cases that ended in an anti-doping sanction.
- Gymnastics, triathlon and shooting were the sports with a higher frequency of cases that were not sanctioned due to medical reasons.
- Gymnastics, boxing and taekwondo presented a higher proportion of cases that are still pending resolution.
- The proportion of cases that ended in no sanction was higher in fencing, skating, and tennis.

### **Conclusion**

- The outcomes of an adverse analytical finding might differ among disciplines because of the characteristics of the sport and differences in the pressure exerted by the national and international anti-doping organisations responsible for the sanctions.

## **AVAILABILITY OF DATA AND SUPPORTING MATERIALS SECTION**

All the data used in this investigation are publicly available at the WADA official website. <https://www.wada-ama.org/en/resources/general-anti-doping-information/anti-doping-rule-violations-adrvs-report>



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