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Original Article

Evaluation of Different Patterns of Drug Consumption in the Ranking of Race Horses in National Racing of Iran: A Retrospective Study 2002-2015

Meysam Tehrani-Sharif[1,*], and Amir Zakian[2]

[1] Department of Clinical Science, Garmsar Branch, Islamic Azad University, Garmsar, Iran
[2] Department of Clinical Science, Faculty of Veterinary Medicine, Lorestan University, Lorestan, Iran

* ***Corresponding author:*** Meysam Tehrani-Sharif, Department of Clinical Science, Garmsar Branch, Islamic Azad University, Garmsar, Iran.
Email: maysamtehrani@yahoo.com

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ABSTRACT

Introduction: Doping is fraudulent and must be prevented in the interests of horse racing as a national recreation. No sport can survive without the confidence of its supporters, so all deceitful practices must be eliminated. This study aimed to determine the rate of drug consumption in horse races in Iran during 2002, 2003, and 2005-2015 and evaluate Iran's current dope control management.
Materials and methods: The winner's method was used to choose horses for drug testing, and only the first and second-place finishers in each race, and seldom the third, were picked. Data of horses during 13 years (2002, 2003, and 2005-2015) were collected. The dope test documents of 2004 were incomplete, so the related data were not analyzed.
Results: The mean dope rate (2002, 2003, and 2005-2015) was 15.83%. The dope rates of 2002, 2003, and 2005-2015 were 29.4%, 33.8%, 21.7%, 10.54 %, 11.14%, 11.47%, 8.62%,4.71%, 18.6%, 20.6%, 16.9%, 22.6%, and 6.72 %, respectively. From 2003 to 2010, the drug rate progressively decreased from 33.8% to 4.71%. Morphine, phenylbutazone, oxyphenbutazone, and caffeine were the most often utilized medicines. Twenty-one drug family types based on the mode of action were used through the years, of which 23.07 percent were combinations. From 2002 to 2010, the variety of medications utilized progressively declined. The noticeable aspect was high prevalence of dope in Iran, compared to developed countries.
Conclusion: The results showed that the dope rate reduced from 2002 to 2015 in Iran racehorses. Routine tests are suggested for controlling doping, and strict rules must be established to prevent doping.

1. Introduction

"Dope" in English means a stupid person. However, in 1889, according to the Oxford English Dictionary, it took a new verb form, "doping," which meant "to administer dope to (a person or a horse); to stupefy with a drug[1]" . In sports, doping refers to using illegal drugs by organizations that regulate competitions to enhance athletes' performance[2]. The Federation Equestre Internationale (FEI, or in English, International Equestrian Federation) is an organization that controls the world of equestrian sports[3]. The FEI regulates show jumping, dressage, carriage driving, endurance riding, reining, vaulting, and para equestrianism, but not horse racing. However, the FEI controls racing through a variety of channels. Administering international competition in traditional equestrian disciplines is the fundamental goal of the FEI to provide advanced equestrian sports worldwide. The FEI's Code of Conduct protects the welfare of horses and has strict rules about doping and medication control[4]. The first official doping test was developed in 1912, the first anti-doping regulations were provided in 1928, and the first doping tests took place at the 1966 European Championships for athletes[5]. Two years later, the International Olympic Committee (IOC) performed the first drug tests at the summer and Winter Olympics[6]. Blood (plasma) is a better matrix for medication control, but most of controls are managed using urine. The drug plasma concentration seems the best substitute for the drug biophase

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concentration from a pharmacokinetic/ pharmacodynamic (PK/PD) point of view. Urine concentration is a better predictor for diuretics, but plasma concentration is the best predictor for other drugs. Furthermore, saliva, sweat, and hair could be used to detect doping[7].

Most countries have strict doping testing procedures. The United States is an exception since the usage of medications such as bute (painkiller) and Lasix/salix (which prevents internal bleeding) is legal in many states. However, other countries want to run their sports completely drug-free[8].

In recent years, Iran's equestrian federation came up with ways to test for doping so that it would happen less often in races[9]. Dope testing for horse races in Iran was performed in 2001 as an official and compulsory event[10]. Horse racing competitions in Iran with Torkaman, Thoroughbred, and mixed breed horses are to be held for 34 weeks every year in four cities, including Gonbad Kavus (15 weeks), Tehran (8 weeks), Bandar Torkaman (7 weeks), and Aq Qala (4 weeks) in distances of 1000 m, 1250 m, 1700 m, and 1800 m respectively. The national racing of Arabian horses in Iran takes place over five weeks in the winter and spring over distances of 1000 m and 1450 m with more than 100 horses aged 3 to 8 years old, and the national racing of Kurdish horses takes place over a distance of 1000 m in Kermanshah province, Iran. On average, 4 to 8 runs occur weekly depending on the number of participants, and 4-12 horses (an average of 8) may participate per run[10]. This study aimed to determine the rate of doping and the use of drugs in horse races in Iran during 2002, 2003, and 2005-2015 years, and also survey the effect of drugs on the ranking of horses, and evaluate current doping control management in Iran.

2. Materials and Methods

2.1. Ethical approval

The experimental protocols carried out in this study were approved by Garmsar Azad University. All animals were treated under regulations on the guidelines of the Iranian Council of Animal Care (1995).

2.2. Sampling and analysis

The horses for drug testing are picked using the winner's method, which selects the first and second-place finishers in each race. In certain runs, the third rank will test for doping. Selected horses are escorted away to a dope-testing facility, where they are identified by their passports and inspected by a veterinarian. The horse is washed and quarantined in one of the drug testing unit's stables until a urine sample is acquired. In some cases, it is not possible to obtain a urine sample. Inevitably, blood samples by sterile needle and vacutainer tube were taken from the jugular vein (10 ml). Samples are transported to the laboratory under the control of an inspector for forensic issues. Doping data from 13 years (2002, 2003, and 2005-2015) were collected by referring to Iran's equestrian federation, and the confirmed doped horses were determined and analyzed. Each week after the end of the race on Friday, all samples in cold boxes in standard condition were transported to Equine Forensic Unit (EFU), Central Veterinary Research Laboratory (Dubai, Emirate). Samples were analyzed by one or more of the following techniques included, Solid Phase Extraction (SPE), enzyme-linked immunoabsorbent assay (ELISA), Thin-Layer Chromatography (TLC), Gas Chromatography/Mass Spectrometry (GC/MS), and Liquid Chromatography/Mass Spectrometry (LC/MS) using appropriate in-housed methods from those listed here: GS01, 02, 03, 04, 07, 08, 09, 10; TA01, 03, 06, 07, 08, 14, 16, 17, 18, 19, 20, 21 and finally, laboratory confirmed the presence of any prohibited substances in received samples base on FEI prohibited substances list [11] and the regulatory threshold adopted for medications in this work was according to National Horsemen's Benevolent and Protective Association[12]. The 2004 dope test paperwork had to be completed, and the total recorded runs were less than 250, therefore, the data for this year did not analyze.

2.3. Statistical analysis

Data were classified by Excel software, then the normality of the data was checked. Descriptive statistics of drugs in each year assessed by SPSS (version 24, USA) and frequency of consumption, the effect of drugs on the ranking of the racehorse, the number of combinatorial regulations, the number of single drug consumption, the percentage of drug regulation and common combination of every year were determined.

3. Results

The mean dope rate (2002-2015) was 15.83%. The dope rates of 2002-2003 and 2005-2015 was 29.4%, 33.8%, 21.7%, 10.54 %, 11.14%, 11.47%, 8.62%,4.71%, 18.6%, 20.6%, 16.9%, 22.6%, 6.72 % respectively. The relative frequencies of the doping results from 2002-2015 are shown in Table 1.

Table 1. Relative and frequencies of doping results in racehorses during 2002, 2003, and 2005-2015 in Iran

Year	Positive	Negative	Total
	Number (%)	Number (%)	Number (%)
2002	104(29.40)	250(70.60)	354(100)
2003	102(33.80)	200(66.20)	302(100)
2005	102(21.70)	368(78.30)	470(100)
2006	33(10.54)	280(89.46)	313(100)
2007	35(11.14)	279(88.86)	314(100)
2008	39(11.47)	301(88.53)	340(100)
2009	30(8.62)	318(91.38)	348(100)
2010	19(4.71)	384(95.29)	403(100)
2011	88(18.60)	385(81.40)	473(100)
2012	103(20.60)	397(79.40)	500(100)
2013	96(16.93)	471(83.07)	567(100)
2014	138(22.62)	472(77.38)	610(100)
2015	43(6.72)	597(93.28)	640(100)
Total	932(15.83)	4702(84.17)	5634(100)

Table 2. Relative and frequencies of prohibited drugs found in the recent study based on the mode of action for each drug family in racehorses during 2002, 2003, and 2005-2015 in Iran

	Mode of action	Number	Percentage
1	NSAID	443	38.42
2	Stimulant	196	17
3	Corticosteroid	48	4.16
4	Narcotic	1	0.088
5	Anabolic androgenic	41	3.55
6	Tranquilizer	3	0.26
7	Antihistamine	12	1.04
8	Local anesthetic	22	1.9
9	Muscular Convulsions	1	0.088
10	Bronchodilator	37	3.2
11	Analgesic	64	5.55
12	Sedative	8	0.7
13	Mucolytic	6	0.52
14	Muscular relaxant	19	1.64
15	Diuretic	1	0.088
16	Muscarinic antagonist	2	0.17
17	Narcotic analgesic	243	21.07
18	Anticholinergic	1	0.089
19	Anxiolytic	1	0.088
20	Hormone	1	0.089
21	H_2-receptor antagonist	3	0.29
	Total	1153	100

NSAID: Non-steroidal anti-inflammatory drugs

From 2003 to 2010, the doping rate progressively decreased from 33.8% to 4.71%. This study's results revealed that 21 drug families were used through the years based on the mode of action. The relative frequencies of prohibited drugs found in the recent study based on the method of action of each drug family are shown in Table 2. According to Table 2, NSAID was the most prevalent (38.42%) drug family used for doping in this study. The number of drugs of each combination used in racehorses during 2002, 2003, and 2005-2015 in Iran is indicated in Table 3. Overall, 229 cases have used a combination of drugs for doping. A single drug doping list of the ranking of a racehorse from 2002, 2003, and 2005-2015 in Iran is shown in Table 4. The results showed that in ranking racehorses, 704 single doping drugs (76.93%) and 229 (23.07%) drug combinations were used during 2002-2015. The most used drugs were morphine, phenylbutazone, oxyphenbutazone, and caffeine. The most and the minimal drug consumed according to the ranking of a racehorse are shown in Table 5.

Table 3. Number of drugs of each combination used in racehorses during 2002, 2003, and 2005-2015 in Iran

	2002	2003	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Acepromazine+Hydroxyl acepromazine													1	1
Ambroxol+Flunixin												1		1
Amphetamine+Methamphetamine						1	1			1				3
Caffeine+Amidopyrine	1					2	2			1				6
Caffeine+Codeine			2											2
Caffeine +Dexamethasone		3												3
Caffeine+Diclofenac			2											2
Caffeine+Dipyrone						3	2				1			6
Caffeine+Flunixin		3												3
Caffeine +Ephedrine			4											4
Caffeine +Epinephrine					1									1
Caffeine+Isoflupredone		1												1
Caffeine+Nicotine	1			1										2
Caffeine+Phenylbutazone			5		2									7
Caffeine+Theophylline	7													7
Codeine+phenylbutazone			1											1
Dipyrone+Aminopyrine	1										1			2
Dipyrone+Flunixin												1		1
Dypirone+Methyl amino Antipyrin									2					2
Dyphylline+Heptaminol									1					1
Flunixin+Lignocaine				1										1
Flunixin+Meloxicam												1		1
Lignocaine+Procaine				1										1
Morphine+Caffeine	5	1			1				1					8
Morphine+Clenbuterol													1	1
Morphine+Codeine	1	3							4	1	2	3		14
Morphine+Flunixin	1				1									2
Morphine+Heptaminol											1			1
Morphine+Ketoprofen	1							1						2
Morphine+Lignocaine					3									3
Morphine+Dyphylline	3	1												4
Morphine+Phenylbuthazone					1									1
Morphine+Prednisolone		1												1
Morphine+Phenytoin	4	1												5
Morphine+Theophylline	1													1
Nandrolone+Estranediol											2			2
Procaine+Ranitidine											1			1
Phenylbutazone+Hydroxy phenbutazone											2			2
Phenylbutazone+Oxyphenbutazone									11	9	3	7		30
Dyphylline+Corticosteroids		8												8
Teri phenylamine+Ranitidine	1					1	1					1		4
Theophylline+aminophylline	3	7												10
Caffeine+Flunixin+Morphine				1	1	1	2							5
Caffeine+Theophylline+Aminophylline	3	4	3											10
Dexamethazone+Morphine+Codeine										1				1
Ibuprofen+Morphine+Codeine								1						1
Ketoprofen+Lignocaine+Caffeine				1										1
Morphine+Caffeine+Dyphylline	1	1												2
Morphine+Codeine+Caffeine	1	1								1				3
Morphine+Codeine+Flunixin	1					2	1							4
Morphine+Codeine+ Dyphylline		1												1
Morphine+Dipyrone+ Methyl amino Antipyrin													1	1

Table 3. Continued															
Morphine+Phenylbuthazone+caffeine										1					1
Morphine+Phenytoin+ Flunixin	1														1
Morphine+ Dyphylline +Flunixin	1														1
Phenylbutazone+Dexamethazone+Lidocaine													1		1
Phenylbutazone+Oxyphenbutazone+Dexamethazone											1		2	1	4
Phenylbutazone+Oxyphenbutazone+Diclophenac									1						1
Phenylbutazone+Oxyphenbutazone+Flunixin										1					1
Phenylbutazone+Oxyphenbutazone+Hydroxy methadone											1				1
Phenylbutazone+Oxyphenbutazone+Morphine											1		1	1	3
Phenylbutazone+Oxyphenbutazone+Procaine									1						1
Phenylbutazone+Theophylline+Aminophylline	1	1													2
Morphine+Codeine+Caffeine+Theophylline						1	1						1		3
Phenylbutazone+Oxyphenbutazone+Ambroxol+ Flunixin													1		1
Phenylbutazone+Oxyphenbutazone+Caffeine+ Morphine												1			1
Phenylbutazone+Oxyphenbutazone+Caffeine+ Theophylline											1	1			2
Phenylbutazone+Oxyphenbutazone+Codeine+ Morphine						1	1		2			1			5
Phenylbutazone+Oxyphenbutazone+Flunixin+ Ketoprofen													1		1
Phenylbutazone+Oxyphenbutazone+Flunixin+ Hydroxy lignocaine												1			1
Phenylbutazone+Oxyphenbutazone+Morphine+ Xylazine						1					1				2
Phenylbutazone+Oxyphenbutazone+Caffeine+ Morphine+Codeine													1		1
Phenylbutazone+Oxyphenbutazone+Caffeine+ Theophylline+Flunixin						1					1				2
Phenylbutazone+Oxyphenbutazone+Morphine+ Codeine+Flunixin												1			1
Phenylbutazone+Oxyphenbutazone+Morphine+ Ketoprofen+Flunixin	1												1		2
Morphine+Codeine+Flunixin+Diclophenac+Tolfenamic acid +Ketoprofen+Caffeine						1					1				2
Total	40	37	17	5	10	15	11	4	23	21	18	23	5	229	

Table 4. Single drug doping list at the ranking of a racehorse during 2002, 2003, and 2005-2015 in Iran

	2002	2003	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Acepromazine						1							1	2
Ambroxol			2									3		5
Amidopyrin						1				1	1			3
Aminophylline	1													1
Amphetamine							1			1				2
Beta hydroxy stanazole							1					1		2
Boldenone	1								1					2
Buprenorphine	1													1
Caffeine	19	4	55	3		6	3		3	10	3	3		109
Chlorpheniramine												1		1
Clenbuterol											4	1	1	6
Codeine			5			3	1	1	6	4	5	5		30
Corticosteroids		2				1								3
Dexamethazone	3	6				2			1	4		4	1	21
Diclophenac								1		1				2
Dipyrone									2	1	2	1	1	7
Dyphylline	1								1					2
Estranediol											2			2
Flunixin	4	7	2	1	2	3	2	2	1	8	8	7	1	48
Furosemide										1				1
Heptaminol								2	1		4			7
Hydroxyl Acepromazine													1	1
Hydroxy ethyl promazine										1		2		3
Hydroxy lignocaine										1	1			2
Hydroxy phenbutazone											2			2
Hydroxy Tilpromazine					1									1
Hydroxy Xylazine					1									1
Ibuprofen								1						1
Isoflupredone		6												6
Ketoprofen	3	9						1	1	1		2		17
Lidocaine			3				1					1		5
Lignocaine				2	2									4
Meloxicam									1			5		6
Methamphetamine										1				1
Methadone									1					1
Methyl amino Antipyrin									2				1	3
Methyl prednisolone							1			2				3
Morphine	22	20		16	15	4	3	2	10	7	12	27	19	157

Table 4. Continued														
Naproxen									1	1				2
Nikethamide			1											1
Nandrolone	1						1				2			4
Nordazepam				1										1
Nordiazepam				1								2		3
Orphenadrine									2			2	1	5
Oxyphenbutazone								2	14	15	10	14	2	57
Phenylbutazone	6	12	16	3	3	3	4	2	17	15	13	15	2	111
Prednisolone	1													1
Procaine			1	1	1			1			1			5
Propoxyphene												4		4
Ranitidine											1	1		2
Staniline												1		1
Stanolone										3	5	7	4	19
Strychnine													1	1
Teripelennamine												1		1
Testosterone							1					4	2	7
Theophylline	1									2	1	1		5
Tolfenamic acid										1				1
Tramadol											1			1
Xylazine										1				1
Total	64	66	85	28	25	24	19	15	65	82	78	115	38	704

Table 5. The most and the minimal drug consumed at the ranking of a racehorse during 2002, 2003, and 2005-2015 in Iran

Ranking horse	**Commonly used drug**		**Minimally used drug**	
	Drug	**Number (%)**	**Drug**	**Number (%)**
First	Morphine	45 (22.05)	Tramadol	1 (0.49)
	Phenylbutazone	29 (14.21)	Teripelennamine	1 (0.49)
	Oxyphenbutazone	25 (12.45)	Acepromazine	1 (0.49)
Second	Morphine	37 (17.7)	Acepromazine	1 (0.48)
	Phenylbutazone	37 (17.7)	Dyphylline	1 (0.48)
	Oxyphenbutazone	28 (13.39)	Clenbuterol	1 (0.48)
Third	Morphine	2 (10)	Stanolone	1 (5)
	Phenylbutazone	3 (15)	Orphenadrine	1 (5)
	Oxyphenbutazone	2 (10)	Nandrolone	1 (5)

4. Discussion

Drug abuse in sports stories appears weekly in the national papers, from the Tour de France to the Olympics to weightlifting. Closely related to betting, horse racing has always been a potential target for performance-inhibiting and performance-enhancing issues[13]. Performance-enhancing agents can be added to the body with different methods, including injection, orally, placed under the skin with gradual absorption, by enema, through membranes, rubbing on the skin, and put illegally in the saddle or harness. Many regulations are intended to prevent doping in horse races. According to anti-dope agency rules, most country racing has developed sophisticated testing procedures to ensure that the most effective deterrents are in place[14]. Doping is committed for a variety of reasons, including the desire to win (the current form of doping to win the competition with caffeine and apomorphine), combatting rivals (for debilitating the competitor with barbiturates, xylazine), treatment (to restore normal functioning of horses and treatment of disease with furosemide, Phenylbutazone, flunixin), and lack of knowledge (contamination of urine sample with nicotine or caffeine during sampling and eating the plants contain salicylate or caffeine before race). The Racing Commissioners International (RCI) has classified determined dope drugs. The drug classification method is based on pharmacology, drug usage trends, and a substance's suitability for use in racing horses[15,16]. The following broad parameters are used to determine categorization. First, in pharmacology, drugs that are known to be powerful stimulants or depressants are classified as higher, while those that have (or would be anticipated to have) minimal influence on the outcome of a race are classified as lower.

Second, include patterns of drug use that mean the positioning of pharmaceuticals is given considerable attention based on real experience with how they are used and the types of positive tests that have been obtained. For example, procaine positives have been connected, in large part, to the administration of procaine penicillin. As a direct consequence of this, procaine was assigned to the Class 3 category rather than the Class 2 category. Third, regarding the appropriateness of the use of drugs, the drugs that are used in horse therapy are categorized into lower groups. Higher drug classifications are assigned to substances that are not designed for use in horses, particularly if there is a possibility that they might influence the outcome of a race[2,5]. Drugs that are legitimately effective in horse therapy but have the potential to alter the outcome of a race are classified in the intermediate or higher classes of medications[7]. Drugs are classified into five groups; Opiates, opium derivatives, synthetic opioids, psychoactive substances, amphetamines, amphetamine-like medications, and related drugs, including but not limited to apomorphine, nikethamide,

mazindol, pemoline, and pentylenetetrazol, belong within Class 1. Class 2 includes Medicines that have a high potential for performance alteration but not as much as those in Class 1. These medications are not routinely utilized as therapeutic agents in racehorses or as therapeutic agents with a high risk of abuse. This category includes psychotropic drugs, specific neurological and cardiovascular system stimulants, depressants, and neuromuscular blocking agents. Injectable local anesthetics are included in this class due to their high potential for abuse as nerve-blocking medicines. Class 3 drugs include the autonomic nervous system, procaine, antihistamines with sedative properties, and diuretics, which may or may not have a generally recognized medical purpose in racing horses. Class 4 includes the therapeutic medications that are less likely to hinder performance than those in Class 3. This class of medications includes less powerful diuretics, anabolic steroids, corticosteroids, antihistamines and skeletal muscle relaxants with notable CNS effects, expectorants and mucolytics, hemostatics, cardiac glycosides and antiarrhythmics, topical anesthetics, antidiarrheals, and moderate analgesics. This category also includes nonsteroidal anti-inflammatory drugs (NSAIDs). Class 5 includes therapeutic drugs that racing jurisdictions that have specified concentration restrictions, as well as particular miscellaneous substances like dimethylsulfoxide (DMSO) and other pharmaceuticals as decided by regulatory organizations. Agents with particularly localized activities, such as anti-ulcer medicines and some anti-allergic medications, are expressly listed. Class five also includes anticoagulant medications[2,5].

According to the findings of this survey, NSAIDs are the most commonly reported drugs. The most notable aspect of this study was the high prevalence of morphine in Iran, which is greater than in developed nations[9]. According to the current study's findings, the dope rate in Iran has significantly grown throughout the study period. Despite the criminality of the morphine administration, the use of morphine as a drug has not decreased in races throughout the years. This high incidence rate may be investigated from two aspects. It might have a forensic or historical background (the use of morphine in horses dates back many years in Iran), or it could be unintentional[9]. Morphine is derived from the *Papaver somniferum* plant and is from the native Middle East[10]. It is used as an anti-analgesic drug for many years. Pharmacological studies indicated that morphine acts as a central nervous system stimulant in equine species, so the drug increases locomotor activity and alertness[9]. A high incidence of morphine in positive samples might be attributed to the consumption of plants containing morphine in the pasture[9,10]. The dope rate has reduced with time. In the current study, the lower amount of dope might be attributed to better trainer understanding and legal attention to this issue.

5. Conclusion

The results showed that the dope rate reduced from 2002 to 2015 in Iran racehorses. NSAID was the most prevalent (38.42%) drug family used for doping. In addition, this study revealed that the most used drugs were morphine, phenylbutazone, oxyphenbutazone, and caffeine in Iran. The results indicated that 704 single doping drugs (76.93%) and 229 (23.07%) drug combinations were used during 2002, 2003, and 2005-2015. Increasing the level of the trainer's knowledge and performing legal attention can be effective in controlling doping.

Declarations

Competing interests

There is no conflict of interest.

Authors' contribution

Meysam Tehrani Sharif and Amir Zakian designed the study and collected data. Meysam Tehrani sharif Analysed the data. Meysam Tehrani Sharif and Amir Zakian prepared the manuscript. The final manuscript draft was reviewed by all authors who approved it.

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Ethical considerations

All authors have reviewed the ethical issues (including plagiarism, consent to publish, misconduct, data fabrication and falsification, double publishing and submission, and redundancy).

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References

1. Stevenson A, editor. Oxford Dictionary of English. Oxford University Press, USA; 2010 Aug 19.
2. Toutain PL. Veterinary medicines and competition animals: The question of medication versus doping control. In: Cunningham F, Elliott J, Lees P, editors. Comparative and Veterinary Pharmacology. Handbook of Experimental Pharmacology, vol 199. Berlin, Heidelberg: Springer; 2010. p. 315-339. DOI: 10.1007/978-3-642-10324-7_13
3. Fédération equestre internationale (FEI) [International Equestrian Federation]. Available at: www.horsesport.org
4. World anti-doping agency (WADA). Available at: https://www.wada-ama.org/en/%20accessed%20in%2001/01/2008
5. Fragkaki AG, Kioukia-Fougia N, Kiousi P, Kioussi M, and Tsivou M. Challenges in detecting substances for equine anti-doping. Drug Test Anal. 2017; 9(9): 1291-1303. DOI: 10.1002/dta.2162
6. Higgins AJ. PL04 from ancient Greece to modern Athens: 3000 years of doping in competition horses. J vet Pharmacol Therap. 2006; 29(1): 1-10.
7. Wong ASY, Leung GNW, Leung DKK, and Wan TSM. Doping control analysis of anabolic steroids in equine urine by gas chromatography-tandem mass spectrometry. Drug Test Anal. 2017; 9(9): 1320-1327. DOI: 10.1002/dta.2090
8. Tou K, Cawley A, Bowen C, Sornalingam K, and Fu S. Measurements of hydrocortisone and cortisone for longitudinal profiling of equine

plasma by liquid chromatography-tandem mass spectrometry. Drug Test Anal. 2022; 14(5): 943-952. DOI: 10.1002/dta.3244
9. Lotfollahzadeh S, Mokhber-Dezfouli MR, Tajik P, Bokaie S, and Watson DG. A survey on two years of medication regulation in horse races in Iran. Equine Vet J. 2010; 42(2): 161-163. DOI: 10.2746/042516409X471449
10. Zakian A, Sharif M, Shahrani H, Gholami N, Rezaeian H, and Elikaei V. Doping with strychnine in Turkomen stallion race-horse in Iran: A case report. Der Pharm. Lett. 2015; 7(6): 110-115. Available at: https://www.cabdirect.org/cabdirect/abstract/20153270948
11. Prohibited substances. International Federation of horseracing authorities, Boulogne; 2009. p. 20-23. Available at: https://www.ifhaonline.org/resources/prohibited_substances_2009.pdf
12. Knych HK, Stanley SD, Harrison LM, and Mckemie DS. Pharmacokinetics of betamethasone in plasma, urine, and synovial fluid following intra-articular administration to exercised thoroughbred horses. Drug Test Anal. 2017; 9(9): 1385-1391. DOI: 10.1002/dta.2170
13. Keen B, Cawley A, Reedy B, and Fu S. Metabolomics in clinical and forensic toxicology, sports anti-doping and veterinary residues. Drug Test Anal. 2022; 14(5): 794-807. DOI: 10.1002/dta.3245
14. Dahlgren AR, Knych HK, Arthur RM, Durbin-Johnson BP, and Finno CJ. Transcriptomic markers of recombinant human erythropoietin micro-dosing in thoroughbred horses. Genes. 2021; 12(12): 1874. DOI: 10.3390/genes12121874
15. Bravo-Veyrat S, and Hopfgartner G. Mass specspectrometry-basedh-throughput bioanalysis of low molecular weight compounds: Are we ready to support personalized medicine?. Anal Bioanal Chem. 2022; 414(1): 181-192. DOI: 10.1007/s00216-021-03583-2
16. Budhraja A, Camargo AF, Hughes C, Lehner AF, Stirling K, Bernna N, et al. Caffeine and theobromine identifications in post-race urines: Threshold levels and regulatory significance of such identifications. AAEP Proc. 2007; 53: 87-92. Available at: https://b2n.ir/d46511