

Use and attitudes toward dietary supplements and drugs amongst Italian elite athletes and its correlation with banned doping substances

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ABSTRACT

Athletes frequently use dietary supplements (DS) to find better results as soon as possible. Moreover, they also will be occurring in “polypharmacy” or in substances prohibited for doping. The aim of this retrospective sectional study was to explore use and attitudes toward drugs and dietary supplements (DS) in Italian Sports Federations and its correlation with banned doping substances token amongst elite athletes. The data shows the results from 2012 to 2017, among Italian Sports Federations elite athletes and the analysis of the anti-doping controls from the Ministry of Health annual reports. The results show that the largest number of supplements consumption declarations was recorded in 2014 in sport as cycling and athletics. Moreover, in the same year and in 2012 there were 48 and 42 declarations on 58 and 52 doped athletes. Among the Italian federations, three are particularly controlled: FCI - cycling, FIDAL - athletics and FIGC – football. Most of the consumers subjects are male athletes. So maybe there is a link between NS and positive results in anti-doping test. The consumption of health products is constantly expanding and educational interventions will be needed to improve drugs and DS use about elite athletes as well in amateur athletes. **Keywords:** Nutrition supplements; Drugs; Sport; Health; Athletes.

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INTRODUCTION

Nutritional supplements can be grouped into dietary supplements, ergogenic aids and sport foods. Their use among athletes is very popular: most studies reported that over half of the athletes use supplements and food supplement use was more common among university students (in particular, those in health professional graduate courses) than high school students. Other studies reported even that 88% of the athletes use one or more nutritional supplements (Biffi et al., 2018; Sirico et al., 2018 a). A large range of different types and brands of products for nutritional supplementation (are present in the form of pills, tablets, capsules and liquids) is now really widespread and accepted by athletes (Mazzeo et al., 2013). Moreover, nourishment is planned for each individual and is established on physicality and type of training (Altavilla et al., 2018; Montesano et al., 2013; 29; Reardon, et al., 2019). In our time, research has clearly documented the beneficial effects of nutrition on exercise performance (Mazzeo et al., 2016). The scientists, then, emphasizes the importance of good nutrition in order to improve performance and they as well can improve the effectiveness using unconventional methods (i.e. pilates) in a Team Sport (Montesano & Mazzeo, 2018). Moreover, many athletes use DS as part of their regular training or competition repetitive. Energy and hydration is a key role also in performance and consequently in the final result of competition (Mazzeo et al., 2016). Moreover, the use of performance-enhancing substances in sport is that relating to the protection of the health of athletes. Health promotion goes through good nutrition and a lifestyle aimed at achieving psychophysical wellbeing and in addition physical exercise improved the inflammatory state in children with obesity (Sirico et al., 2018). Anyway, recently, has there been a growing understanding of human nutrition and its effects on metabolism and its implications on sports performance. Unfortunately, nowadays, "intense training - adequate diet" paradigm seems to have gone out of fashion as the athletes try to improve their physical performance in the shortest possible time. For those reasons, they are willing to assume substances of various types, including supplements (Mazzeo et al., 2016; de Hon et al., 2015; Lazic et al., 2011).

Among the various pharmacological substances used by athletes, we can distinguish supplements, drugs and doping substances. The Italian decree n. 164 of 21.05.2004 defines supplements are *"food products intended to supplement the common diet and which are a concentrated source of nutrients, such as vitamins and minerals, or other substances having a nutritional or physiological effect, in particular, but not exclusively, amino acids, fats essential acids, fibres and extracts of plant origin"*. Moreover, according to the Directive 2002/46/CE, they are marketed in dose form, namely form such as capsules, pastilles, tablets, pills and other similar forms, sachets of powder ampoules of liquids, drop dispensing bottles, and other similar forms of liquids and powders designed to be taken in measured small unit quantities (Mazzeo et al. 2018).

As concern the drug, for the Italian and National Drug Agency, it is a substance or association of substances used to treat or prevent diseases. At least, doping substances are drugs used by athletes in order to illegally enhance physical performance (Mazzeo et al., 2016) and they are included into the World Anti-doping Agency (WADA) list (Mazzeo et al., 2018). Another difference between the above-mentioned substances is the availability: illegal drug, in fact, is less available than a nutritional supplement and thus, consumption of supplements is more widespread. Furthermore, the greater availability leads athletes to believe in their safety (Mazzeo & Raiola, 2018).

People intake supplement for different reasons: to build muscles, to increase strength, to prevent diseases and to improve performance in sport (Molinero et al., 2009; Cust et al. 2008; Braun et al. 2009). Some researches show that older people usually intake multivitamin and mineral supplements while younger, creatine (Maughan, 2005). Moreover, people choose supplements according to the type of exercise program and sport (Scofield et al. 2006; Mazzeo et al., 2018).

Unfortunately, an excessive and incorrect use of supplements can have negative consequences on health, not known by athletes (Mazzeo et al., 2016e). This is due not only to the poor knowledge of those last one but also because, often, people who advise supplements, such as the technical staff, don't have knowledge of the aforementioned substances (Molinero et al., 2009). In a study of Sundgot-Borgen the authors found that 50% of coaching Norwegian elite female athletes don't have education in sports, physiology or nutrition (Sundgot-Borgen et al., 2003).

In addition, the information on the packaging of these products is incomplete or even hidden. In fact, the nutritional supplements labels may hide the presence of illegal substances, such as doping substances (Mazzeo et al. 2016). Some stimulants, for example, such as caffeine and ephedrine, are present in herbal tonics (Maughan, 2009; Pipe et al. 2002). The intake of certain concentrations of these substances is considered doping by WADA (Mazzeo et al., 2018). In fact, many recent studies have shown contamination of supplements with prohibited compounds. In some cases, the presence of these substances was mild, but in other cases, the quantity exceeded declared up to 150% (Pipe et al., 2002; Gurley et al., 2000).

Anyway, the consumption of health products is constantly expanding in United States. For example, the US population at a cost of 6.5 billion dollars in 1996 reached 18 billion in 2002 and the intake of supplements by American athlete's ranges from 40% to 88% (Scofield et al. 2006; Dodge et al. 2003). Moreover, there isn't evidence about the long term benefits linked to supplements (Reinert et al., 2005).

The aim of this retrospective sectional study was to explore use and attitudes toward drugs and dietary supplements (DS) in elite athletes of Italian sports federations and the correlation with banned doping substances token by athletes.

MATERIALS AND METHODS

Participants and Procedures

The investigation was conducted from 2012 to 2017, among professional elite Italian athletes of National Sports Federations. The data, during race periods, show of the anti-doping controls carried out by the Ministry of Health. During the test, to the athletes is required to submit a semi structured questionnaire concerning the use of products from the health.

The authors have firstly analysed the data of each single report of the above mentioned Ministry, then they have extrapolated and combined the information on the consumption of NS.

RESULTS

Analysing the number of athletes who declared the consumption of health products compared to the total of those who have been subjected to doping tests, it is noted that in 2014 there was the highest number of declarations. In fact, out of 1427 athletes subjected to doping tests, 1040 were the registrants. In that year, then, there was the highest number of men and women reporting supplements 'consumption (671 men and 369 women). As for the men, their number has always been higher than 600 from 2012 to 2014. Similarly, for women, in the aforementioned period, the number has been constant: 360 in 2012, 363 in 2013 and 369 in 2014 (Figure 1).

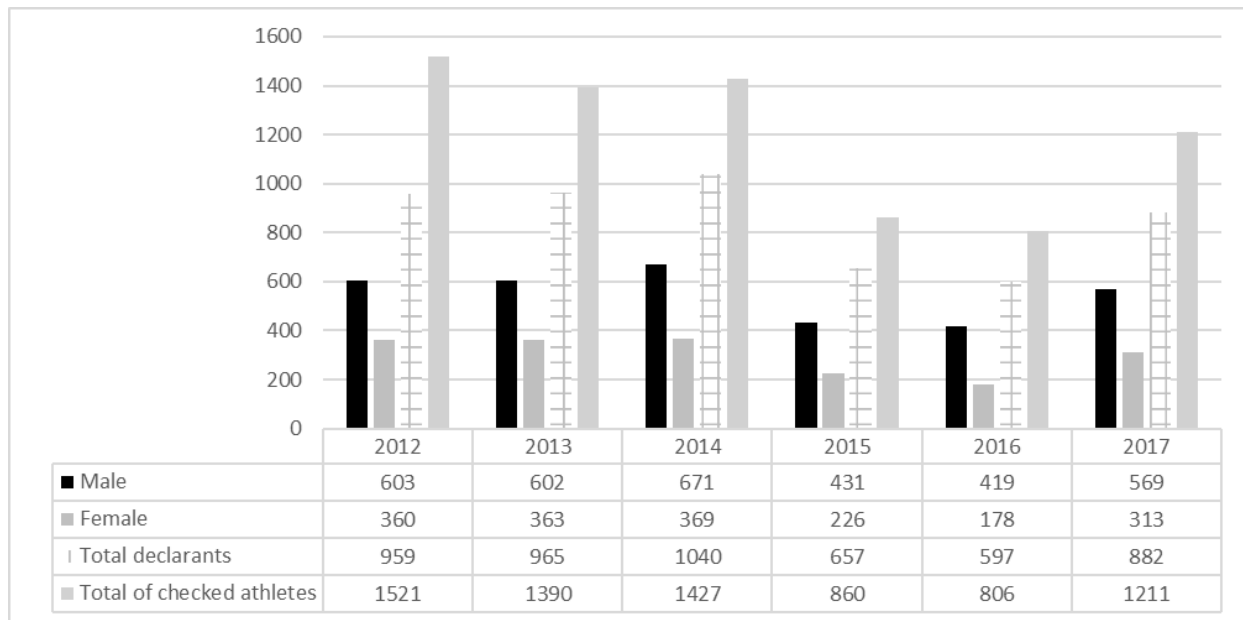


Figure 1. Distribution of athletes who have declared the intake of health products.

Among the Italian federations, three are particularly controlled: FCI - cycling, FIDAL - athletics and FIGC - football. They, in fact, not only have been checked every year during the considered period, but the number of athletes checked is relatively high: 1544 in cycling, 999 in athletics and 831 in football. In addition, the largest number of supplements 'consumption declarations was recorded in 2014 in cycling (123) and in athletics (99). In cycling, then, there are the highest numbers of declarations of consumption of vitamins: from 54 in 2014 to 40 in the previous year. Even athletics, after cycling, records the highest numbers that settle below 30 (2014 is the highest value of 26) (Table 1).

Table 1. Distribution of athletes who have declared the consumption of vitamins (V) and supplements (N) on the total number of athletes analysed (T)

Sports Bodies	12			13			14			15			16			17		
	T	N	V	T	N	V	T	N	V	T	N	V	T	N	V	T	N	V
ASC- Beach trail																8	7	2
CSEN -CrossFit																18	13	6
FASI - Climbing	12	0	0	8	1	0	16	2	2	4	3	0	4	2	0	4	1	0
FCI – Cycling	298	57	30	323	112	40	373	123	54	190	71	24	140	55	18	220	103	28
FGI - Gymnastics	12	5	1		2	1	15	7	1	8	2	0						
FIBBN - Amateur Bodybuilding Natural				6	0	1	7	6	2							4	2	0
FIBS - Baseball and Softball	64	9	2		5	2	12	2	0	48	17	2	4	0	0			
FIC - Rowing				12	2	1	20	3	4	12	2	0	8	3	0	45	8	4
FICK - Canoe Kayak	20	8	1	20	13	1	44	12	4	22	4	0	6	2	0	12	5	0
FICSF - Canoe seat fixed													4	0	0	8	2	1
FIDAF - Amer. Football	8	2	0	12	4	0	12	1	0									
FIDAL - Track and field	137	56	21	158	53	12	237	99	26	120	44	21	178	71	23	169	78	25
FIDS - Dance Sport				8	2	1	24	5	1				8	0	0			
FIG – Golf	35	10	2	8	5	0	23	3	3									
FIGC - Football	184	38	4	172	46	8	77	13	1	100	37	3	122	29	8	176	40	7
FIGH - Handball	60	7	1	100	15	8	36	3	1	29	5	0	12	2	1	40	2	2

FIGMMA -Grappling JiuJitsu Martial Arts	8	3	1				8	4	0				7	4	0			
FIGS - Squash				4	1	1	4	3	0				4	0	0	4	0	0
FIH - Hockey	24	2	1	4	0	0												
FIHP - Hockey and Skating							4	1	0				8	4	1			
FIJLKAM - Judo Wrestling Karate	16	5	2				16	5	1	16	10	2	23	5	3	34	7	1
FIKB - FIKBMS Kick Boxing	14	2	1	23	9	0	16	5	1									
FIN -Swimming	56	22	5	92	23	8	125	40	11	56	22	2	47	20	2	76	32	4
FIP - Basketball	108	32	10	40	16	4	28	7	2	24	4	0	64	19	1	132	50	11
FIPAV - Volleyball	28	5	1	73	16	4	11	3	0	32	7	0	36	16	2	68	31	8
FIPE - FIPCF Weights and physical culture	5	2	0		2	0	8	4	2							20	11	1
FIPL - Powerlifting																8	7	0
FIPM -Modern Pentathlon													8	2	0			
FIPSAS - Game fishing					2	0	24	9	1				8	3	1			
FIR -Rugby	76	7	4	20	3	0	28	7	2	30	9	1	32	9	2	17	7	0
FIS -Fencing	56	17	4	53	9	1	48	20	4	16	4	0				29	14	5
FISB -Bowling				4	0	0												
FISE - Equestrian sports				8	4	1				1	1	0						
FISG - Ice Sports	53	5	2	60	11	3	12	5	0	16	6	1	16	4	2	36	9	1
FISI - Winter Sports	94	22	8	71	30	10	42	17	2				22	9	3			
FISKY- Skyrunning																7	4	0
FISO - Sport and orientation				11	0	0												
FIT -Tennis	52	15	2	8	3	1	12	3	0	24	10	3	20	5	0	4	2	0
FITA - Taekwondo	16	3	1	8	1	0	8	3	0	8	1	1	4	0	0	8	1	0
FITARCO -Archery	8	3	1	4	0	0	32	4	2	20	10	1				36	12	5
FITAV - Clay Pigeon Shooting							4	1	0	8	4	0						
FITeT - Table tennis	28	5	1	8	1	0												
FITRI -Triathlon	35	13	7	12	3	2	46	25	1	44	14	5	24	16	4	20	11	3
FIV - Sailing				4	0	0	12	5	0	12	1	0						
FIWuK - Wushu Kung Fu										4	2	3						
FPI -Boxing				4	2	0	4	3	1	8	0	0				8	6	2
IBFF - International Bodybuilding and Fitness Federation	2	2	0															
NBFI- Natural Bodybuilding Fitness	8	7	3							8	6	6						
UISP - Unione Italiana Sport per tutti							4	0	0									
UIITS - Shooting gallery							37	3	2									
WABBA - World amateur body building													3	3	1			

The Table 2 shows what kind of the health products hired by athletes: in 2017 there was the highest consumption of supplements with 798 statements, followed by 727 in 2014. In the same years, there was, in fact, an almost similar consumption of amino acids and its derivatives (159 in 2017 and 155 in 2014). The highest vitamin consumption was recorded in 2014 with 155 statements followed by 137 in 2012 and 136 in 2017. Finally, the highest intake of mineral salts occurred in 2014 with 135 statements.

Table 2. Distribution of consumption declarations of supplements

	Declaration of consumption	Nutritional supplements	Amino acids and derivatives	Vitamins	Mineral salts
2017	1215	798	159	136	122
2016	736	494	79	85	78
2015	753	457	101	88	107
2014	1172	727	155	155	135
2013	938	584	106	120	128
2012	776	495	77	137	67

** Attention: the number of declarations could be higher than the checked athletes because the athlete could declare the intaking of one or more supplement

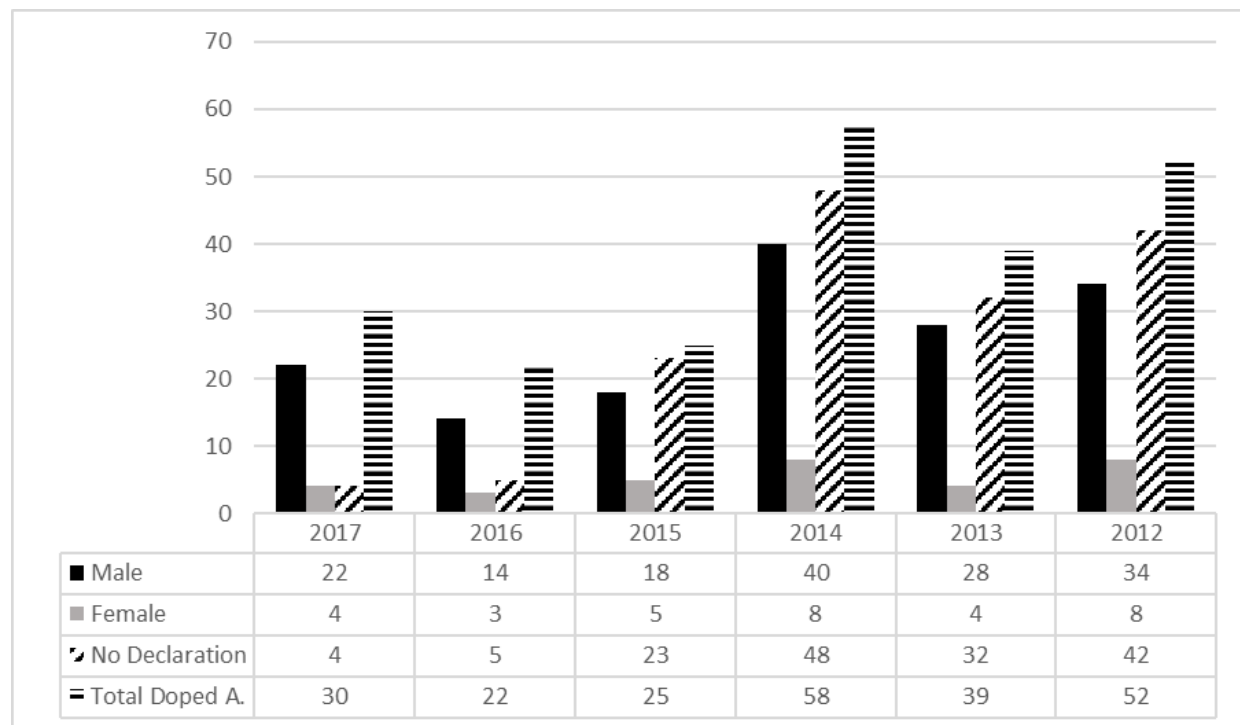


Figure 2. Doped Male and female athletes who have declared the consumption of supplement and total of all doped athlete.

Table 3. Population age distribution for year

	2012	2013	2014	2015	2016	2017
< 19	193	301	259	220	143	242
19-24	505	370	315	191	173	324
24-29	290	233	194	147	140	185
29-34	197	166	143	84	101	158
34-39	103	111	139	80	84	117
39-44	101	95	146	60	67	79
> 44	126	111	231	78	95	103
No data	6	3		0	3	3
Average Age	30	33	43	38	37	35

As regards the number of doped athletes who declared the consumption of healthy habits, we can see that in 2014 and 2012 there were 48 and 42 declarations on 58 and 52 doped athletes (Figure 2). Furthermore, it is well known that most of the above-mentioned subjects are male (Figure 2) and (Table 3).

DISCUSSION

Knowing the diffusion of the consumption of the healthy products is very important in order to understand what kind of products are most consumed, in which sports, and what correspondence is there between the doped athletes and those who have taken the said products.

Reviews of the published literature reported that the consumptions of NS depends on several factor: the type of sport, the sex of the athletes and the level of competition (Pesce et al. 2004; Mazzeo, F., Santamaria, S., & Montesano, P., 2019). For example, in the study of Burke & Read 1993 and Brill & Keane 1994, all the analysed weightlifters or bodybuilders intake NS (Burke et al. 1994; Brill et al. 1995).

According to Suzic et al., 2011 the athletes who practice individual sport take more dietary supplements than those of collective sports.

Mazzeo et al., 2016 showed that boxers take DS for sport and health. They have no awareness of the benefits of supplements and when and which supplements can be used in the event of a sedentary or sporting life.

The study of Boardley et al., 2016 shows that the consumption of supplements depends on the athlete gender. In his investigation, the author have analysed dances and he believes that the difference is linked to the desired effect: physical or aesthetic. In particular, male athletes want strength and the increase of muscles while female aims to achieve a drier, more defined body. Another important factor in the consumption of supplement is the level of the athlete. The higher the level of athletes, the greater the chance that they will take supplements to bear the physical load of intense workouts and competitions, to recover strength and endure pain (Boardley et al., 2016; Giannopoulou et al., 2013).

The study shows that athletes practicing middle-distance athletics improve performance if the training programs are also based on the administration of an adequate diet and on the calculation of oxidative stress that evaluates the amount of release of free radicals (Altavilla et al., 2018). The athletes must perform training sessions that prepare the competition and must then be able to recover the exhausted energies during the work process.

During the recovery phase the disposal of lactic acid must be favoured, exploiting the activity of the circulatory stream, and the reintegration of glycogen through the intake, in the two hours immediately after the competition, of 1gr of glucose per body weight and, if necessary, the controlled use of supplements.

Moreover, in elite athletes, the misuse and abuse of the abovementioned substances represents a serious health problem, as well as sports lawfulness, because the ergogenic aids can conceal doping substances present in the WADA list and are not always subject to strict controls (Mazzeo, 2016; Mazzeo et al., 2016). In competitive competitions, in fact, the use of any drug substance prohibited by WADA is allowed only for medical reasons and only by virtue of an exemption for therapeutic purposes and therefore documented by the doctor. The anti-doping code establishes the sanctions that violators must meet, and there are many information campaigns on health risks related to the use of drugs without a real therapeutic purpose (Mazzeo et al., 2018).

Polypharmacy", which is the prolonged intake of one or more supplements over time, which could have negative consequences on the health (Mazzeo et al., 2018). Moreover, supplements could hide substances included in the WADA list and, therefore, be prohibited. In the case of positive substances, WADA provides for severe penalties (Mazzeo et al., 2018).

From a generic point of view, the nature of the action of any ergogenic aid can be explained by: the direct action of muscle fibre, the neutralization of fatigue products, the supply of energy substrates necessary for muscle contraction, an influence on the cardiovascular and respiratory system, a delay in the beginning of fatigue or its perception, the neutralization of the inhibitory effects of the central nervous system on muscle contraction and other functions (Mazzeo 2018; Karimian et al. 2011).

Lots of studies show that the high values of micronutrient indicators does not match an enhanced athletic performance in healthy athletes (Sundgot-Borgen et al. 2003) and some NS can decrease the performance (Malm et al., 1997). Nevertheless, elite athletes intake NS, in particular creatine and amino acids, believing that they can boost the performance (Terjung et al., 2000).

While it is undisputed that athletes do not know the negative consequences of taking NS, on the other hand, they make a careful cost-benefit comparison before taking them (Maughan, 2005). Moreover, more and more often athletes are encouraged to take substances of any kind pushed by their coaches in order to achieve ever greater success and, therefore, financial income (Mazzeo et al. 2016c). The problem is not only of a medical nature but also of ethics, as it attempts to alter physical performance through the use of these substances (Mazzeo et al., 2018). It would be advisable not only for greater controls but for the widespread diffusion of greater knowledge on what sportsmen really need, starting from the family environment up to the athlete's technical and medical staff (Mazzeo et al. 2016). Compared to a recent past, now we are well aware of the fact that not all food supplements are safe, despite the label saying otherwise (Suzic et al. 2011). The athlete must pay close attention to the contents of the supplement both to protect his health and his sports career because he could be accused of having taken doping substances (Mazzeo et al., 2016). In fact, the principle of strict liability is applied for having taken the doping substance, even in a non-fraudulent manner (Maughan, 2005). As concern the food supplements sector, it is regulated by the Directive 2002/46/EC which provides the definition of food supplement, as above mentioned (Mazzeo et al. 2016e). Moreover, the Directive 2000/13/EC regulates the labelling which, together with the presentation and the advertising, must not attribute to food supplements the property of preventing, treating or curing a human disease, or refer to such properties. Every kind of information or advertisement must not assert that a healthy and balanced diet is not able to make nutritive substances in sufficient quantities. The labelling, in fact, shall contain the name of the categories of nutrients or substances that characterize the product or an indication of the nature of those nutrients or substances, the portion of the product recommend for daily consumption. A warning does not exceed the stated recommended daily dose, a statement to the effect that food supplements should not be used as a substitute for a varied diet, a statement to the effect that the products should be stored out of the reach of young children.

CONCLUSION

There are potential risk of a positive doping result, as a consequence of the presence of prohibited substances that are not declared on the label associated with all dietary supplement. Finally, the Italian Decree n 169 of 2004 obliges that, in case of presence plants or other natural substances, the advertising must contain the warning that may be incurred in the unwanted side effects. In the perspective of the organic measures for the training and recruitment of teachers, particular attention deserves the field of motor and

sports sciences that preside at the teaching of physical education in secondary school of first grade and of motor and sports science in secondary school of second grade (Mazzeo et al. 2016; D'Elia et al., 2018).

This data are compared and analysed with the available data reported in web scientific databases. The authors concluded that the consumption of health products is constantly expanding and educational interventions will be needed to improve drugs and DS use about elite athletes as well in amateur athletes.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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