

## Dietary Supplements Use in Competitive and Non-Competitive Boxer: An Exploratory Study

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Received date: January 20, 2016; Accepted date: April 10, 2016; Published date: April 15, 2016

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### Abstract

Intensity training, talent, and an adequate diet represent the crucial factors for the success of athletes. Unfortunately, athletes prefer intaking substances to quicker and easier increase their performance compared to traditional training. For this reason there has been a significant spread of enhancing substances drugs and dietary supplements (DS), although, as already broadly evidenced, the abuse of those substances could seriously damage athletes' health. Indeed, DS could contain substances that are not declared on the label, which are banned by the World Anti-Doping Agency (WADA). This exploratory study aims to investigate DS phenomenon, specifically, we want to describe this phenomenon among boxers, analyzing typologies of DS intaken, knowledge about DS, main reasons for justifying DS abuse, and places where boxers buy them and potential consultants about suggesting their consumption. Data were collected through a total of 214 anonymous self-report questionnaires administered to boxers in Campania (Italy), 169 questionnaires were considered valid. The study collects data exclusively for male athletes. Indeed, the results demonstrate that boxers, mainly men (88.4% of the sample), practice sport mostly for fun and they intake DS for balancing out nutritional deficiencies and having more energy. Mineral salts (N=88) and vitamins (N=85) are broadly intaken compared to other substances. The consumption of DS is recommended by coach in the competitive athletes (N=33), against non-competitive boxer whom consultant is the doctor (N=25). Boxers mostly buy the supplements in the drugstore. In summary, the results demonstrate that boxers widely intake DS for improving their performance. Also, implications for research and practice are discussed.

**Keywords:** Dietary supplements; Box; Food supplement regulation; Sport; Anti-doping; Economic impact

### Introduction

Intensity training, talent and adequate diet have been recognized as the main factors which contribute to the success of athletes [1-3]. Unfortunately, because of the numerous changes occurred in the world in the last decades, such as the globalization of the market, the internationalization of the firms, and the high level of competitiveness in terms of commodities and services provided, the stakeholders practice an increasing pressure in the sport industry, especially on athletes, making deep changes in the values system [4-6]. Indeed, the athletes look for and want the maximum success quicker than before and in every way. For those reasons, in the last years we observe an explosive spread of enhancing substances drugs and dietary supplements (DS) [7-9]. Otherwise, some scholars argue that DS can have positive effects on athletes' health, improving their performance; in fact numerous studies have shown that athletes can benefit from higher protein intakes [10], especially those who are in a caloric deficit such as a boxer cutting weight for a competition [11]. Dietary protein supplements can provide a convenient and affordable way to meet this increased intake. No adverse effects have been observed with protein intakes as high as 5.5 times the RDA [12,13].

Furthermore the International Society of Sports Nutrition has called creatine monohydrate one of the safest and most effective supplements legally available [14]. No adverse effects of creatine monohydrate have been observed in individuals with normal kidney function [15]. In fact, 1-2 kg lean mass is typically observed within the first 4-28 days as a result of intracellular water [16].

Caffeine consumption (3-5 mg/kg bodyweight) has been shown to increase muscular power [17,18], endurance [19], and exercise performance in a fatigued state [20,21]. These beneficial effects are observed at a dosage below what has been shown to be safe to consume (6 mg/kg bodyweight/day) [22].

For instance, the substance ephedra plus caffeine can boost immediate physical performance for fit young men, although no evidence shows that ephedra or ephedrine improve long-term physical performance of athletes, but both substances can increase the risks for nausea, vomiting, palpitations and jitteriness [23].

Likewise, other contributions in the literature evidence serious damages to athletes' health because of using DS [24].

However, the main negative effect related to the abuse of those substances consists of serious damages for athletes' health; in fact, athletes do not exactly know all the effects of those substances on their health and in general on their body. Moreover, information and data are often incomplete, indeed, DS could contain substances drug which

are not declared on the label and, thus, have been banned by the World Anti-Doping Agency (WADA). Hence, the consumption of these substances could be not only harmful but also illicit. Furthermore, all athletes, amateurs and professionals, could be in serious danger because their medical and technical staff, their friends and others could often suggest the consumption of the above-mentioned substances. Several reasons could explain the decision made by athletes to intake DS: to balance nutritional deficiencies, to reduce inflammation and/or to enhance performance [25-27].

Focusing our attention on the consumption of DS, we already outlined that this phenomenon is spreading very quickly [28-30]. For instance, in the United States (U.S), Americans have spent 6.5 billion dollars in 1996 against 18 billion in 2002, with an increase about more than 55% [31-33]. This massive consumption is mainly due to the large different types and brands available everywhere: drugstore, sport stores and internet [34-36]. Indeed, over 30.000 supplements are available only in the U.S [37-39]. Furthermore, some recorded data show that their consumption in professional athletes covers a broad range from 57% to 94% [40-42].

Lastly, another significant reason of this spreading can be associated to the sponsorship from DS companies. Indeed, all the media play a crucial role in their consumption, significantly affecting its development [43,44], for instance, relevant effects derived from the advertisement during an important sport event.

Starting from the above brief considerations, this exploratory study aims to investigate DS phenomenon, specifically, we want to describe this phenomenon in one specific sport discipline, that is among Italian boxers, analyzing typologies of DS intaken, knowledge about DS, main reasons for justifying DS abuse, and places where boxers buy them, and potential consultants about suggesting their consumption [45].

## Methodology

This is a survey field study conducted through anonymous self-report questionnaires administered among non-competitors and competitors boxers in Campania Region (Italy). We collected and gathered information and data about the DS phenomenon investigated conducting primary surveys, which is anonymous self-report questionnaires which become essential component for analyzing unknown issue. Indeed, surveys are able to collect quantitative information and data about the characteristics, actions, behaviours, or opinions of a large group of people, referred to as a predefined population.

The research was executed in several stages. We firstly carried out a deep literature review on DS issue evidencing the main considerations by scholars on the phenomenon trying to exam insights and challenges of the regulations on this issue, also analyzing its economic impact and the main managerial implications. Specifically, all the main contributions in the literature concerning DS were searched through various web databases, such as PubMed, Scopus and web institutional databases. Secondly, we conducted a survey field study, collecting data through anonymous questionnaires to boxers in Campania (Italy) during 3-months' time (Oct-Dec 2012).

## Methods and sample

Study was carried out in Italy, in fact, 214 anonymous self-report questionnaires were administered to boxers in Campania Region between October and December 2012; 169 questionnaires were

considered valid. The authors personally contacted the manager of sport's club asking the authorization to contact some of their affiliated box athletes.

They have been identified from the Italian Olympic Committee's (C.O.N.I.) database. The questionnaire contains 18 questions, divided into 5 sections. The first one concerns general information, mostly demographic data, such as age, gender, residence and education. The second one focuses on boxers' category and the reasons for which athletes decide to play. The third one is about how many times and hours per week athletes on average train. The section four concerns information and knowledge about DS, specific benefits athletes have intaking DS substances and what they know about the phenomenon, positive and negative effects, and where athletes can buy them and who recommend them. The last section is about athletes' diet.

The authors have distinguished competitive (C) from non-competitive (NC) boxers categories: the first one concerns professionals and beginners, while the second one includes only amateurs.

The authors' hypothesis is the presence of lots differences between the above-mentioned categories concerning what kind of DS they intake and the reason of this consumption. At the same time the authors think that all analysed athletes have the same knowledge about DS, that they buy them at the same place and mainly the medical staff recommends the consumption. Finally, differences would be about that consumption for health and sport reasons.

Thanks to the deep study of previous contributions of the literature, the following hypotheses have been developed:

**Hypothesis 1:** Competitive (C) boxers, that are professionals and beginners, differ from non-competitive (NC) boxers that are amateurs, for two reasons: typologies of DS intaken and reasons to justify this DS consumption.

**Hypothesis 2:** Competitive (C) boxers, that is professionals and beginners, do not differ from non-competitive (NC) boxers that is amateurs, in terms of knowledge they have about DS, the place where they buy them and in both categories the medical staff recommends the consumption.

**Hypothesis 3:** Competitive (C) boxers, that are professionals and beginners, differ from non-competitive (NC) boxers that are amateurs, for reasons to explain DS consumption, in details for sport or health reason.

## Statistical analysis

The R Project for Statistical Computing software (version 3.1.0) was used for statistical analyses. Means and SD were calculated for each experimental variable and statistical significance was set at  $p < 0.05$ .

## Results

### Personal data and education

On 169 questionnaires, 6 are without answer about categories and age. Perhaps the age of only 163 athletes, both categories C and NC boxers, have their peak between 18-28 ages with 58.1% of C and 47.1% NC (Table 1). There is statistically significant difference between the gender's athletes in both categories. In C and NC the percentage of male athletes is respectively 81.4% and 96.6% against women with 18.6% and 6.4%. More than half of C and N-C come from Naples.

Information	Data	Competitive	Non-Competitive
Age	10-17	31 ± 2-3.3%	9 ± 0.02-2.9%
	18-28	54 ± 1-58.1%	33 ± 0.05-47.1%
	29-39	7 ± 0.2-7.5%	22 ± 0.7-31.4%
	40-50	1 ± 0.03-1.1%	4 ± 0.02 -5.7%
	51-61	0	0
	62-72	0	2 ± 0.07-2.9%
Sex	Male	57 ± 2-81.4%	88 ± 4-96.6%
	Female	13 ± 1-18.6%	6 ± 0.5-6.4%
Residence	Naples	54 ± 2	57 ± 2
	Salerno	6 ± 0.4	1 ± 0.05
	Caserta	32 ± 5	3 ± 0.02
	Avellino	1 ± 0.004	8 ± 1
Education	Middle s. certificate	48 ± 1-51.1%	16 ± 1.1-22.2%
	Secondary s. degree	41±2-43.6%	3 ± 60.9-50%
	Degree	5±0.02-5.3%	17 ± 0.05-23.6%
	Post degree	0	3 ± 0.2-4.2%

**Table 1:** Personal information Comparison between Competitive (C) and Non-Competitive (N-C) boxers (Mean, SD and %).

With reference to the education level, 38.1% declared have Middle school certificate, 47% Secondary school degree, 13% Degree, 1.8% Post degree. Comparing C and NC boxers, the highest level of education in the first one is the bachelor but most of them have middle school certificate (51.1%) while in the second one, the highest level is post degree but most of them have secondary school degree (50%).

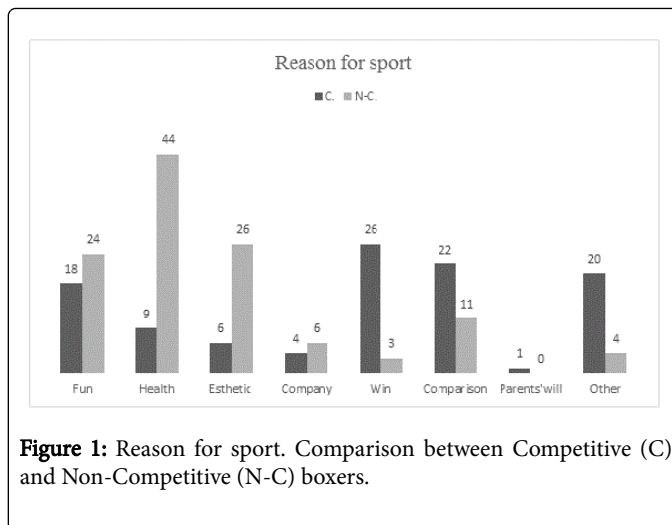
### Reasons for sport

Question 2 is about the reasons for which athletes practice sport. Most of boxers practice sport mainly for health (N=53) and for fun (N=40). C boxers practice sport for win (N=26), comparison (N=22) and "other" (N=20). On the other hand, NC boxers play for health (N=44), for aesthetic reasons (N=26) and fun (N=24) (Figure 1).

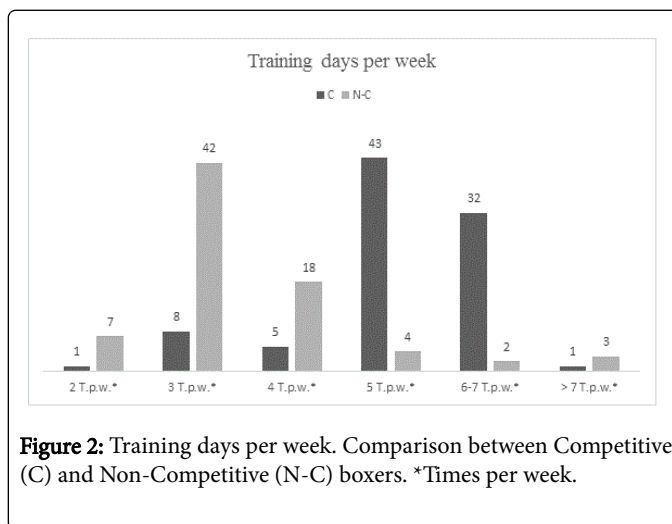
### Training

Questions 3 and 4 concern how many hours and times per week athletes spend for training.

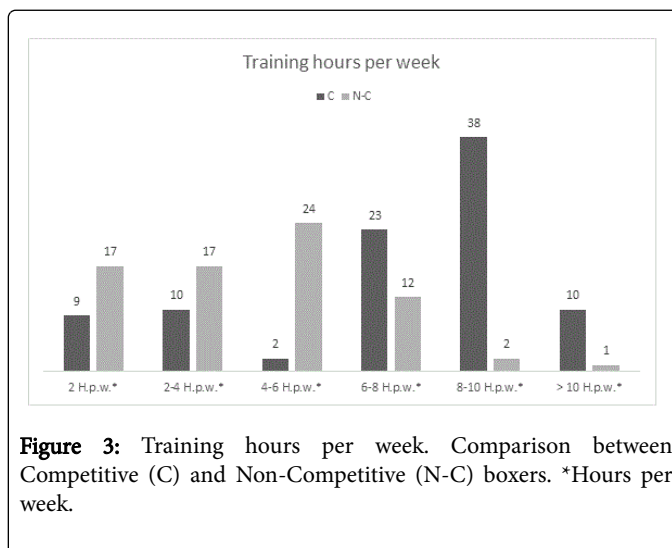
There is statistically significant difference in times per week (t.p.w.) of training between the analysed categories. Indeed C trains mainly 5 and/or 6/7 t.p.w. (respectively 43 and 32 answers – 25.9% and 19.3% of 166 considered answers) and NC mainly 3 t.p.w. (43 a. – 25.3%). Similar responses concern hours spent for training (h.p.w.). Indeed, on 165 (4 are without answer about h.p.w) questionnaires 23% of C (N=38) trains 8-10 h.p.w and 13.9% (N=23) trains 6-8 h.p.w., while 14.5% (N=24) of NC trains from 4 to 6 hours and 10.3% (N=17) trains 2 hours and from 2 to 4 (Figures 2 and 3).



**Figure 1:** Reason for sport. Comparison between Competitive (C) and Non-Competitive (N-C) boxers.



**Figure 2:** Training days per week. Comparison between Competitive (C) and Non-Competitive (N-C) boxers. \*Times per week.



**Figure 3:** Training hours per week. Comparison between Competitive (C) and Non-Competitive (N-C) boxers. \*Hours per week.

Concerning the knowledge about the effects and benefits of DS, C boxers have mainly answered that they are supplements for nutritional deficiencies and they are useful only in this specific case. N-C boxers completely agree with the first category about the benefits but for those

DS are mainly energy substances (Figure 4). Anyway, most of them answered that they use DS substances to balance the nutritional deficiencies and to enhance their performance, respectively for C boxers 29 and 20 answers and for NC boxers 25 and 15 (Figure 4). Moreover, 79 C boxers and 55 NC boxers have answered that DS are vitamins and 77 C boxers and 47 NC boxers conceive DS as mineral salts (Figure 5). The above-mentioned substances are the most taken for health and sport (Figure 6). On the other hand, no one boxer says that they do not intake anabolic substances.

In both categories the doctor recommends to intake DS. In contrast, the coach is the main person who suggests the above-mentioned intaking DS in C boxers with 33 answers against 14 of NC boxers (Figure 7). Anyway, both categories mostly buy DS in drugstore (Figure 8).

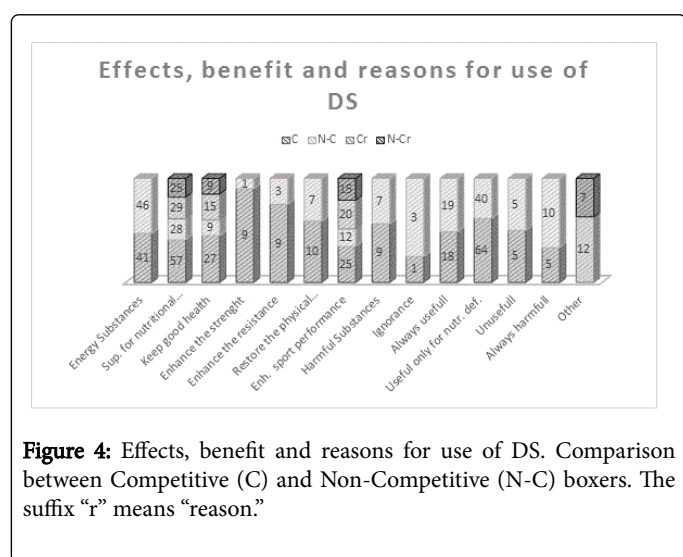


Figure 4: Effects, benefit and reasons for use of DS. Comparison between Competitive (C) and Non-Competitive (N-C) boxers. The suffix "r" means "reason."

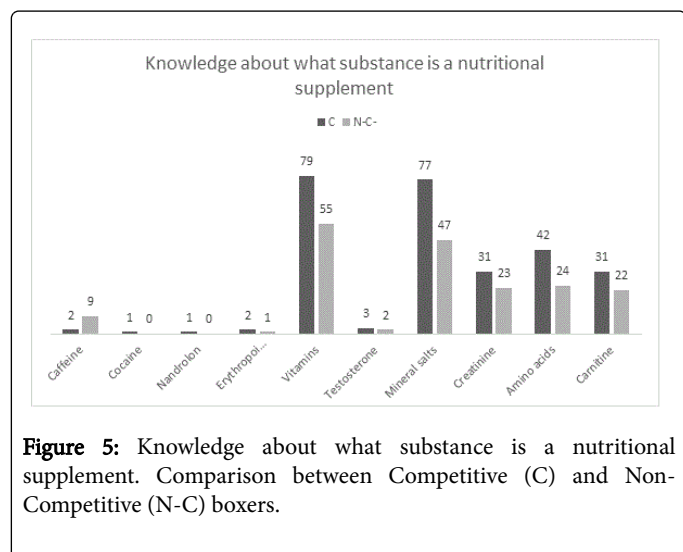


Figure 5: Knowledge about what substance is a nutritional supplement. Comparison between Competitive (C) and Non-Competitive (N-C) boxers.

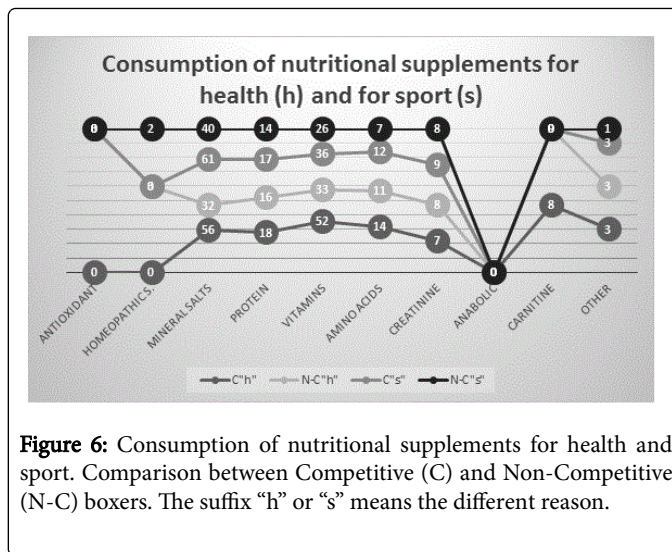


Figure 6: Consumption of nutritional supplements for health and sport. Comparison between Competitive (C) and Non-Competitive (N-C) boxers. The suffix "h" or "s" means the different reason.

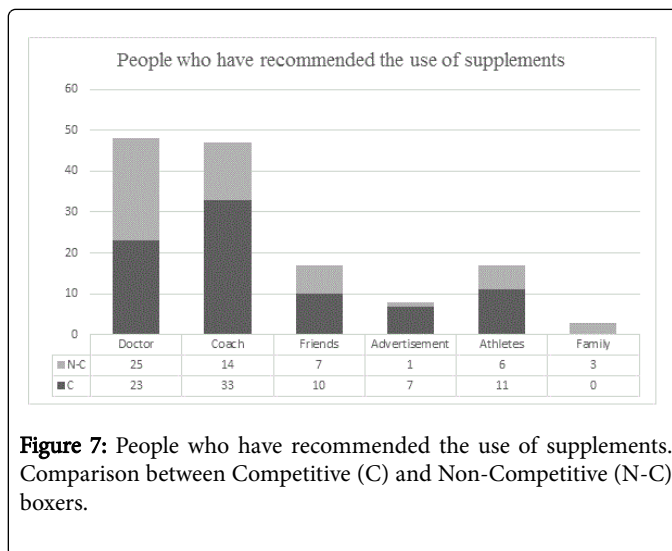


Figure 7: People who have recommended the use of supplements. Comparison between Competitive (C) and Non-Competitive (N-C) boxers.

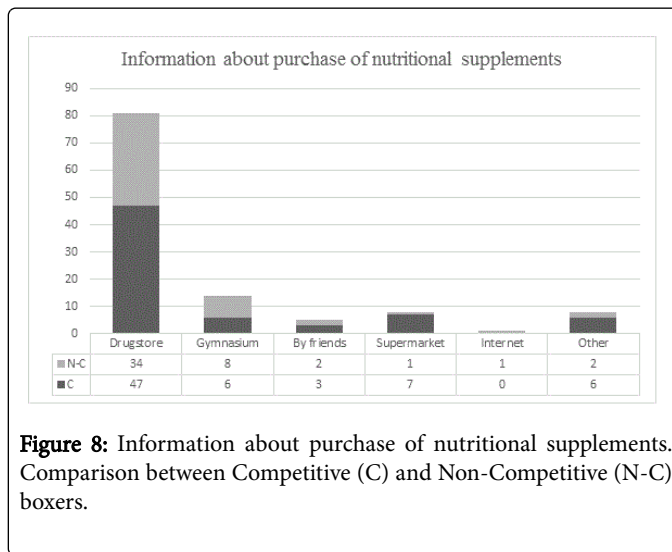


Figure 8: Information about purchase of nutritional supplements. Comparison between Competitive (C) and Non-Competitive (N-C) boxers.

Last two questions of questionnaire concern information about boxers' diet. Regarding the question about if athletes follow a balanced diet and in case of affirmative answer, if there is someone who check it, most of athletes regularly follow a diet, in particular C boxers (N=56) (Figure 9). Almost all the boxers in the sample are autonomous: only 5 C boxers and 5 NC boxers are monitored by one doctor and 12 C boxers and 2 NC boxers by one coach.

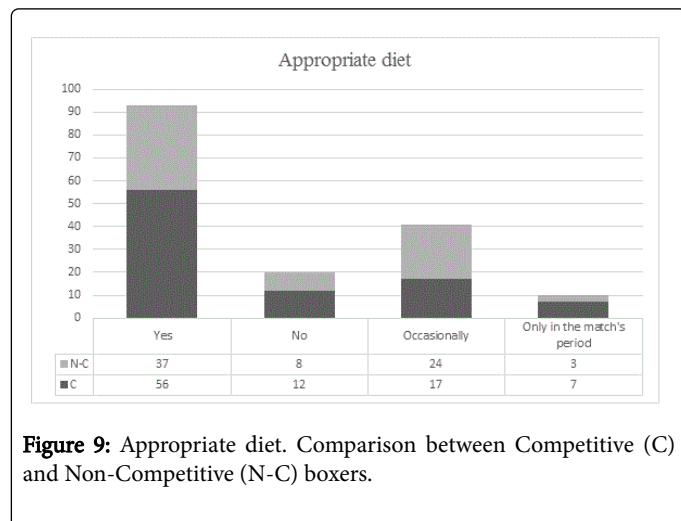


Figure 9: Appropriate diet. Comparison between Competitive (C) and Non-Competitive (N-C) boxers.

## Discussion

Knowing the nutritional and eating habits of athletes is very important [46] and the frequent use of a questionnaire as instrument of evaluation is due to understand if athletes implement the recommendations received by the government [43,47].

Suzic et al. found that athletes involved in individual sport practice used higher quantities of DS compared to those competing in team sport; indeed, in individual sport a small advantage could be very important [40].

Results show that C and NC boxers practice this kind of sport for different reasons. Firstly, C boxers mainly practice this sport for win and in order to compare with others, while NC boxers practice this sport for health, to improve physical appearance and for fun. Certainly, this context regarding the reasons to practice plays a relevant role in the regularity of training. Indeed, the times and the hours spent per week for training of C boxers are greater than -C boxers. Maybe this result could explain why most of C boxers answered that they intake DS for nutritional deficiencies against NC boxers who easily consider DS as substances able to give energy [48,49].

Both categories, C and NC boxers, mainly intake vitamins and mineral salts. There are not relevant differences in consumption for health and for sport. This result maybe means that athletes do not have adequate knowledge about the different benefits of other DS and when one specific DS is more useful than others in case of sedentary and/or sport lifestyle [50,51]. However, the most important result is about that no one intakes drugs like cocaine and anabolic substances although those substances give to the athletes, respectively, better ability to concentrate, reduced sense of fatigue, increased aggressiveness and competitiveness and increase of muscle mass, strength and power.

Moreover, considering that C boxers tend to spend more than their time in the gym, maybe they have a close relationship with their coach

who recommends the consumption of DS compared to NC athletes. Furthermore, both athletes buy in drugstore the DS [52].

Finally, the study does not support the initial hypotheses developed about the differences in consumption of DS between C and NC boxers, the reason of using DS and people who recommend them. However, the study confirms that the athletes have the same knowledge about DS and they usually buy them in the same place.

## Benefits linked to the intake of the main DS

In this section, the focus is on some specific main DS, such as mineral salts, vitamins and antioxidant, amino-acids and protein, caffeine, and creatine [53,54].

Mineral salts are natural elements with various benefits for the body. They carry out a plastic function in the structure of teeth and bones. Moreover, they help to maintain a normal pulse, control the muscle's contraction, the nervous transmission and carry out the cellular metabolism [55-57].

Nowadays, well-known vitamins are 13. They are divided in hydro-soluble and lipid-soluble. They are organic substances, which do not give energy and do not implement the development of body mass. Anyway, they help the body to acquire energy from the food [58,59]. They regulate metabolism, and influence a number of physiological processes important to exercise or sport performance, such as in processing carbohydrate and fats for energy production. Moreover, B vitamins are essential to help form hemoglobin in red blood cells too.

Antioxidant vitamins include vitamins C, E and beta-carotene, while coenzyme Q10 (CoQ10) is a lipid with vitamin characteristics [60,61]. They could prevent and/or restore muscle tissue damage (vitamin C). Vitamin E enhances oxygen utilization during exercise at altitude. Coenzyme Q10 may improve oxygen in the heart and skeletal muscles, and could improve aerobic endurance performance. Anyway, there are controversial studies about the real benefit of them. At the same time, there are not adverse effects linked to its use. May be, its consumption is suggested in the daily diet [62,63].

Simple molecules generate proteins. Amino-acids and protein carry out lots of functions in the body. Indeed, they control lots of processes inside the body in the form of hormones and enzymes. Like mineral salts, they have a plastic function and transport lots of nutrients and other substances (fat, oxygen and so on). Moreover, amino-acids give to the body energy and protect it from external dangerous thanks to the improvement of immune system and the presence of keratin which generates nails and hair [64,65]. Caffeine, like stimulant, reduces the sense of fatigue, improves the brain answer and implements muscle fiber recruitment. It stimulates reaction time, the mental alertness and the psycho stimulatory action. Moreover, it increases heart rate [66,67].

Caffeine is rapidly absorbed and has a long-term effect. However, the body's response depends on the athlete's habits. Indeed, if an athlete regularly intakes a high dose of caffeine, to improve his/her performance; he/she has to intake higher doses of that than normal. Furthermore, an abuse of caffeine can generate adverse effects such as aggression, an insulin resistance in skeletal muscle and tachycardia [68-70]. Lastly, caffeine was considered a doping substance banned by WADA but right now it is in the 2016 monitoring program. Indeed, according to the art. 4.5 of World Anti-Doping Code "WADA, in consultation with Signatories and governments, shall establish a monitoring program regarding substances which are not on the

Prohibited List, but which WADA wishes to monitor in order to detect patterns of misuse in sport”.

Regarding the creatine, its positive effects on performance stem from its ability to release energy during the maximum need to the metabolism. Moreover, athletes intake creatine in order to increase muscle strength and power. Furthermore, it implements the fat-free mass, the recovery from exercise, and it reduces muscle relaxation time [71-73].

### Risks associated with the use of dietary supplements

Although most literature still lack of important scientific data on the improvement of athlete's performance in case of consumption of DS, there are several studies on the adverse effects in the body in case of “polypharmacy”: an inadequate and abuse of DS. In particular, some scholars found out that a long-term consumption of one or more DS has many strong consequences [74]. Moreover, associated to the use of DS, relevant troubling considerations are about the consumption of illicit or harmful substances too. Indeed, in many cases, DS contain undeclared enhancing substances drug which are banned by WADA [75]. DS could derive from plants, such as ephedra. Perhaps, even if they are natural products, they could be prohibited by WADA (see e.g. ephedrine). Moreover, though a low ingestion is accepted, the presence in the body of a high quantity of a particular substance could be forbidden. In this case, an athlete could be positive to anti-doping tests and undergo to a sanction. Furthermore, DS could contain less active ingredients than reported on the label and the athlete does not have the desired effects.

From a hygienic point of view, not always DS can be sure due to inadequate packaging. Indeed, most DS come from other countries and, during the transport, the packaging could broke [76,77].

### Concluding Remarks

All studies show that an adequate and various diet ensures, under normal circumstances, all micro and macro-nutrients of which the human body needs [47,48]. DS may be ingested from different and variegated foods and they can be naturally contained in foods or added to them both for technological or nutritional purposes. Otherwise, the evolution occurred in the way to cook and eat and the actual and contemporary people lifestyle has led individuals, specifically athletes, to intake low vitamins and minerals. Maybe, they choose to supplement their diet with DS; indeed, we observe an explosive spread of enhancing substances drugs and nutritional supplements.

Anyway, the advantages linked to the consumption of DS are not still scientifically demonstrated [75] and an excessive abuse of vitamins and minerals may result in adverse effects. Unfortunately, people do not know the effects of those substances in their body. Therefore, it is necessary that people, in details athletes, know the maximum quantity of DS to intake per day and for this reason, EU and Italian regulations establish specific rules about this issue and prohibit to the pharmaceutical companies the writing on the packaging DS benefits non-existent or not scientifically proven.

Boxers investigated in this study from Campania in 2012 mainly intake vitamins and mineral salts for health and for sport and they also mainly buy them in drug store. May be they or their technical medical staff does not have a complete knowledge about DS and they do not disclose relevant information on DS in terms of their benefits and negative effects on the individuals' health. Otherwise, our study

represents a starting research point with several limitations. First, the sample of Italian boxers is too small. Second, the positive and negative impact of DS on athletes' health need to be better investigated especially considering box sport discipline with its peculiarities and criticisms. Finally, this study could benefit from a control group that does not use DS, but in this step of our working progress research the data detection occurred during the training session for the athletes before the main competitions. Thus, it could be useful and interesting to investigate the athletes and their habits in using DS after the completion or far from any specific training sessions, and data can be compared. We are already conducting new test, and collecting other data administrating surveys to athletes not waiting for competitions.

**Declaration of interest:** The authors report no conflicts of interest.

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