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RISK FACTORS

Doping use among tertiary education students in six developed countries

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Abstract. Data on doping among young non-professional athletes are scarce. In order to estimate the prevalence and predictors of doping use, a standardized, anonymous questionnaire was self-administered by 2650 tertiary education students from five European Union countries (Finland, France, Germany, Greece, Italy) and Israel. The reported usage rate of a doping agent (at least once) was 2.6%, with no significant variation in the frequency of doping reporting among the participating countries. Doping was, however, less common among students of biomedical schools (OR: 0.49, 95% CI: 0.27–0.89) and was higher among males (OR: 2.16, 95% CI: 1.25–3.74). Students, who use to drink coffee or recall frequent occasions of involvement in drunkenness episodes, were more likely (twice and three times, respectively) to report doping, and students using nutritional supplements or having participated in a major athletic event were more likely (four times and twice, respectively) to report doping in comparison with students who do not. Of note is the high odds ratio for reporting individual doping when having a friend who uses doping (OR: 8.61, 95% CI: 4.49–16.53). Given the large size of the physically active young individuals in the population and the small number of professional athletes, doping in the general population may be, in absolute terms, as sizeable problem as it is among the professional athletes. There was evidence that high-risk behaviour and supplement use increased the risk of doping.

Key words: Amateur athletes, Behaviour, Doping, Drugs, Physical activity, Young adults

Abbreviations: BMI = body mass index; CI = confidence intervals; CEREPRI = Centre for Research and Prevention of Injuries; OR = odds ratios

Introduction

The number of individuals participating in sports has increased considerably in the last few decades and health authorities have encouraged this trend due to the widely recognized benefits of physical activity [1]. Along with the increasing number of individuals involved in sport activities, however, the use of doping agents has emerged as a crucial public health issue [2–5]. Doping is the use of an expedient (substance or method) that is potentially harmful to the athletes' health and/or capable of enhancing their performance or the presence in the athlete's body of a prohibited substance or evidence of the use of a prohibited method [6]. Doping violates sports ethics and may have serious implications on the physical and mental health of the athletes [7–9], including cardiovascular conditions [10], renal complications [11], rhabdomyolysis [12] infectious complications from the injection technique used in self-administration [13], tendon and ligaments ruptures [14] thyroidal impairment [15], azoospermia [16], major mood disturbances [17] and even increased premature mortality [18].

Among professional athletes there are strict anti-doping regulations although the problem persists [9, 19]. Elite athletes are a highly visible but relatively small group, at high risk for using doping agents. There is concern, however, that doping may be increasing among amateur athletes and even among

young people who are physically active. Indeed, the use of doping agents by this group is not uncommon [20–22]. Most of these studies were conducted in North America and Northern Europe and the majority has focused on high school students. The converging evidence is that the prevalence of single trial of doping agents among young amateur athletes is not negligible, occasionally reaching 15% [23, 24]. Use of doping agents in this group probably involves not only a desire to enhance appearance or sports performance but appears also to relate to the use of alcohol, tobacco and psychotropic drugs [25]. Several studies suggest that doping is frequently part of a broader constellation of personality characteristics that include high-risk behaviours and substance abuse [22, 25, 26]. High-risk behaviour can be related to individual psychological factors such as low self-esteem, lack of control and need for acceptance in the social network [27].

In order to ascertain the prevalence and the predictors of doping use among young non-professional athletes, six academic centres from the European Union countries and Israel have undertaken the present study, which was coordinated by the Centre for Research and Prevention of Injuries (CEREPRI) in Greece. Given that non-professional athletes form a large fraction among the young, their health represents an obvious public health priority. In particular, the target population was students of tertiary education who represent a relatively large as well as accessible fraction of young persons in the developed countries. In operational terms, the aim of this study was to ascertain the prevalence and predictors of doping use among tertiary education students in five European countries and Israel. In particular, because high risk behaviours tend to cluster within the same individual [28], we explored whether doping was more frequent among those with higher BMI, those who use to smoke or are heavy coffee drinkers, and those being involved more frequently in binge drinking episodes.

Materials and methods

Following successive meetings with the project collaborators from the six participating countries and after a thorough review of the literature, an anonymous, self-administered questionnaire was developed. The questionnaire focused on doping by categories of substances that were at the time prohibited by the International Olympic Committee, such as androgens, anabolic substances, diuretics, beta-blockers, stimulants, unspecified hormones or unspecified prohibited substances. These categories of substances are still banned in the new list of the World Anti-Doping Agency that came into effect January 1st 2006 [29].

There was a specific question about the use of pharmaceutical substances ever, with the intention of increasing the user's sports performance (''Have you ever taken any pharmaceutical substance with the intention of increasing your sports performance?''), addressed only to those who replied positively to the question ''Do you usually exercise?''. Another question addressed whether a close friend of the responding individual had ever used a performance enhancing substance. Additional information concerned demographic, anthropometric and life style variables as well as intake of supplements and physical activity parameters of the responding individual. Individuals who answered that they do not usually exercise were considered physically inactive and were not eligible for the main analysis. The questionnaire was pilot tested among a group of students of the Athens Medical School and it was subsequently translated in the national languages of the participating countries and back translated in English to ensure consistency.

The questionnaires were randomly administered by research collaborators, to tertiary education students of bio-medically oriented (Medicine, Pharmacy, Dentistry) and non-bio-medically oriented Departments (Economics, Technology, Nutrition and Sports) during class time of the academic period 2001–2002, and the students filled in the questionnaire by themselves. The overall response rate reached 79% (Table 1). The project collaborators sought approval of the study protocol by respective University Ethics Committees.

A uniform coding system was adopted and the data were computerized in Excel files. Initial analyses were performed through simple cross tabulations. Subsequently, odds ratio (OR) for doping (the dependent variable) by specified exposures were estimated through multiple logistic regression. The SAS statistical software was utilized. SAS/STAT User's Guide [30]. Potential confounding factors were always controlled in the models. The following independent variables were included in the analysis: country of origin (five European Union countries, plus Israel); university school (biomedical and non-biomedical with the latter as reference); gender (females as reference and males); age (continuous variable every 1 year); and body mass index (BMI) calculated as a ratio of reported body weight in kilograms over height in square meters (three indicator variables for the categories: <18.5, 18.5–25.0, 25.1–30.0 and 30.1 + kg/m^2 with the second category as reference). The following variables were alternatively introduced into the core model described above: participation in a sporting activity (continuous variable approximately 3 h per week), participation in an international sport event (no, as reference and yes); tobacco smoking (no, as reference and yes); recall of ever drunkenness occasions during lifetime (three indicator variables for the categories: never, 1–3, 4–10 and 11+ occasions with the first category as reference); coffee drinking (no, as reference and yes); supplement

Table 1. Reported doping use among 2650 tertiary education students by country of origin and university department

	No. of participants (response rate %)		No (%) reporting minimal exercise			
Country	N	(%)	N	(%)	Department	University
Finland	671	(57%)	21	(3.13)	Medical, Technology, Sports	University of Tampere University of Jyväskylä
France	219	(94%)	7	(3.20)	Sports	University Paris 5
Germany	500	(97%)	51	(10.20)	Medical, Sports, Economical	University of Bochum
Greece	592	(97%)	220	(37.16)	Medical, Sports, Nutrition	University of Athens, University of Thessaloniki Harokopion University
Israel	550	(79%)	131	(23.82)	Medical, Pharmacy Dentistry, Medical Sciences, Sports	Hebrew University of Jerusalem, The Zinman College of Physical Education and Sport – Wingate Institute. Natanya
Italy	118	(95%)	47	39.83	Medical	University of Trieste
Total	2650	(79%)	477	18.00		

use (no, as reference and yes); and doping peer (no, as reference and yes).

Results

Overall 2650 tertiary education students were enrolled in the study. The number of completed questionnaires per country varied according to the number of registered students per participating university unit. A total of 477 (Table 1) students indicated that they have minimal interest or involvement in physical activity and these were not included in further analysis. Therefore, subsequent analyses rely on the 2173 students who reported at least a minimal interest or involvement in sports activities. It is worth noting,

Table 2. Reported doping use among 2173 tertiary education students by sociodemographic variables

	Doping reporting		Total	*p* Value from chi square (degrees of freedom)
Variable	N	%	N	
Country of origin				
Finland	25	3.9	650	0.10 (5)
France	3	1.4	212	
Germany	16	3.6	449	
Greece	16	4.3	372	
Italy	2	2.8	71	
Israel	6	1.4	419	
University School				
Biomedical	19	2.1	911	0.02 (1)
Other	49	3.9	1262	
Gender				
Female	21	1.9	1097	0.001 (1)
Male	47	4.4	1076	
Age				
<21 years	5	2.2	224	0.02* (1)
21–26	45	2.8	1611	
27+	18	5.3	338	
BMI				
<18.5 kg/m^2	2	1.7	120	0.04 * (1)
18.5–25.0	54	2.9	1837	
25.1–30.0	11	5.9	188	
30.1+	1	3.4	28	

**p*-Value derived from chi-square for trend.

however, that the proportion of those admitting minimal interest or involvement in physical activity varied widely across participating countries (3–40%).

A total of 68 students (2.6%) reported having used, at least once, a physical performance-enhancing substance (Table 2). Of those, 18 admitted using androgens and/or other anabolics, one growth hormone, one erythropoietin and four other hormones, 20 stimulants of various types, 3 diuretics, 1 beta-blocker, whereas 20 students did not identify the specific substance. Table 2, shows the distribution of students with at least a minimal involvement in sports activities and, among them, those admitting doping by country of origin, type of tertiary education, gender, age and BMI. There was no significant variation on the frequency of doping reporting among the six countries in the study. Doping reporting was less common among students of biomedical schools, higher among male compared to female students, increased with age, and was higher among students with augmented BMI. These data cannot be directly interpreted, however, and serve only descriptive purposes.

Table 3 shows the relation of doping reporting with the extent of involvement in sport activities and by major lifestyle variables. The frequency of doping reporting increased with increasing involvement in sport activities and the linear trend was statistically significant. Moreover, the frequency of doping reporting was more than twice as high among students who participated in international athletic events than among other students. There were significant positive associations of doping reporting with occasions of involvement in drunkenness episodes and coffee drinking. Students who were using nutritional supplements were more than four times as likely to report doping in comparison to students that did not use these supplements. Lastly, students who reported that one of their friends was using doping were more than seven times more likely to admit that they have used doping at least once themselves.

In Table 4 we evaluated the association of doping reporting with each of the variables indicated in Table 3 after controlling for the basic socio-demographic variables shown in Table 2, which is country of origin, type of education, gender, age and BMI. Only type of education and gender retained their significant predictive value of doping reporting in this core model, while age and BMI have no statistical significant associations with doping. Similarly there was a positive association of doping reporting with weekly time spent in sport activities, but this association did not reach statistical significance. All remaining alternatively introduced variables retained

Table 3. Reported doping use among 2173 tertiary education students by variables indicating involvement in sport activities and by major lifestyle characteristics

Variable	Doping reporting		Total	*p* Value from chi square (degrees of freedom)
	N	%	N	
Sporting activity (hrs/week)				
< 4	13	2.4	535	0.04 * (1)
4–6	18	2.5	724	
7–10	21	3.7	571	
11+	16	4.7	343	
Participation in major sport event				
No	47	2.6	1838	0.001 (1)
Yes	21	6.3	335	
Tobacco smoking				
No	49	2.9	1681	0.29 (1)
Yes	19	3.9	492	
Drunkenness occasions never				
Rarely (1–3)	8	1.4	559	0.001*(1)
Frequently (4–10)	15	2.4	637	
Often (11+)	16	4.7	340	
	29	4.6	637	
Coffee drinking				
No	16	2.1	762	0.04 (1)
Yes	52	3.7	1411	
Supplement use				
No	16	1.3	1209	0.001 (1)
Yes	52	5.4	964	
Doping peer				
No	12	0.9	793	0.001 (1)
Yes	56	7.1	1380	

*p-Value derived from chi-square for trend.

Table 4. Multiple logistic regression derived adjusted ORs and 95% confidence intervals (95% CIs) for reporting of doping by socio-demographic variables, involvement in sports activities and lifestyle characteristics

Variable	Category	Ors	95% CIs		*p*-Value
Country of origin	Germany	Reference			
	Finland	1.12	0.58	2.15	0.74
	France	0.36	0.10	1.28	0.11
	Greece	1.60	0.76	3.35	0.21
	Italy	1.46	0.30	7.10	0.64
	Israel	0.56	0.21	1.49	0.25
Gender	Female	Reference			
	Male	2.16	1.25	3.74	0.01
Age	1 years more	1.03	0.98	1.09	0.24
BMI	<18.5 kg/m^2	0.85	0.20	3.70	0.83
	18.5–25.0	Reference			
	25.1–30.0	1.50	0.75	3.01	0.25
	30.1+	1.06	0.14	8.10	0.96
University school	Biomedical	0.49	0.27	0.89	0.02
	Other	Reference			
Alternatively introduced additional variables					
Sporting activity (hrs/week)	~3	1.16	0.90	1.49	0.25
Participation in major sport event	No	Reference			
	Yes	1.98	1.14	3.46	0.02
Tobacco smoking	No	Reference			
	Yes	1.26	0.71	2.24	0.44
Drunkenness occasions	Never	Reference			
	Rarely (1–3)	1.41	0.59	3.38	0.45
	Frequently (4–10)	3.07	1.25	7.55	0.01
	Often (11+)	2.75	1.16	6.54	0.02
Coffee drinking	No	Reference			
	Yes	1.83	1.03	3.27	0.04
Supplement use	No	Reference			
	Yes	4.16	2.28	7.62	0.0001
Doping peer	No	Reference			
	Yes	8.61	4.49	16.53	0.0001

their significant predictive value of doping reporting. Of note were the high ORs with respect to dietary supplement use and having a friend who uses doping (4.16 and 8.61, respectively).

In Table 5, we examined a possible predictive interaction between having a ''doping friend'' and using of self-dietary supplements without medical prescription**.** Being a dietary supplement user and having a friend who uses doping had a supperadditive predictive effect. Thus, using supplements but not having a ''doping friend'' increased the odds of doping reporting 4.9 times, whereas having a friend reporting doping but not him/herself using dietary supplements increased these odds 10.6 times. Combination of these exposures, however, increased the odds of admitting doping to more than twice the level that would be expected by simple addition of the ORs corresponding to the individual exposure.

Discussion

Sports ethics are marred by the use of doping agents. In spite of repeated and valuable efforts, the extent and the correlates of the problem have not been established. In this study we attempted to assess them

Table 5. Reported doping use in relation to dietary supplement use by the individual and peer doping: independent and superadditive effects

	Supplement: no, doping peer: no	Supplement: yes, doping peer: no	Supplement: no, doping peer: yes	Supplement: yes, doping peer: yes
Doping user	3	9	13	43
Non-doping user	846	522	347	390
% of doping users	0.4	1.7	3.6	9.9
Relative risk	1	4.9	10.6	31.1

among tertiary education students of six developed countries who, if anything, should be under-users of these substances. The study relied on population groups that were not, and clearly could not have been, strictly representative, but the similarity of results across the six developed countries provided a mutual reinforcement of their reliability.

This investigation had some unusual features, including its international nature, the use of a standardized common protocol and the coverage of countries in most of which doping among young amateur athletes had not been previously investigated. The results indicated that doping among tertiary education students was rather common, without striking variation among the participating countries. Men were more likely than women to make use of doping agents as shown in most previous studies [24, 25]. Frequency of excess drinking of alcoholic beverages, coffee drinking and participation in major sport events, are all positively associated with doping. These findings were compatible with those reported from several other populations and adjacent age groups, although the strengths of the respective associations may vary [24, 26, 31]. It was of interest, however, that there were no associations of doping reporting with tobacco smoking and weekly time spent in sport activities, after controlling for potential confounding socio-demographic variables. There were also highly significant and striking positive associations of doping with use of supplements and with having a peer who uses doping and an interaction was noted among the latter two factors. On the positive side, being a student of a biomedical school reduced the likelihood of doping, which suggested that increased familiarization with the health risks of doping may have contributed to the reduction of the likelihood of this risk behaviour.

It has been suggested that doping agents may represent a gate leading to a more general substance abuse [25, 26]; our data suggested that dietary supplement use may direct young people towards an ethos of chemically conditioned physical performance and well-being. Dietary supplement industry is frequently unregulated; as a consequence, an abundance of supplement products of dubious value, content, and quality are now available around the world [32–34]. Many supplement products contain substances that are prohibited in sports e.g. ephedrine [33, 35, 36]. Although the participation rate in this investigation was very high, it is still possible that the small proportion of non-participants included a high fraction of individuals who use doping [26]. This would have led to an underestimation of the true prevalence of doping in the study population. Indeed, when referring to their peers, usually the closest friend, the study participants reported a very high frequency of doping. Moreover, it can be argued that doping use may be higher among lower-educated young non-professional athletes who were not addressed as population target in this study. The prevalence, however, of a single trial of doping should not be confused with regular doping. Experimentation is a characteristic of youth and many of those who have tried doping may have decided that it is not worth the risk.

The temptation of using drugs and supplements to improve athletic performance or even to enhance appearance (e.g. with bodybuilding) is very seductive to young people, who are eager for quick results and have little concern for long-term consequences [20]. The results of this study indicated that doping in the general population of young adults was not uncommon in any of the participating countries. In fact, given the relative size of the physically active individuals in the population at large and the number of professional athletes, doping in the general population may be, in absolute terms, as sizeable a problem as it is among the professional athletes. Moreover, there was evidence that the use of supplements increased the risk of doping and some hopeful indication that knowledge of the health risks of doping may reduce its prevalence, as has also been reported by other investigators [21, 37].

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