

## **Can we measure accurately the prevalence of doping?**

### **Abstract**

Questionnaires are used in the majority of the studies on doping prevalence in sport. Nevertheless prevalence is not easy to evaluate and previous epidemiologic studies demonstrated a wide variance. This variance has mostly been explained by sample differences. The way to evaluate doping prevalence in the survey is questioned in this paper. A questionnaire was administered to 1810 amateur athletes (993 male, 817 female). Doping use was ascertained in various ways, using different definitions of doping and types of question in the survey. Depending on the definition of doping and the type of question used, the prevalence of doping obtained can differ enormously, between 1.3% and 39.2% of athletes. Marijuana and drugs for asthma were the two banned substances most used. The majority of athletes often ignored the banned list and did not use prohibited substances to dope. Using various way to question athletes, observing the usage of substances, cross-checking the data, taking into account the aim of substances uses and the various definitions of doping are necessary to give more reliable prevalence of doping. Moreover, doping at amateur level seems to be less a sport problem than a social problem.

### **Key words**

Doping prevalence, definition of doping, amateur athletes, questionnaire, marijuana, drugs for asthma, prohibited substances

## Can we measure accurately the prevalence of doping?

### Introduction

The prevalence of doping in sport is not easy to evaluate, each method (observation, interview, questionnaire) has limitations (Laure et al. 2004). The questionnaire has been used in the majority of the epidemiologic studies (Laure 2000; Laure & Binsinger 2004). Most of the studies evaluated the prevalence of anabolic-androgenic steroid usage among adolescents or athletes. The studies on the prevalence of usage of multiple drugs are less numerous (Franques et al. 2001; Laure 1997; Urbach et al. 2003; Yesalis & Bahrke 2000). Previous epidemiologic studies demonstrated a wide variance in the prevalence of doping. In his review (on 44 studies found on Medline, Pascal and Embase during 1980 to 1996), Laure (1997) evaluated that in sport, 3 to 5% of children and adolescents, and 5 to 15% of adults report using doping substances. But as Castillo and Comstock (2007) highlight, “*published studies are difficult to compare because of the focus of varying ages, athletic backgrounds, selection variation, and analysis stratification*” (p. 664). While using only one way of questioning and one definition of doping to evaluate doping prevalence, the majority of previous studies explained mostly the differences of doping prevalence obtained in each study by sample differences (Franques et al. 2001; Laure 2000; Laure & Lecerf 1999; Urbach et al. 2003). High differences of doping uses and attitudes exist between each sport (e.g. swimming, cycling, football, dance, etc.), according to athletes’ gender and age, level of sports practice (e.g. local, national, international level), type of sports practice (e.g. competitive or recreational sport), athletes’ status (e.g. amateur or professional), quantity of practice, etc. Sample differences can explain a part of the doping prevalence’s variations. However, the method to evaluate the doping prevalence and the definition of doping can also change the prevalence rates. The type of questions used to evaluate doping has not often been questioned, but they may influence the evaluation of doping (Pitsch et al. 2007). There is a diversity of questions that were used by researchers. Some used closed-ended questions in which athletes have to declare whether they use or ever have used doping substances to enhance their physical performance (Althaus et al. 2000; Laure & Lecerf 1999; Turblin et al. 1995). This type of closed-ended question sometimes comes with an open-ended question to cite substances used (Laure & Binsinger 2007; Laure & Lecerf 1999; Pillard et al. 2000; Pillard et al. 2002). In other studies, the researchers used a list of substances and investigated people so they have to tell, for each substance, whether they have ever consumed it (Ama et al. 2003;

Bergsgard et al. 1996; Kartakoullis et al. 2008; Kindlundh et al. 1998; Lorente & Grélot 2003; Melia et al. 1996; Valois et al. 2002). The use of closed-ended questions based on declaration of doping seems to lead to lower doping prevalence than the use of a list of substances. For example, according to Valois et al. (2002) using a list of substances in their survey, 25.8% of athletes have already used at least one doping substance and in Laure and Lecerf (1999) using a closed-ended question, 6.3% declared whether they had ever doped. Furthermore, the reference period to evaluate doping prevalence differs between each study: lifetime (at least once, current or past use), previous month, past 12 months or frequency of use, etc.

The measure of doping prevalence is linked with the definition and delimitation of doping. Doping prevalence evaluated by a closed-ended question to declare doping use is based on personal athletes' definition of doping. The official definition of doping is the standard used when researchers propose a list of substances in the survey or open-ended questions to cite substances used. Researchers classify substances as legal or prohibited thanks to the official banned list. Athletes' definition of doping often differs from the official one, since the banned list is not known by athletes and particularly so at the amateur level. For example, in Pillard et al. (2002), out of 58 athletes who had accurately used prohibited substances, 19 declared not to dope (33% of them), 22 had doubts on the substance used (38%) and 17 were conscious of having doped (29%). Moreover, based on norms constructed by sport governments, the official definition of doping changes over time. Before the establishment of the World Anti-Doping Agency (Wada) in 1999 and the World Anti-Doping Code on January 1, 2004, there were important differences between each country concerning the fight against doping in sport and also the definition of doping. Since 2004, there has been an international harmonization of the definition of doping. Nevertheless, the World Anti-Doping Code and the prohibited List are updated annually. As Castillo and Comstock (2007) highlighted, "*determining the category into which a substance falls can be difficult because the lists of substances that are banned by the various sporting governing bodies are amended frequently*" (p. 664). These changes over time have consequences when measuring the doping prevalence. Before 2004, epidemiologic studies on doping achieved in different countries or studies not achieved the same year, do not use the same list of banned substances to evaluate the prevalence of doping. For example, in the study of Pillard et al. (2002), caffeine was considered as a doping substance, but today this substance is not included on the banned list. In the study of Valois et al. (2002), marijuana was not included in doping substances but this substance is registered in actual banned list. As a consequence, comparing epidemiologic studies on doping leads often to comparison of studies using different standards for prohibited substances.

For the purpose of this article, we have used the 2009 Wada Code as well as its related documents, as official international standards. To include a substance or method on the Prohibited List, two of the following three criteria must be present: it has the potential to enhance or enhances sport performance, it represents an actual or potential health risk to the athlete and it violates the spirit of sport described in the introduction to the Code (Code 2009). On the 2009 Prohibited List, some substances, methods are prohibited at all times (in- and out-of-competition) because of their performance-enhancing effect (e.g. anabolic agents, hormones and related substances, beta-2 agonists, blood doping). Some substances are prohibited only in-competition, mostly to protect athletes' health (e.g. stimulants, narcotics, cannabinoids, glucocorticosteroids). And some substances are prohibited only in particular sports (e.g. alcohol, beta-blockers often prohibited only in-competition, except in archery and shooting). It is necessary to take into account the type of sports practices to accurately evaluate doping use, since some substances are banned only in-competition or in particular sports. As Lorente et al. (2005) highlight, "*only a few works have addressed illicit drug use in relation with sport practice*" (p. 1382). Previous studies have mostly evaluated the use of substances included on banned list; sports involvement was rarely taken into account. Moreover, even though it is well known that the forming of questions and variations in the definition of core concept influence the outcome of the study, few previous studies used several methods and doping definitions for estimating doping prevalence (Pitsch et al., 2007; Striegel et al., 2009). The purposes of our study were threefold: (a) to test the influence of the type of question used on the doping prevalence obtained; (b) to test the influence of the definition of doping used on the doping prevalence obtained; (c) to evaluate the most used banned substances among amateur athletes.

## **Materials and methods**

### **Sample**

Our questionnaire was administrated to a sample of 1920 French Swiss athletes in 24 different schools. Of 1920 questionnaires, 90 questionnaires were not correctly filled out and were not included in the analyses. Our final sample was constituted of 1810 athletes, 993 male (54.9%), 817 female (45.1%) aged between 16 and 22 years-old ( $M_{age}=18.7$  years,  $SD=2.1$ ). The 60.2% of athletes were from high-schools ( $M_{age}=17.5$  years,  $SD=1.5$ ) and 39.7% from

superior schools (University, professional superior school (HES))<sup>1</sup> (Mage=20.6 years, SD=1.3).

The 66.0 % of the 1810 athletes were involved in a second sport in addition to their principal sport, and 30.2% a third sport. In all, 48.8 % athletes practiced at least one sport in competition.

## Materials

Our data were collected thanks to a self-administered questionnaire, designed by the authors for this study. Pilot surveys were conducted to ensure that the questionnaire could be easily understood and completed by adolescents. Our questionnaire included 21 questions concerning social and demographic information, sports practices, perceptions and opinions on doping in sport, and legal and prohibited substances uses. In the present study, only the information concerning the sports practices and the use of banned substances has been used.

Doping use was ascertained in various ways, leaning on previous studies on doping:

- In one question (Q4), participants were asked whether they had ever used any doping substances in their sports practices. To answer, athletes had the choices between three answers (“Yes” / “No” / “*I am not sure that the substances used were doping substances*”). The answers “Yes” and “*Not sure*” came with open-ended questions: the athletes had to cite the substances used (“*Which?*”). The answer “No” came with another closed-ended question: “*If No, could you take in the future any doping substances? Yes/No*”.

- Another question (Q7) offered a list of 30 legal and banned substances or methods to participants. They had to give, for each substance, their frequency of use on a 4-point scale. This list contained the most known and used substances and methods in sport. Of the 30 substances and methods proposed, 16 were prohibited (Code 2009). Five substances and one method were prohibited at all times (in- and out-of-competition): diuretics, growth hormones, drugs for asthma, anabolic steroids and blood transfusions. Six substances were prohibited only in competition: morphine, marijuana, heroin, corticosteroids, cocaine, and amphetamines. Two substances were prohibited only in particular sports: alcohol and beta-blockers. At the end of this list, athletes could add other substances they use thanks to an open item (“*Others*”). 18 athletes of our sample added other substances (e.g. magnesium, iron, trace element), but none was banned.

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<sup>1</sup> 3 athletes did not specify their education level.

To evaluate their sports practices, athletes could cite three different sports thanks to an open-ended question. For each, they had to specify whether they practice it in competition or not (closed-ended question).

### **Procedure**

Permission for the study was obtained from the University's Research Ethics Board. The head of the various schools of our sample were also asked to give us permission to distribute the questionnaire and were asked to propose teachers who could give some time during their course so that pupils can fill the questionnaire. Before administering the survey, athletes and school administrators were informed that participation was totally voluntary. The 21-item self-report instrument was administered in different schools during the year 2008 by a survey researcher, who could answer questions and ensured that there was no communication between subjects. Only students who practice sports outside school were asked to fill out the survey. Athletes were reminded to answer all questions independently and honestly and the anonymity and confidentiality were guaranteed. Participants did not write their names on the surveys. Surveys were completed at the beginning of a physical education classroom in high schools, and of a lecture in superior schools. When finished completing the surveys (15 minutes later in average), athletes were asked to place them in a closed box.

### **Data analysis**

Data was managed and analysed using Statistica Software. Three levels of data analyses were undertaken:

- The first level was based on the athletes' declaration of doping use: this analysis concerned only the closed-ended question based on declaration of doping (Q4). At this level of analysis, the standard was the athlete's definition of doping and was labelled "athletes' declaration of doping".

The second and third levels of data analyses concerned the data obtained in the open-ended question ("*Which?*") (Q4) and in the question offering a list of banned substances and methods (Q7).

- The second level of analysis was based on the 2009 prohibited list, the international standard. These analyses permitted evaluation of the athletes' use of prohibited substances included in the Wada code 2009. They were labelled "prohibited substances users" or "prohibited substances use". Substances cited by athletes in open-ended question ("*Which?*")

were post coded in five different categories: prohibited substances, legal drugs, nutritional supplements, energy and recovery drinks and others.

- The third level of analysis permitted accurate evaluation of doping use. Some substances included in Wada List 2009 were not prohibited for some athletes. For example, the use of marijuana by a recreational athlete is not considered as doping, since marijuana is banned only in-competition. Prohibited substances used were post coded in three categories: prohibited in- and out-of-competition, in competition, and in particular sports. To evaluate the use of prohibited substances in competition, only the athletes who were involved in competitive sport were considered (883 athletes). To evaluate the use of prohibited substances in particular sports, the sports cited (e.g. karate, gymnastics, skiing, etc.) and the competitive practices were considered. These analyses were labelled “doping users” or “doping use”.

## Results

To the question “*In your sports practices, have you ever used any doping substances?*” (Q4), 2.7% of the participants answered “yes” and 2.2% were “not sure” that the substances used were doping substances (4.9% in all). The majority of athletes answered they had never used any doping substances (95.1%) but 8.6% of them declared that they could dope in the future. Concerning the athletes who declared to have ever used doping substances (2.7% of participants), only 42.9% of the 56 substances cited were registered on the prohibited List. This trend was even clearer among athletes who were not sure that the substances used were banned (2.2% of participants). Of the 74 substances cited, only 23.0% were prohibited (Wada List 2009). Other substances cited were legal drugs (e.g. caffeine, aspirin, creatine), nutritional supplements (e.g. vitamins, proteins supplements) and energy and recovery drinks (e.g. Gatorade, Red Bull, Isostar, Powerade) (Table 1).

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**Table 1**

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The most frequently banned substances cited were drugs for asthma (inhaled B2-agonists, e.g. Ventolin) and marijuana, prohibited only in competition (both cited 12 times): these two substances represent 58.5% of prohibited substances cited. Other banned substances were infrequently cited: diuretics, ephedrine, amphetamines, corticosteroids, ecstasy, ritaline, cocaine, etc.

Finally, if 4.9% of athletes declared to dope or had doubt on the substances used, only 2.0% of the respondents (37 athletes) had actually taken prohibited substances. But it is not sure

that the substances registered on the 2009 Wada list were banned in their sports practices. On the 41 prohibited substances cited, 56.1% were prohibited only in competition (marijuana, cocaine, corticosteroids, ritaline, ephedrine), 39.0% were prohibited at all times, in and out-of-competition (salbutamol, diuretics, anabolic steroids), and 4.9% were prohibited only in-competition in particular sports (alcohol) (Wada List, 2009).

In our sample, 13 of the 37 athletes who cited banned substances in competition or in particular sports were allowed to use them in their sports practices. Thus, the number of athletes who used substances considered as doping substances in their sports practices were 24 athletes, that is to say 1.3% of the respondents.

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**Table 2**

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When proposing a list of substances (Q7), the declared prevalence was higher: 986 uses of prohibited substances were registered. The banned substances most used were alcohol (27.4% of athletes), drugs for asthma (10.2%) and marijuana (9.8%) (Table 2).

Usage of these banned substances concerned 709 athletes (39.2% of respondents), some athletes using various banned substances (Table 3): the substances prohibited at all times (\*) were used by 11.4% of athletes, the substances prohibited only in-competition (\*\*) by 11.7% of them and the substances prohibited only in-competition in particular sports (\*\*\*) by 28.5% of them. This last high percentage was due to the alcohol used by 27.4% of athletes in their sports practices.

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**Table 3**

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For the substances prohibited only in particular sports and only in competition, it was necessary to take into account the athletes' sports practices to evaluate the doping rate. Concerning the usage of substances prohibited only in particular sports (alcohol and beta-blockers, 528 uses), only 14 uses were actually occurring in sports in which these substances were prohibited and qualified as doping.

Concerning the usage of substances prohibited only during competition (245 uses), 113 uses were actually occurring during competition (Table 3) and qualified as doping. In all, we observed 340 doping uses; representing 34.5% of the 986 uses of substances registered on the

prohibited list (2009) (including substances prohibited at all times, only in particular sports and only in competition).

Of these 340 doping uses, 39.1% (133 uses) were regular doping (“often” and “every day or almost”) and 60.9% (207 uses) were occasional doping (“sometimes”) (Table 2). As the results obtained in open-ended questions to cite substances used (Q4), the most used doping substances were marijuana and drugs for asthma (10.2% and 4.1% of doping uses respectively). Some athletes used various prohibited substances. In all, 17.5% of athletes had used at least one doping substance in their sports practices.

The comparison of the answers obtained in the closed-ended question (Q4) based on declaration of doping and in the question based on different substances’ use (Q7) showed that prohibited substances were not often used to dope. Concerning the substances prohibited in particular sports (alcohol and beta-blockers), the 85.7% of users (Q7) declared they had never used any doping substances (Q4) (Table 4). Concerning the substances prohibited only in competition, 83.2% of competitive users declared that they had never used any doping substances. For example, 83.8% of the users of marijuana (4.1% of doping use) considered themselves as not doped (Table 4). Concerning substances prohibited at all times, 85.9% of users declared to have never used doping substances in their sports practices. Some substances, as erythropoietin or anabolic steroids, were always used intentionally for doping. But most substances were not used for this purpose. Concerning the drugs for asthma, mostly used (Q7: 10.2% of doping uses), 87.5% of users declared they had never used doping substances in their sports practices (Table 4).

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**Table 4**

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To summarize, the definition of doping and the question used have a high influence on the prevalence of doping obtained, included between 1.3% and 39.2% (Table 5). With analyses based on athletes’ definition of doping (Q4, first level of analysis), 2.7% athletes declared to have used at least once doping substance in their sports practices and 2.2% had doubt on the substances used. Thanks to analyses based on substances registered on the Wada prohibited list (2009) (second level of analysis), the prevalence of prohibited substances was included between 2.0% and 39.2%, depending of the type of question used. With analyses based on substances prohibited in athletes’ sports practices (third level of analysis), the prevalence of doping substances was included between 1.3% and 17.5%, depending on the type of question used.

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**Table 5**

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**Discussion**

This study shows the difficulties of unambiguously evaluating doping prevalence. Depending on the definition of doping, the type of questions used in the survey, the prevalence rates differs significantly: between 1.3% and 39.2%. Using various questions and standards of doping can explain an important part of differences of prevalence obtained in the previous epidemiologic studies. The various perimeters of doping depend both on methods, on the diverse definition of doping, on the social uses of substances and on many ways we can analyse doping. There is no absolute definition of doping that can't be challenged; each definition presents its limits because each has to be related to the social, psychological and institutional situation of groups of people defining doping, including researchers. Thus, important questions for research arises concerning the official definition of doping in sport, the Wada one (1), the athlete use and definition of doping (2) and the methods that are used when trying to assess doping prevalence (3).

*1. Is the Wada definition useful?*

In the Wada Code (2009), “*doping is defined as the occurrence of one or more of the anti-doping rule violations set forth in Article 2.1 through Article 2.8 of the Code*” (p. 17): the article (2.2) concerns the use and attempted use of prohibited substances. But in the Wada Code, there are 7 other anti-doping rule violations: presence of a prohibited substance or its metabolites or markers in an athlete's sample; violation of applicable requirements regarding athlete availability for out-of-competition testing; tampering or attempted tampering with any part of doping control; possession of prohibited substances and prohibited methods; trafficking or attempted trafficking in any prohibited substance or prohibited method, etc. (Code 2009). In consequence, the use of questionnaires leads to under-estimation of doping, as defined by the Wada code (2009). But the question arises of the benefit for researchers to refer to the Wada definition. Of course, we can think that using the Wada definition could be a good basis for comparative studies and help to analyse changes, to assess the efficiency of prevention or repression policies. But in fact, the official definition is so difficult to use that the goal of assessing prevalence based on this definition is not really feasible. We can only try to observe prevalence in the consumption of some substances that are usually forbidden in sport.

Furthermore, even if the official definition of doping could be judged accurate to evaluate doping prevalence, some problems persist. As we have already said, the Wada banned List is updated each year. The banned list is a human construction based on fluctuant norms and subject to criticisms. As Docherty (2008) underlined, *“although the list is not meant to be definitive, some major omissions are obvious there is no mention of methylenedioxyethylamphetamine (MDEA) (the recreational drug “Eve”) [...] and also not of cathinone (widely consumed in Khat in the Horn of Africa)”* (p. 609). This observation was done on the 2007 Wada banned List, but these substances are not always registered on the 2009 banned list. However, Deveaux and Gosset (2000) underlined that “Eve” as other substances “Adam”, “China white”, “Ice” were the best-known substances used to enhance performance, thanks to a psychotropic effect. Backer et al. (2007) questioned the status of inhaled corticosteroids and inhaled beta2-agonist as prohibited substances. These variations of doping definition over time make the comparison of epidemiologic studies difficult, even impossible.

Thus, the best way to really evaluate doping prevalence is not to base the analyses on the prohibited substances included in the Wada list. Since there are some substances prohibited only in competition and others only in particular sports, it is necessary to take into account the athletes’ sports practices. The use of prohibited substances registered on Wada List is not always a doping use: in fact in our study, only 34.5% of the prohibited substances usage collected thanks to the list of substances (Q7) were for doping; furthermore, in the open-ended question (Q4), 13 of the 37 athletes who cited banned substances in competition or in particular sports were allowed to use them in their sport. Taking into account sports practices leads to lowest prevalence: 1.3% instead of 2.0% of athletes for the question based on declaration of doping (Q4), and 17.5% instead 39.2% with the list of substances proposed (Q7). Nevertheless, sports involvement was rarely taken into account in previous epidemiologic studies (Lorente et al. 2005), which mostly focused on prohibited substances usage and not on doping substances, leading to an over-estimation of doping prevalence.

## *2. Athlete defining doping and using substances*

The use of athletes’ definition of doping also leads to a bias in the evaluation of doping prevalence for different reasons. Athletes’ definition of doping often differs from the official definition of doping, athletes having a bad knowledge of prohibited substances: in our study, only 31.5% of the 130 substances cited in open-ended questions (Q4) were prohibited substances (Code 2009). Moreover, more than 80.0% of doping users (Q7) declared that they had never used doping substances in their sports practices. At the amateur level, the

prohibited substances are not always used to dope; athletes often ignore the banned list. Thus, the 317 doping users (17.5% of athletes) could have a positive anti-doping control, despite the majority of them being unwilling to dope. Consumption, even if it is forbidden substances, can't be only defined objectively, meanings are very important to consider when analysing behaviours. Those using enhancement substances without being willing to enhance performance should not be classified in the same category as those using substances to cheat. Another question related to the usage is that most of the social drugs used in amateur sport are usually not used to enhance performance. A lot of studies have shown the use of banned substances (e.g. marijuana, amphetamine) among adolescents in other areas than sport, in school, at work, in parties, etc. (Franques et al. 2001; Laure 1997, 2000; Michaud et al. 2006; Urbach et al. 2003; Yesalis & Bahrke 2000). For example, Laure's (2000) survey suggested that among French medical students, more than half of the population reported enhancing-substance use in their first year of studies, especially marijuana usage when preparing their exams. Marijuana is one of the banned substances most used by athletes in our study, it remains popular for millions of individuals (Greydanus & Patel 2003). Moreover, there is a relation between the use of marijuana to enhance both sportive and non-sportive performances. According to Lorente et al. (2005), marijuana use to enhance sportive performance leads to marijuana use to enhance non-sportive performance and reciprocally. According to Kayser et al. (2007), "*the cannabis (marijuana, hashish) and its active substance THC are not performance enhancing; THC is probably merely deleterious for performance for any elite sport activity*" (p. 7). Although cannabis could be responsible for lowering biomechanical performances, it is used by athletes to improve psychological performances (Mura et al. 2000). The relaxing properties of cannabis may be frequently used to enhance performance (Lorente et al. 2005). Thus it can make sense to ban this substance and it is only banned in competition, to protect the athletes' health. But this prohibition is often not known by amateur athletes: in our study, only 12.2% of competitors using marijuana declared to be doped, 4.1% were not sure, and 83.8% declared never having used doping substances. As Laure (1997) underlined, "*some substances as cannabis, cocaine, although prohibited, are not considered as doping by athletes*" (p. 221). Or a high incidence of positive cases for cannabinoids in analyses for doping control in sports has been observed since the IOC included them in the 1989 banned list of prohibited drugs (Lorente et al. 2003). Another way to use banned substances is the "Therapeutic Use Exemptions" (TUE). Thus, drugs for asthma are the most used banned substances in our study. But drugs for asthma (beta2-agonists) as corticosteroids are sometimes medically justified and sometimes

improperly used. These substances are legal if athletes have a TUE. But our survey, as previous epidemiologic surveys, had no question about TUE. In the question with a list of proposed substances (Q7), the use of drugs against asthma (10.2%) such as corticosteroids (0.6%) were probably over-estimated since the question was not focused on doping use but on substance use. A lot of athletes have asthma problems and possess a TUE (Backer et al. 2007). But drugs for asthma are sometimes used in doping aim. In our study, drugs for asthma, with the marijuana, were the most cited substances (12 times both) in the open-ended question about doping substances (Q4). So, drugs for asthma and marijuana seem to be the two most banned substances used at amateur level.

### 3. Methodological limits

This study has shown that we need to be very careful concerning the results obtained in epidemiologic studies on doping; the prevalence of doping can be both under-estimated or over-estimated, according to the definition of doping and type of question used. The type of question used in the survey has high influence on the prevalence obtained. The use of a list of substances leads to higher prevalence than questions based on an open-ended question: 17.5% against 2.0% in our study; the declaration of doping is based on athletes' social representation of doping. As we have already mentioned, the amateur athletes have poor knowledge of the banned list (Laure 1997; Pillard et al. 2002). Moreover, athletes can forget in open-ended questions to cite one among the used substances. The list of substances in the survey permits evaluation of the use of several prohibited substances in sports practices. It is very important when a list of substances is proposed in the survey, to take into account the athletes' sports practices. For example, 496 athletes declared using alcohol in their sports practices, but only 9 were prohibited from using it. Contrary to the question based on declaration of doping, this question cannot evaluate if the prohibited substance is used for doping. The difference of doping prevalence obtained in the two types of question (2.0-17.5%) can be explained by the fact that the majority of amateur athletes ignored the banned list and they did not use prohibited substances to dope. In previous epidemiologic studies on doping, few questions are related to the aim of substances uses: to enhance performance, to treat a disease or an injury, recreational usage, etc. According to Greydanus and Patel (2005), "*sports doping is the use of various drugs in hopes of improving appearance and/or augmenting sports performances*" (p. 94). But some substances such as alcohol (prohibited only in particular sports) or marijuana (prohibited only in-competition) are not often used to enhance sports performances but as recreational drugs. With a list of substances proposed in the survey, it is very difficult, even impossible, to differentiate the use of doping substances in and out of sport. The high

doping prevalence obtained with the list of substances (17.5%) shows that doping is mainly related to ordinary social behaviours that can have consequences on sport.

Furthermore, as other methods, the use of a questionnaire presents other problems to evaluate doping prevalence. Using a list of substances in the survey can lead to under-estimating doping since not all of the substances registered on the banned list were included in the list of substances proposed in our survey. Some athletes declared using other banned substances as ephedrine, ritaline (stimulants) in an open-ended question (Q4), not included in the list of substances proposed in the survey. Moreover, in order to answer to a question about doping uses, the athletes *“must also know the name or the pharmaceutical class of drugs used. However, some of them are unaware of this, particularly involved have been medically administered or obtained on the black market”* (Laure 1997, p. 221). For example, the athletes can use an ointment for rectal problems and do not know that this ointment contains glucocorticosteroids, substances prohibited in-competition. In this case, athletes would not declare using corticosteroids in the question accompanied with a list of substances (Q7), as in open-ended question (Q4).

Yesalis and Bahrke (2000) underlined that *“it is important that we gain a better understanding of the prevalence of these other drugs and supplements [next to anabolic steroids] in order to develop better prevention and treatment programmes”* (p. 26). But, it is very complicated to evaluate accurately the prevalence of doping by questionnaires. The survey by questionnaires is the most used, allowing contact with a lot of persons, in standardized and systematic way, with a low cost and the data analysis can be automated. Nevertheless, a questionnaire is difficult to build and it is limited in gaining verbal answers. The answers can be close to the reality of practices but are not always reliable for getting information on the real present or future behaviours (Laure 2000; Laure et al. 2004). According to Striegel et al. (2009), a standard questionnaire failed to indicate a realistic prevalence of doping among elite athletes, leading to under-estimation. One reason for this could be that the elite athletes see the danger of being detected through standard questionnaires with regard to doping. Nevertheless, this fear is less important among amateur athletes, and the standard questionnaire may help to obtain more honest answers from amateur athletes than from elite athletes. Our observations of these young amateurs filling a questionnaire indicate that social desirability, which could explain an underestimation among elite athletes, is not at stake in the expected way. In contrast, social desirability incites some of them to declare the consumption of most of the substances, in a provocative manner. It is rooted in a main trend identified among youth consumption illustrated by the figure of the

consumer as a rebel (Gabriel & Lang 1995). Of course, these provocative questionnaires were excluded from our sample. The reliability of our data can also be confirmed by another study based on a very close sample (1247 young people living in the same region and with the same age). Using the same questions with a different method (a web-survey) to evaluate doping prevalence, the results obtained were comparable (Belanger et al. 2010).

Are there other ways to evaluate accurately doping prevalence? Each method (observation, interview, questionnaire) present some limits to evaluate doping prevalence (Laure, Binsinger 2004; Waddington & Smith 2009). Striegel et al. (2009) comparing three different methods<sup>2</sup> suggest that the randomized response technique is the best way to evaluate doping prevalence among elite athletes. This technique seems to give more reliable responses and detects the proportion of "*honest yes' respondents*" and of "*cheaters*" (Pitsch et al. 2007). Even if this method could be significantly superior to direct questioning in a number of different studies, Pitsch et al. (2007), using this method in a web-survey, identified various limitations when using it to evaluate doping prevalence. Moreover, "*this method may still underestimate the true prevalence of doping, if athletes are reluctant to answer the sensitive question truthfully*" (Striegel et al. 2009, p. 231). Even if it limits the influence of social desirability, its complexity and unfamiliarity for respondents could also incite some of them to answer carefully and not necessarily honestly. As for other methods, none could pretend that all the respondents answered honestly. Thus, researchers should not use only one way of questioning to evaluate doping prevalence. Triangulating data obtained thanks to various methods - randomized response techniques, questionnaires, observations, interviews - could help to give a reliable picture of doping prevalence and reduce the risks of inaccurate estimation. But it is very difficult, even impossible to find one truth on doping prevalence in sport. Doping is a prohibited way to improve sports performance, conflicting with sport ethics, is usually hidden and also people do not always know what is doping. Some people may not know if their consumption is illicit or choose not to reveal their use of doping substances, even if the anonymity and the confidentiality are guaranteed, leading to an under-estimation of doping prevalence (Laure 1997; Pitsch et al. 2007; Striegel et al. 2009). According to Holt et al. (2009), "*the true prevalence of modern doping is unknown because of the secrecy surrounding it*" (p. 322). One certainty exists: doping is not reserved to professional level and exists in amateur sports. Nevertheless, this study shows that at youth amateur level, prohibited substances are mostly not used for doping purposes, athletes often ignore banned list. The use

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<sup>2</sup> a standard questionnaire technique, a randomized response technique (an anonymous indirect interview technique) and the official anti-doping data

of alcohol and recreational drugs (mostly marijuana) represents 30.6% of doping uses (Q7). So it is important to treat doping in amateur sport more as a societal phenomena than as a sport problem. As Gilberg et al. (2006) argued, *“the use of performance-enhancing substances and methods must also be viewed on the background of the general development in society. With values such as individualism, performance, progress, pushing the limits and the use of technology and science, sport coheres with and strengthens key values in modern society”* (p. 342).

Observation of social usage of doping substances is very important when trying to assess a social phenomenon. It avoids both moral panic and ignoring the possible threat to health. Thanks to our observation, it does not seem very relevant to identify one single rate of prevalence. Studies should consider various rates to take into account the diversity of definitions and uses of substances. Regarding our data in Switzerland, which is probably close to other European countries, it is surprising to consider doping in sport as a big threat for public health. Of course, doping can be a problem and can have consequences on health, especially for some professional sports in which drugs consumption can be important. Nevertheless, our data show that in amateur sport the question of doping refers to the broader question of the spreading of substances in society and is not specific to sport. What is specific is that consuming ordinary enhancing substances is more a moral problem for sport people than for ordinary citizen for whom the taste for enhancing substances seems to increase and to be supported by an important supply and marketing that goes with it.

Regarding the complexity of the definition of doping, the diversity of the substances uses, the diversity of population doing sport and consuming substances, the various forms of social desirability we suggest that enquiries should not try to give one prevalence rate and so we offer the following insights:

- Prevalence rate depends on the definitions of doping used by researchers including the frequency of consumption and the reference period;
- The aim of the substances' uses should be analysed because some substances, especially the social drugs are used without doping aim; to count these substances uses artificially increases doping prevalence;
- Questionnaires should include several questions to evaluate doping prevalence (closed-ended questions, open-ended questions, questions with a list of substances proposed, etc.) because amateur sportspeople do not know precisely which substances are banned. That gives the possibility to have at least two prevalence rates and offers better indications on the wish to dope;

- To differentiate methods regarding the population. The social desirability is not a uniform anthropological invariant: the fears of elite athlete are not necessary shared by the rest of the population.

### **Perspectives**

According to Kayser et al. (2007), “elite athletes only represent a small fraction of the global population but the resources of anti-doping almost exclusively go into testing of these athletes” (p. 6). Prevention should reach sport and non-sport people both concerning by enhancement substances including doping ones. Instead of considering doping from a sporting point of view, which is a bit narrow, we should think of it regarding a significant trend towards human enhancement. The market of enhancing substances, drugs but also drinks and foods, is growing. Moreover, future possibilities of “neuro-enhancement” are important and we can be sure that new enhancing substances will be soon on the market (Normann & Berger 2008). Sport is an interesting and ambiguous matter; it reflects the social trends for enhancement but it also feeds it through the glorification of performance, the wish to be always at the top, to go further, higher and stronger. Unsurprisingly, many people have the feeling that our body and our spirit are cramped within our ordinary “natural” resources.

### **Acknowledgements**

We would like to thank the “Office Federal of Public Health” in Switzerland which has supported this study and all athletes, principals and affected teachers for the different schools which have accepted to participate to this study. We also thank Elisabeth Pike from University of Chichester for her precious help.

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### Tables, Figure legends and Figure

**Table 1. Categories of substances cited in open-ended questions (Q4): “Which [substances have you ever used]?”**

<b>Substances cited by athletes who declared to have ever used doping substances</b>	<b>N (%)</b>
Prohibited substances	24 (42.9%) <sup>1</sup>
Legal drugs	13 (23.2%)
Nutritional supplements	12 (21.4%)
Energy and recovery drinks	5 (8.9%)
Others	2 (3.6%)
<b>Total</b>	<b>56</b>
<b>Substances cited by athletes who had a doubt on the substances used</b>	<b>N (%)</b>
Prohibited substances	17 (23.0%) <sup>2</sup>
Legal drugs	19 (25.7%)
Nutritional supplements	20 (27.0%)
Energy and recovery drinks	17 (23.0%)
Others	1 (1.4%)
<b>Total</b>	<b>74</b>

**Legend:** <sup>1</sup> Number (percentage) of substances cited by athletes who declared to have used doping substances

<sup>2</sup> Number (percentage) of substances cited by athletes who had a doubt on the substances used

**Table 2. Answers with a list of banned substances and methods proposed (Q7): Number (percentage of athletes)**

Substances, methods	Prohibited substances uses	Doping uses	Sometimes	Often	Every days or Almost	No answers
Alcohol***	496 (27.4%) <sup>1</sup>	9 (0.5%) <sup>2</sup>	5	3	1	0
Amphetamines**	9 (0.5%)	4 (0.2%)	2	2	0	1
Beta-blockers***	32 (1.8%)	5 (0.3%)	2	3	0	1
Cocaine**	27 (1.5%)	14 (0.8%)	10	3	1	0
Corticosteroids**	10 (0.5%)	5 (0.3%)	3	2	0	0
Diuretics*	12 (0.7%)	12 (0.7%)	7	3	2	0
Erythropoietin (EPO)*	1 (0.1%)	1 (0.1%)	1	0	0	0
Heroin**	5 (0.3%)	3 (0.3%)	1	2	0	0
Growth Hormone*	4 (0.2%)		2	1	1	0
Marijuana**	177 (9.8%)	74 (4.1%)	58	10	6	0
Drugs for asthma*	184 (10.2%)	184 (10.2%)	95	56	33	0
Morphine**	17 (0.9%)	13 (0.7%)	12	0	1	0
Anabolic steroids*	2 (0.1%)	2 (0.1%)	2	0	0	0
Blood transfusions*	10 (0.6%)	10 (0.6%)	7	3	0	0
<b>TOTAL</b>	<b>986</b>	<b>340</b>	<b>207</b>	<b>88</b>	<b>45</b>	

**Legend:** \* Substances, methods prohibited at all times (in- and out-of-competition)

\*\* Substances prohibited only in competition

\*\*\* Substances prohibited only in particular sports

<sup>1</sup> Number of prohibited substances uses (percentage of athletes)

<sup>2</sup> Number of doping uses (percentage of athletes)

**Table 3. Users, uses of prohibited substances in sport (Q7, list of banned substances and methods): Number (percentage of athletes and uses)**

	<b>Total</b>	<b>Substances prohibited in- and out-of-competition</b>	<b>Substances prohibited in-competition</b>	<b>Substances prohibited in particular sports</b>
<b>Users of prohibited substances</b>	709 (39.2%) <sup>1</sup>	206 (11.4%) <sup>1</sup>	212 (11.7%) <sup>1</sup>	516 (28.5%) <sup>1</sup>
<b>Dopers</b>	317 (17.5%) <sup>1</sup>	206 (11.4%) <sup>1</sup>	95 (5.3%) <sup>1</sup>	14 (0.8%) <sup>1</sup>
<b>Uses of prohibited substances**</b>	986	213 (21.6%) <sup>2</sup>	245 (24.8%) <sup>2</sup>	528 (53.5%) <sup>2</sup>
<b>Doping uses**</b>	340	213 (62.7%) <sup>2</sup>	113 (33.2%) <sup>2</sup>	14 (4.1%) <sup>2</sup>

**Legend:** <sup>1</sup> Number (percentage) of athletes

<sup>2</sup> Number (percentage) of declared uses

**Table 4. Comparison of answers obtained in the closed-ended question (Q4) based on declaration of doping use and the question based on the list of substances' use (Q7): Number (percentage of athletes)**

Substances, methods registered on the 2009 list	Answers to the question 7 (list)	Answers obtained to the question 4 (declaration of doping use)		
	Athletes doped	“Yes”	“Not sure”	“No”
<b>Substances prohibited at all times</b>	<b>206<sup>1</sup></b>	<b>17 (8.3%)<sup>2</sup></b>	<b>12 (5.8%)<sup>2</sup></b>	<b>177 (85.9%)<sup>2</sup></b>
Diuretics	12	3	1	8
Erythropoietin (epo)	1	1	0	0
Growth Hormone	4	1	1	2
Drugs for asthma	184	12	11	161
Anabolic steroids	2	2	0	0
Blood transfusions	10	1	1	8
<b>Substances prohibited in-competition</b>	<b>95<sup>1</sup></b>	<b>11 (11.6%)<sup>2</sup></b>	<b>5 (5.3%)<sup>2</sup></b>	<b>79 (83.2%)<sup>2</sup></b>
Amphetamines	4	1	0	3
Cocaine	14	3	1	10
Corticosteroids	5	1	0	4
Heroin	3	1	0	2
Marijuana	74	9	3	62
Morphine	13	1	2	10
<b>Substances prohibited in particular sports</b>	<b>14<sup>1</sup></b>	<b>2 (14.3%)<sup>2</sup></b>	<b>0</b>	<b>12 (85.7%)<sup>2</sup></b>
Alcohol	9	1	0	8
Beta-blockers	5	1	0	4

**Legend:** <sup>1</sup> Number of athletes doped according to answers to question 7 (list of substances)

<sup>2</sup> Number of athletes (percentage of athletes doped according to answers to question 7)

**Table 5. Doping prevalences according to definition of doping and question used**

	<b>Standard to evaluate doping</b>	<b>Total</b>	<b>Substances prohibited in- and out-of-competition</b>	<b>Substances prohibited in-competition</b>	<b>Substances prohibited in particular sports</b>
<b>Question 4</b> <i>Closed-ended question + open-ended questions</i>	<b>Prohibited substances users / uses</b>	2.0% of athletes	16 (39.0% of substances cited)	23 (56.1% of substances cited)	2 (4.9% of substances cited)
	<b>Doping users</b>	1.3% of athletes	16 (57.1 % of substances cited)	12 (42.9% of substances cited)	0
<b>Question 7</b> <i>List of banned substances and methods</i>	<b>Prohibited substances users</b>	709 (39.2% of athletes)	206 (11.4% of athletes)	212 (11.7% of athletes)	516 (28.5% of athletes)
	<b>Doping users</b>	317 (17.5% of athletes)	206 (11.4% of athletes)	95 (5.3% of athletes)	14 (0.8% of athletes)
<b>Question 4</b> <i>Closed-ended question</i>	<b>Athletes' declaration of doping</b>	2.7% of athletes declare to use doping substances and 2.2% are not sure that the substance used was prohibited			