Biology of Sport, Vol. 26 N^{o}2, 2009

CANNABINOIDS CASES IN POLISH ATHLETES

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Abstract. The aim of this study was to investigate the number of cases and the profiles of Polish athletes who had occasionally been using marijuana or hashish throughout the period of 1998-2004, with respect to: sex, age, and discipline of sport as well as the period of testing (in- and out-of-competition). Results of the study were compared with some data reported by other WADA accredited anti-doping laboratories. Totally, 13 631 urine samples taken from Polish athletes of both sexes, aged 10-67 years, performing 46 disciplines of sport were tested. Cannabinoids were detected in 267 samples. Among Polish athletes the relative number of positive THC (tetrahydrocannabinol) samples was one of the highest in Europe. The group of young Polish athletes (aged 16-24 years) was the most THC-positive. THC-positive cases were noted more frequently in male athletes tested during out of competitions. The so-called contact sports (rugby, ice hockey), skating, boxing, badminton, body building and acrobatic sports were those sports, where the higher risk of cannabis use was observed. The legal interpretation of some positive cannabinoids results would be difficult because of some accidental and unintentional use of the narcotics by sportsmen. It was concluded that national anti-doping organizations (NADO's), which are competent to judge whether the anti-doping rules were violated, should take into account the possibility of non-intentional doping use of cannabinoids via passive smoking of marijuana.

(Biol.Sport 26:119-135, 2009)

Key words: Cannabinoids - Tetrahydrocannabinol - THC - Doping

Introduction

The source of cannabinoids is plant hemps (*Cannabis sativa*). Both genders of the plant produce a resin having hallucinogenic influence on the human central nervous system but most psychoactive ingredients can be finding in female form of the hemp plants. The resin, called hashish, has been long use in the South Asia as a

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psychoactive substance. In South America *Cannabis sativa*, known as marijuana, has been used in the form of cigarette smoking to achieve a state of euphoria [14].

There are over 400 chemical substances in *Cannabis sativa* among which about 60 are biological active [2,37,38]. The significant representatives of the active substances are tetrahydrocannabinol (THC), cannabinol and cannabidiol. Tetrahydrocannabinol is the most important and, depending on its percentage in the total volume of substances, has been classified as marijuana, hashish or resin (Table 1).

Table 1
Different forms of cannabis and its concentrations (according to: 2,11,31,34)

Form	THC content (references)			
	Robson (1994)	Hall and Solowij (1998)	Ashton (2001)	Schänzer (2004)
Marijuana	1-10%	0.5-5%	1-3% 6-20% (modern cigarette)	1-3%
Hashish	10-15%	2-20%	10-20%	3-6%
Hashish oil	15-30%	15-50%	15-30% (sometimes up to 65%)	30-50%

Robson reported that the marijuana cigarette constitutes from 1 to 30 mg of THC [31].

The improvement of *Cannabis sativa* planting causes an increase in concentration of THC in marijuana cigarettes to 10 mg (in sixties years) up to 20-200 mg in nineties [2]. Since the threshold dose of THC is about 2 mg the narcotic effect can be sense by smoking just one cigarette [2,31].

THC is a powerful psychodysleptic drug. It's known medical properties include anti-convulsion, analgesic and anti-vomiting activities as well as decreasing both the body temperature and appetite. The effects of THC application can last up to 48

hours. In society *Cannabis sativa* has been used as a "recreation narcotic" to intensify the sense of pleasure.

After smoking hashish or marijuana about 50% of THC is excreted during 3 days mainly in the form of 11-nor-Δ^9-THC-9-carboxylic acid glucuronide, together with the other carboxylic acids in free and conjugated form. The remained 50% of THC, stored in the fat cells, has been slowly released in the organism during next days. THC is excreted within days and weeks, mainly as acid metabolites, about 20–35% in urine and 65–80% in faeces, less than 5% of an oral dose as unchanged drug in the faeces [10]. Among 20 identified metabolites of THC the 11-nor-9-carboxy-THC has been proved to be the best marker of THC consumption by humans. Metabolites of THC can be present in urine for many days (3-7 days after smoking of single cigarette and up to12 days after oral application of hashish or marijuana) and are detectable even for months after prolonged application of the narcotics [2,24].

In 1989 the Medical Commission of the International Olympic Committee (IOC) located marijuana on the list of doping substances. However, decision concerning punishment of sportsmen after using of marijuana was assigned to involved international sports federations. Such unclear legal solution brought a case of Canadian snowboard athlete during Winter Olympic Games in Nagano (1998). In result of this case the position of marijuana on the doping list was corrected by note that the presence of carboxy-THC in athlete urine exceeding the threshold of 15 ng/ml will be considered as a positive result of doping test but only during Olympic Games [4,28].

On the doping list published in 2004 by the World Anti-Doping Agency (WADA) cannabinoids were indicated in the group of substances and methods forbidden during competition.

The aim of the study was to investigate the problem of cannabinoids use by Polish sportsmen and sportswomen. For this purpose data from the Department of Anti-Doping Research of the Institute of Sport in Warsaw (since 2004 the WADA accredited laboratory) were analysed for the period 1998-2004. Additionally, the results of the study were compared with those available from other WADA accredited laboratories.

Materials and Methods

In the process of cannabinoids search 13 631 urine samples were tested. The samples were taken from sportsmen (9 398) and sportswomen (4 228) representing 46 disciplines of sport. 8 490 samples were analysed during competition and 5 141

during out-of-competition. The average age of the tested subjects was 22.5±5.4 years.

Analytical indicator of cannabinoids presence in the urine sample was carboxy-tetrahydrocannabinol (carboxy-THC). As an internal standard a diluted solution of deuterated carboxy-THC, (±)-11-Nor-9-Carboxy-Delta-9-THC-D3, (Radian International, T-015) was applied. The analysed substances were identified as trimethylsilil derivatives (Fig. 1) by gas chromatography linked to mass spectrometry. In doubtful cases a gas chromatography-tandem mass spectrometry was used. The estimation of uncertainty for the carboxy-THC measurement in the urine samples was calculated as 6.2%.

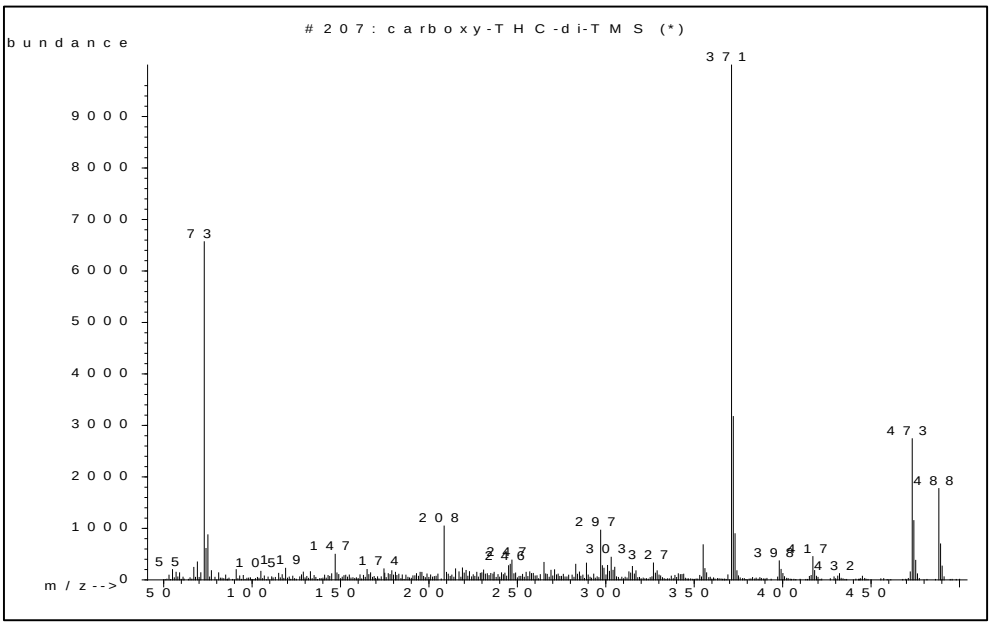

Fig. 1
Mass spectrum of carboxy-THC-di-TMS

Results

Cannabinoids were found in 267 samples (1.96%) most frequently in the years 2001-2002 (Fig. 2). Among those cannabinoids samples 4 contained also amphetamine, 1 amphetamine and 4-hydroxyamphetamine, 1 morphine whereas 26 samples contained other forbidden doping substances. In 118 samples (0.87%)

concentration of carboxy-THC exceeded the threshold of 15 ng/ml meaning violation of the current anti-doping rules.

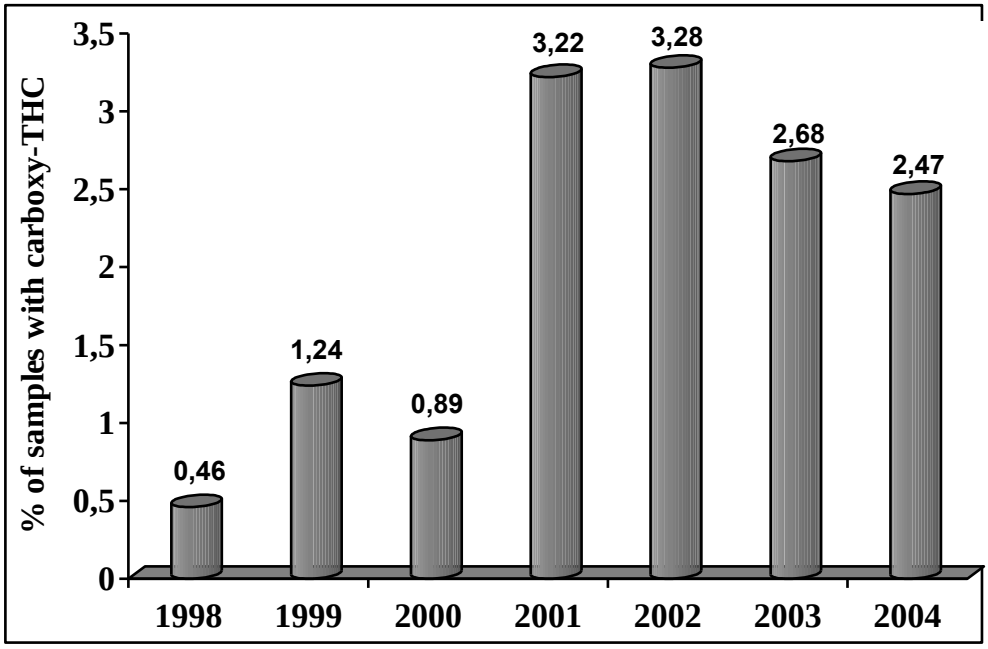

Fig. 2
Relative number of carboxy-THC samples detected in Polish competitors in the years 1998-2004

Only 45% of the carboxy-THC samples were taken during out-of-competition and, according to WADA regulation, was treated as a doping negative. However, the relative number of cannabinoids cases was greater during out-of-competition (2.3%) than during competition (1.7%) (Fig. 3). As far as age of the athlete is concerned cannabinoids have been mostly used by athletes in the age of 16-24 years (Fig. 4). As presented in the Fig. 5 Polish cases of cannabis use by sportswomen were about 13 times lower than for sportsmen.

In analyses of frequency of THC cases in individual disciplines of sport only those were considered in which the total number of urine sample was 50, or more. Carboxy-THC was found frequently in the following disciplines of sport: rugby (11.3%), figure skating (5.6%), boxing (4.9%), badminton (4.2%), speed skating

(3.4%), body building (3.4%), acrobatics (3.2%), ice hockey (3.1%), wrestling (3.0%), and sailing (2.9%) (Fig. 6).

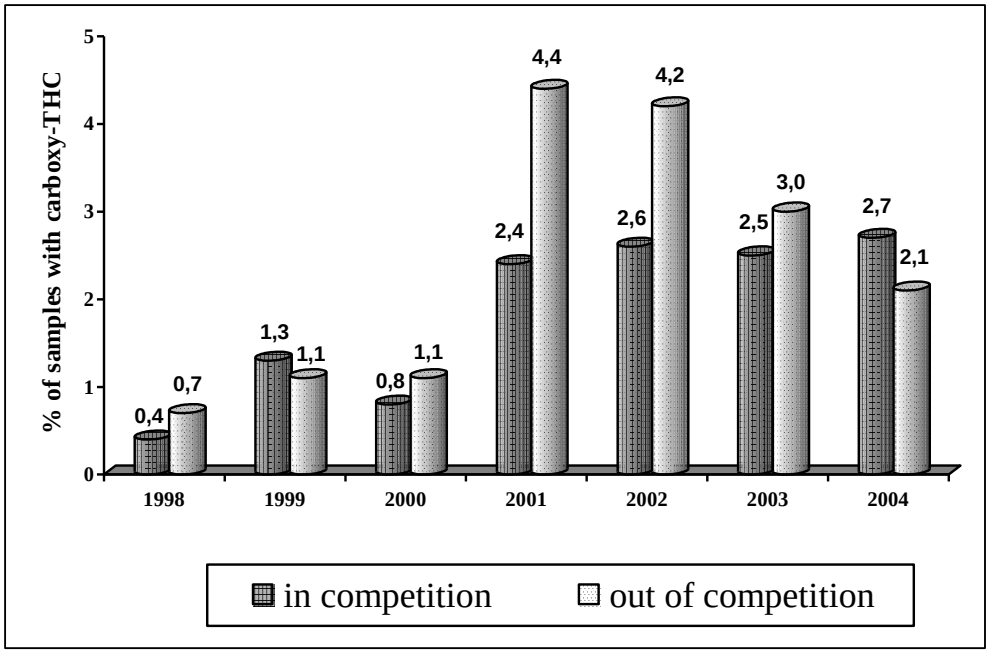

Fig. 3
Relative number of carboxy-THC samples taken during competition and out-of-competition

Discussion

Cannabinoids and anti-doping legal threshold: Decision of the International Olympic Committee establishing the threshold for carboxy-THC concentration in athlete urine at the level of 15 ng/ml was mainly caused by the effects of passive smoking [22,39]. However, the threshold has been still controversial and questioned.

In 1984 Law *et al.* showed significant individual differences in urine THC metabolites after 3 hours exposure to passive smoking but observed concentration of the markers did not exceeded 6.8 ng/ml [20]. The concentration of smoke in the air for passive inhalation seems to be a critical factor [5]. In the study of ElSohly and Jones 4 marijuana cigarette smokers were assisted by 4 passive smokers in a small room. In all of the passive smokers concentration of carboxy-THC was

below 15 ng/ml [9]. In other study of these authors, non-smokers were exposed to smoke of 16 marijuana cigarettes in a small room for 1 hour. Only in one of the non-smokers the carboxy-THC was found to achieve value of 87 ng/ml [9].

Results of the present study indicated that 44% of the samples containing cannabinoids had a greater concentration than accepted carboxy-THC legal threshold. The samples were, therefore, positive and brought to the athletes proper disciplinary sanctions. However, the remained cannabinoids samples (56%) were not sanctioned and the reason for the presence of THC is difficult to explain. It seems that following causes should be taken into account for explanation of THC presence in these samples:

- The athletes could be exposed to passive smoking of cannabis. Although, social contacts with smokers of hashish or marijuana is not forbidden such behaviour would potentially bring a risk of narcotics dependence;
- The samples were collected after a time long enough to remove metabolites of cannabinoids after active smoking. This effect would be related to natural process of elimination of some substances from the organism. On the other hand, the condition of transport of the samples and the period between sample taking and its time of analysis would also be of some importance. Mareck-Engelke *et al.* reported that bacterial flora usually present in urine can decrease the concentration of carboxy-THC [21]. Also Jaźwiec showed that concentration of carboxy-THC can possibly decrease in the sample especially when Staphylococcus aureus, Pseudomonas aeruginosa and Proteus vulgaris bacteria are present in urine [12];
- Concentration of cannabinoids took by users was too small to exceed the legal threshold. The great choice of cannabinoids in the black market and their different forms (dried flowers, stems, seeds and pressed plants) cause a large and unpredictable variation in cannabinoids concentration of the product [16];
- THC would get into organism together with meal. Cannabis can be added to some foodstuff such as gelatine dessert, honey, cookies, candies and some drinks. Former Polish regulations concerning cannabis presence in food products was changed to less restricted regulations of the European Union. In result, the access to foodstuff containing legal, normalized quantity of tetrahydrocannabinol becomes much easier. Fortunately, the concentration of THC in food products is generally very low. No carboxy-THC was found in urine samples of volunteers after ingestion of beer (with name suggesting cannabis ingredients) [33] and tea with hemp leaves [18].

Cannabinoids during competition and out-of-competition: The results obtained in the present work suggest some preference of cannabinoids use during different stages of preparation to competition. Despite of the fact that absolute number of analysed samples was greater for competition the relative number of THC samples was greater for out-of-competition. Such result would mirror the WADA anti-doping regulations in which cannabinoids application is forbidden only during competition.

Positive influence of cannabinoids on sport performance is quite problematic because of their sedative action. Some authors describe the cannabinoids as illusory doping substances. From one hand the cannabis decrease the nervous tension and fear, act as an anti-stressor and bring relaxation. On the other hand, cannabinoids decrease concentration and muscles strength, reaction time, vision reactions and ability to distance estimation. Prolonged use of cannabinoids causes toxic psychosis, intellectual degradation, apathy and body weakness [25,31]. The anti-fear action of cannabinoids would have some meaning in extreme sports where the narcotic could decrease the fear level and help to take a higher risk for sport success [26,32]. According to Rivier cannabinoids could be beneficial for athletes before competition (as an anti-stressor agent) and after competition (calming and relaxing agent) giving self-reward or inhibiting effects of stimulants taken before the competition [30].

In spite of controversial benefit of cannabis application in sports there is a growing number of positive doping cases with THC. Kindermann reported that in Germany, in the year 2003, cannabinoids were the third doping substance after anabolic-androgenic steroids and stimulants [13]. For the years 2000-2004, in Switzerland cannabinoids were most frequently used as a doping substance [29].

The mentioned above facts lead to the conclusion that cannabinoids are used by some sportsmen consciously to enhance their sport chances and/or are used unintentionally for some social reasons. Both situations indicate a lack of professionalism of the athlete in fulfilment of sport requirements, spirit and ethics. This should be a signal for trainers, coaches and medical doctors that some extra measures should be undertaken to help athlete in coping the narcotics problem. From the social point of view, the sport society does not differ to other social groups where narcotics become more and more popular. A strong education actions targeted towards young athletes are, therefore, necessary to explain the medical, legal and sport consequences of cannabinoids use. This is of special importance because of lack of knowledge in this matter by some athletes for whom the presence of cannabinoids on the list of forbidden substances is sometimes a total surprise.

Cannabinoids and age of an athlete: The age distribution of athletes using cannabinoids did not differ to that observed in normal Polish population. It has been reported that about 18.6% of Poles, in the age 16-24 years, had contact with hashish and marijuana, with decreasing frequency of cannabinoids consumption with an increase of age [35]. Maximum percentage of cannabinoids use observed in the present work for athletes of the same age group (Fig. 4) clearly indicate the lower cannabinoids use in young people practicing sports. Such result would be an effect of protective influence of sports against cigarette smoking in general and, especially, against smoking of cannabis. This is also in an agreement with a popular opinion that cigarette smoking cannot be positively combined with professional sport.

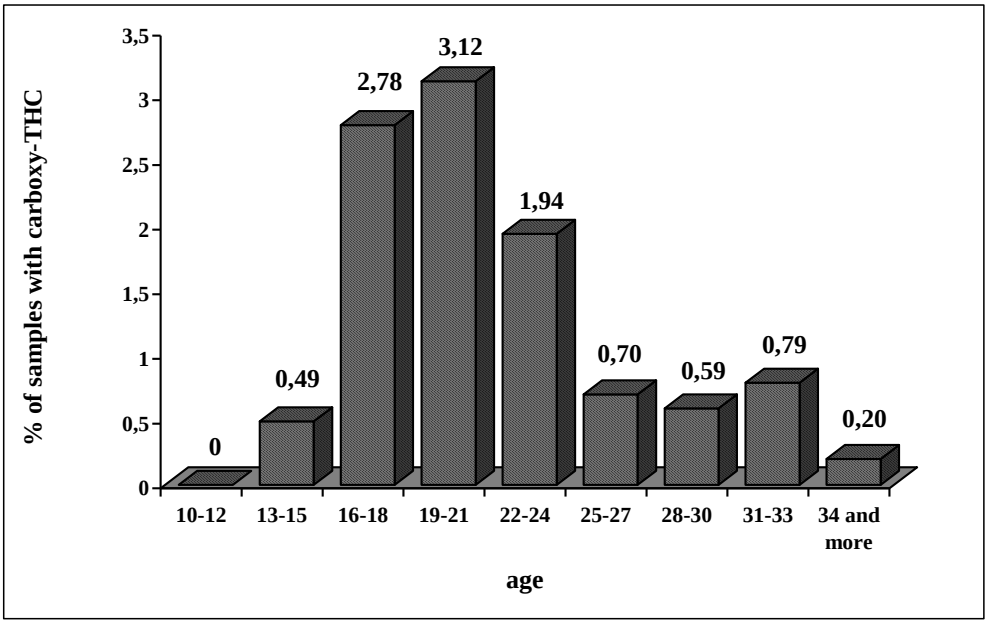

Fig. 4
Realtive distribution of carboxy-THC cases in relation to the age groups

Cigarette smoking can be regarded as a first step towards cannabis smoking. Ellickson *et al.* reported that young people smoking cigarettes are 3 times more vulnerable for marijuana smoking than non-smokers [8]. Also early experiments

with drug consumptions increases the risk of narcotic use more in smokers than in non-smokers [7].

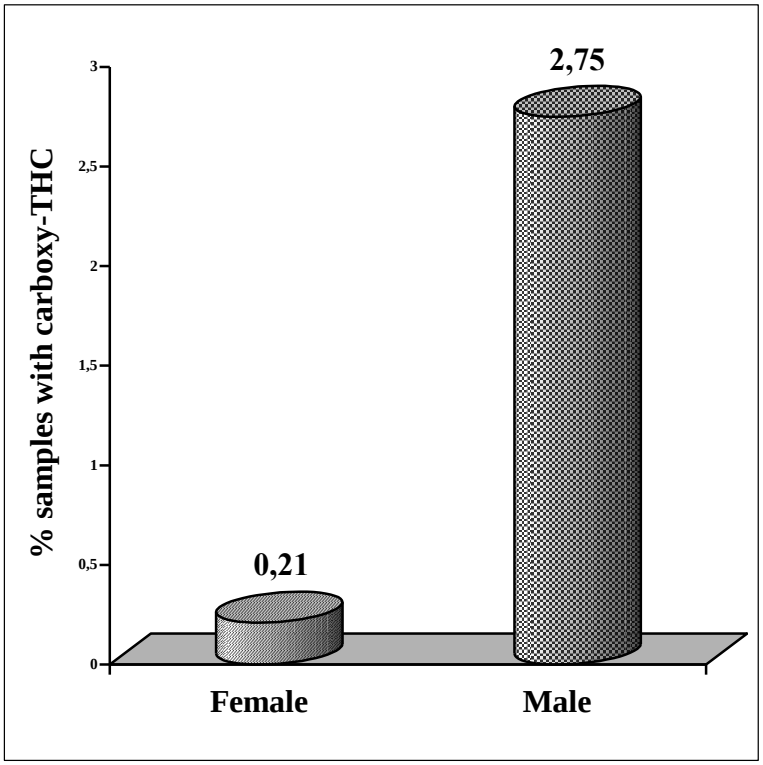

Fig. 5
Carboxy-THC samples in Polish male and female competitors

Another factor which should be taken into account is availability of cannabis for the group of young people in the age 16-24 years. This very active, but inexperienced, social groups is a special target for narcotics dealers. As was reported by Sierosławski over 16.3% of Polish young people aged 16-24 years get direct proposal of cannabis purchasing and use while for the age group of 25-34 years such proposals amounted to only 3.9% [36].

Cannabinoids and gender: Polish sportswomen used cannabis much less (0.21%) than Polish sportsmen (2.71%). This finding is in agreement with other reports showing lower inclination to narcotics in women than in men. In France

67% boys and 51% of girls declared marijuana smoking at least one time in their lives [27]. In Poland, the respective numbers were 10% and 3.4% [35]. Latimer *et al.* studying students smoking marijuana concluded that women prefer rather normal, nicotine cigarettes smoking whereas men, having a choice, prefer rather marihuana smoking [19]. It seems that men are generally more prone to use doping substances than women what is supported by results of the study of Kwiatkowska *et al.* showing a gender preference of anabolic-androgenic steroids use in sports [19].

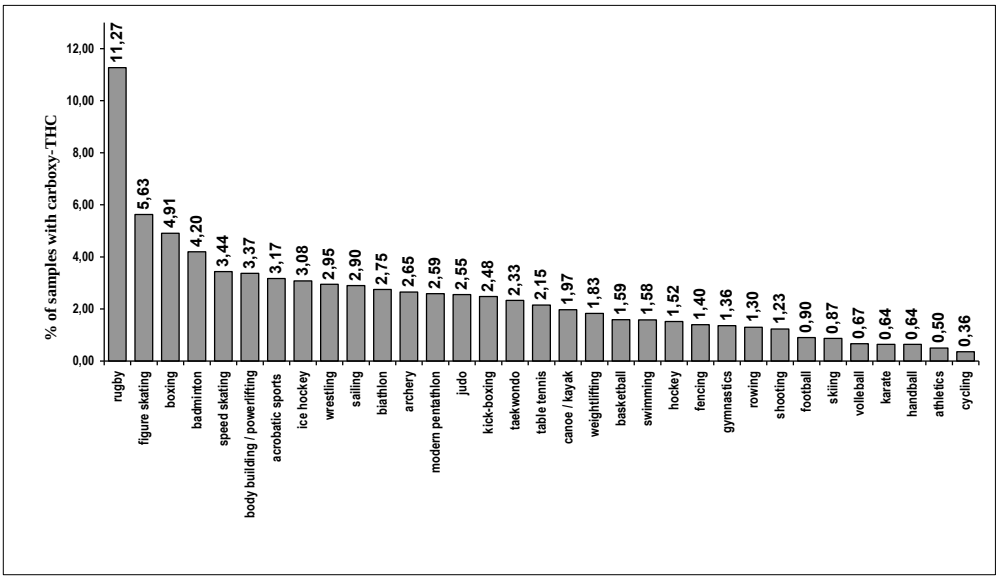

Fig. 6
Relative frequency of carboxy-THC detected in Polish competitors of different disciplines of sport

Cannabinoids and disciplines of sport: Frequencies of cannabinoids use for specific disciplines of sport in Poland are presented in Fig. 6. These results did not much differ to other international reports. In Belgium, for the years 1998-2001, the disciplines of sports in which carboxy-THC in samples was greater than 15 ng/ml were as follows: kick-boxing (8.7%), boxing (7.5%), ice hockey (6.9%), body building (6.4%), volleyball (6.3%) and sailing (5.1%) [39]. Laboratory in Cologne (Germany) reported, for the years 1998-1999, the following numbers: baseball (12.5%), squash (11.1%), badminton (10.5%), water skiing (8.3%), rugby (5.8%), American football (4.2%), taekwondo (3.7%) and wrestling (3.8%) [21,22]. In

some countries a high percentage of carboxy-THC samples were noted in volleyball (6.2% in Brazil, for the years 1998-2000) [3].

Up to now, no correlation was fund between the number of carboxy-THC cases and discipline of sport. The lack of such relationship would suggest that the THC cases in sport could be rather a social effect than an intentional doping use [6,40]. However, it might be inferred that those athletes practicing extreme and risk sports such as snowboard, water skiing, contact sports and fight sports are more eager to search an extra sensation in narcotics. Such view could be additionally supported by the fact that in all available statistics the number of carboxy-THC samples for such sports as cycling and track and field is extremely low.

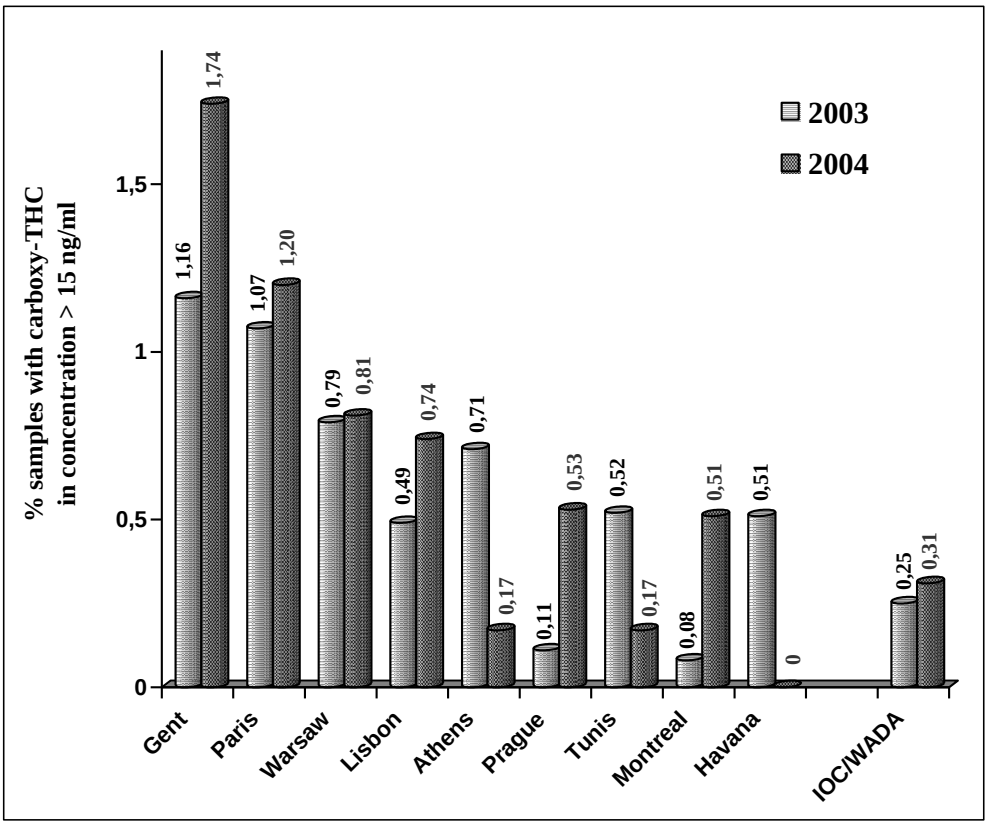

Fig. 7
Relative number of positive carboxy-THC samples reported by some accredited laboratories during 2003-2004

Cannabinoids in Poland and in other countries: In recent years the number of positive cannabinoids samples in Polish sportsmen is similar to that observed in the countries of Benelux and is one of the highest in the world. According to reports published by anti-doping laboratories accredited by IOC/WADA only in Belgium and France the number of carboxy-THC positive samples was greater than in Poland (Fig. 7) [1,41]. In the year 2000, among 2.0% of world antidoping samples tested by laboratory in Ghent (Belgium) as many as 8.0% of the cannabinoids samples was detected by this laboratory [39,40]. It is most probable that such result would be an effect of legal access to cannabinoids in Holland. Also in Belgium, especially in Flanders region, the social acceptance for cannabis use is quite high and possession of small quantity of hashish or marijuana for personal use is not prosecuted. Finally, the high number of positive carboxy-THC samples reported by Ghent laboratory included samples taken from all competitors, from amateurs up to professional athletes, tested during competitions [6,39,40]. Thus, the all samples were also tested for THC what is not obligatory for anti-doping analyses performed during out-of-competition. In result, the high relative amount of carboxy-THC samples reported by Ghent laboratory could probably be lower.

In France, consumption of marijuana continuously increases and is one of the highest in Europe. According to official data every two of three boys and all of second girl tried marijuana multiplying the number of users, aged 16-17 years, from 7% to 21% during just one decade. This significant spreading of marijuana users among youngsters convinced the French Government to undertake special measures to counteract this social problem.

In Poland, the access to marijuana is relatively easy for all social groups. In opinion of 89% of occasional narcotics users there is no problem to get cannabis [36]. Mellibruda *et al.* published data indicating that about 7% of students have been using marijuana during 30 days before they were questionnaired [23]. The health problems for narcotics users in Poland are additionally enlarged by traditional high alcohol consumption in the society. This directly leads to risk of cross-dependence to alcohol and narcotics and to intensification of psycho-pharmacological effects of both substances. It should also be noticed that marijuana is not a basic narcotic and that the amphetamine, hallucinogens and cocaine are frequently used by Polish drug addicted person [27].

Easy access to cannabis may be treated by some athletes as an „acceptance climate" for its use. In Poland, in early eighties, the marijuana smoking was a part of sub-culture limited to the group of "alternative youngsters". In nineties, marijuana become much more popular changing the style of its use from ritual to accepted social joy [15]. Devaluation of the position of marijuana in social

perception from narcotic to occasional source of pleasure causes that many youngsters do not see any potential danger of marijuana use [27]. This would be a reason of some positive THC anti-doping tests in Polish young athletes who may treat marijuana smoking similarly as tobacco smoking or drink.

Conclusions

Tetrahydrocannabinol is a narcotic most frequently detected in urine anti-doping samples taken from Polish sportsmen. The number of carboxy-THC samples in Polish athletes is one of the highest in Europe. THC is most popular in male competitors, aged 16-24 years, during period of sport preparation (out-of-competition) representing mainly the following disciplines of sport: rugby, skating, boxing, badminton and body building.

It is suggested that those competitors preferring THC use should be immediately covered by a special educational and control programmes. When carboxy-THC doping case is considered the National Anti-doping Agency should always take into account the possibility of unintentional, social use of this narcotic.

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Accepted for publication 20.03.2007

Study financed by:
Institute of Sport, Warsaw – E.7.1/1998, D.7.2/2002, E.7.2/2003, and F.7.2/2004.
Polish Confederation of Sport – 3/DSW/2003

Results of this study were partly presented during EU-Symposium, Biomedical Side Effects of Doping (Munich, Germany, 21st October 2006)