SUPPLEMENT

Cannabis and sport

M Saugy, L Avois, C Saudan, N Robinson, C Giroud, P Mangin, J Dvorak

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See end of article for authors' affiliations

Correspondence to: M Saugy, Swiss Laboratory for Doping Analyses, Institute of Legal Medicine, Lausanne, Switzerland; martial.saugy@chuv.ch

Background and objectives: Cannabis is on the list of prohibited substances in the practice of sport, although its performance enhancing effect has not yet been proved. Its popularity among the younger generations as a social drug puts cannabis at the top of the list of compounds detected by the anti-doping laboratories accredited by the World Anti-Doping Agency worldwide. The management of the results of urine analysis is quite difficult for the medical and disciplinary committees not only because of the social use of the substance, but also because of the interpretation of the analytical data from urine samples. This paper gives an overview of what is presently known about cannabis in relation with the practice of sport.
Methods: Review of literature on the cannabis and exercise, its effect in the body, and the problems with interpretation of results when it is detected in urine.
Results: The paper outlines the major effects of cannabis in the context of its social use and its use for sport activities. The difficulties in the interpretation of urine sample analysis results because of the protracted excretion time of the main metabolite, long after the intake, are described.
Conclusions: There is an urgent need for sport authorities to take measures necessary to avoid players misusing cannabis.

The consumption of substances derived from cannabis, such as hashish (resin) and marijuana (''grass'', ''pot''), particularly in the form of joints, is widespread. The relatively high incidence of cannabinoids detection in urine reflects the high prevalence of cannabis use among young adults. Various studies carried out in Europe and elsewhere have shown an impressive increase in the frequency and quantity of consumption, essentially in the younger population, with an earlier onset of use. In a report by the European Monitoring Center for Drugs and Drug Addiction,[1] 1.2–16% of young people aged 15–24 from 18 European countries indicated cannabis consumption during the last month whereas 16% of young US adults aged 18–25 reported past month use of cannabis.[2]

As cannabis smoking impairs cognition, and psychomotor and exercise performance, it is considered to be an ergolytic drug. Renaud and Cormier[3] showed that marijuana smoking reduce maximal exercise performance; when 12 healthy young adults cycled to exhaustion 10 minutes after smoking, exercise duration decreased from 16 to 15 minutes. Driving and piloting skills are also negatively affected, and point to the dangers of cannabis exposure when high level of alertness and quick reflexes are required, such as in automobile sports.[4] Thus it can be inferred from the psychological effects of marijuana that cannabis is effective only in allowing an athlete to relax and to escape from social pressures.

The main feature of recreational use of cannabis is that it produces a feeling of euphoria with decreased anxiety and increased sociability, which may alleviate the stress generated by competition. However, cannabis can also produce dysphoric reactions, including severe anxiety[5] and panic disorders, paranoia, and psychosis.[6 7] These undesirable reactions are commoner in naïve, anxious subjects and psychologically vulnerable individuals and occur more frequently after oral use than after smoking. Because cannabis diminishes alertness, and has relaxing and sedative properties, it may be used to improve sleeping time and sleep quality. Lorente and coworkers[8] reported that relaxing, pleasure, and improved sleeping were the main motives to use cannabis as indicated by students from French sport science universities. A good sleep before competition should improve performance. Athletes engaged in ''X-treme'' sports are more likely to use cannabis. A relation between drug use and ''sensation seeking'' behaviour has been often reported. Competition level must be also considered as an increased risk factor for cannabis use for coping with stress and anxiety.[9]

CANNABIS ANALYSIS IN URINE

The active substance in cannabis is tetrahydrocannabinol (THC). It is metabolised into its main metabolite carboxy-THC and conjugated, and then excreted chiefly in the urine.

According to the World Anti-Doping Agency (WADA) standards, urine samples are considered positive for cannabis exposure if the sum of the concentrations of free and conjugated carboxy-THC is greater than 15 µg/l, when determined by gas-chromatography/mass spectrometry. This threshold value distinguishes active users from passive smokers.[10] It makes also less likely a positive result due to intake of commercial foods containing traces of cannabinoids (see Leson *et al*,[11] and ElSohly[12]). Since the mid-1990s, the ingestion of food products containing seeds or hemp seed oil has increased considerably in several Western countries. However, several US states have enacted regulatory limits for THC in foodstuffs and beverages, thus lowering THC intake from hemp containing foods and reducing the risk of a positive urine test. Regulations in Canada, the main supplier of hemp seeds to the USA, limit THC levels in hemp seed products to 10 parts per million (ppm).[13]

There are several other problems with carboxy-THC analysis in urine. The relevance of the 15 ng/ml cut-off value could be improved by correcting the THC concentration with the creatinine level. With this approach, the quantitative results would be corrected for urine dilution and possible adulteration. It will also be possible to predict repetitive or new marijuana use by analysis of the urinary cannabinoid to creatinine ratio in two consecutive urine samples collected at least 24 hours apart.[14] Quantitation of carboxy-THC in urine

Abbreviations: THC, tetrahydrocannabinol; WADA, World Anti-Doping Agency

alone cannot predict time of last marijuana use or suggest any relation between urine concentration and psychomotor effects. Huestis and coworkers found that occasional users of marijuana had positive urine specimens for three to four days after receiving a standard dose of marijuana.[15] In heavy smokers, urine specimens have been shown to remain positive for seven to ten days after last drug use.[16] Ellis *et al* reported an average time until the last positive result of 31.5 days (4–77 days) in urine for THC metabolites screened by immunoassay with a cut-off value of 20 ng/ml.[17] According to Manno *et al*,[18] determination of the time of last cannabis use is possible by measuring total THC in urine. Significant levels of THC could be measured by including a hydrolysis step in the extraction protocol. A concentration greater than 1.5 ng/ml would suggest marijuana use within a five hour time window, a time during which psychological and performance effects are known to occur.

EFFECTS OF CANNABIS CONSUMPTION

There has been an increase in the use of cannabis and cannabis derivatives in some countries, both in society in general and also among members of football clubs, even those at top professional level. However, the issue is not restricted to football—it affects all sports. This has led to increasing concern and uncertainty among young players, parents, coaches, and managers.

Sportspeople who consume cannabis derivatives usually restrict themselves to low doses. Consumption usually takes place outside sports facilities and so is beyond the control of team coaches and/or doctors. The lack of control is accentuated by the fact that testing for the substance is only done during competitions. Data gathered from WADA-accredited laboratories show that cannabis is easily the commonest drug leading to positive results, in particular, it is ahead of testosterone and nandrolone. Positive results only relate to competition testing. They do not take into account any positive results found in urine samples taken out of competition; these are not reported by the laboratories.

As stated above, the main active ingredient of cannabis is THC, and with development of cultivation methods it has become possible to grow cannabis plants that have significantly higher levels of THC than before. These high THC levels may reinforce and change the immediate effects of consumption. The effects of high levels of THC in terms of long term damage to health have not been well documented, although any activity requiring concentration and energy will be affected by its use.

The effects of cannabis derivatives are varied with physical and psychological repercussions as well as influencing a player's social behaviour. Isolated or infrequent consumption can lead to:

- mild intoxication
- sedative effect on behaviour
- slower reaction times
- memory problems
- tendency towards drowsiness.

In terms of the effects on the body, although heightened sensory perception can be expected, THC also engenders a certain heaviness, marked relaxation, and excessive fatigue of the limbs. As the dose increases, the user may experience hallucinations, an alteration of the perception of reality, and a marked reduction in concentration. Furthermore, as these products are generally smoked, this can only have a negative effect on sporting performance and the player's health (detrimental effects on the lungs, oral cavity, and upper respiratory tract). As regards psychological and social behaviour, cannabis accentuates the mood. So a user may become carefree, happy, and relaxed, but also risks becoming stressed, depressed, or paranoid. Other effects on a user include reduced inhibition and developing a certain indifference. Regular consumption leads to psychological dependence, a chronic sedative effect, and even social detachment.

DOES CANNABIS HAVE A DOPING EFFECT?

The question often asked in the case of a positive result for cannabis is whether it was consciously used for doping purposes. The answer is that this substance can only indirectly improve performance—it can have a euphoric effect, reducing anxiety and increasing the sociability of a player who may be particularly nervous before an important match. It can also have a relaxing effect after the game. In this way, cannabis can be considered as a doping product that calms the mind. It has already been described that use of cannabis in sporting environments is basically motivated by the effects of relaxation and wellbeing, allowing the user to sleep more easily. However, if consumed regularly, it risks harming performance and motivation.

It is when cannabis is consumed regularly that the signs become apparent in young athletes. There may be changes in behaviour during training as well as inconsistent performance, concentration, or motivation. Particular care should be taken when a player is vulnerable, for example if lacking support, during prolonged or repeated injury, when isolated from family or if subject to excessive pressure for results on the pitch. In these cases it is up to the club coaches and doctors to look out for any symptoms that may appear and to intervene tactfully, although firmly, when necessary. In some cases referral to a psychologist will be necessary.

THE PROBLEM OF PROTRACTED URINARY ELIMINATION

As described above and according to the World Anti-Doping Code, an abnormal result must be announced for cannabis if the main metabolite of THC, carboxy-THC, is discovered in a player's urine at a level in excess of 15 μg/l as a result of competition testing. This limit has been established to distinguish between active consumers and smokers of cannabis and players who may have been passively exposed to cannabis smoke. The limit also reduces the risk of a positive urine result after the consumption of some commercial products which contain traces of cannabis. The use of

What is already known about this topic

Cannabis is widely used by the younger generations as a social drug. However, it is actually at the top of the list of forbidden compounds detected by the WADA accredited anti-doping laboratories. The specific social use of the substance and the interpretation of the data from urine sample analysis make the handling of the results quite difficult for the medical and disciplinary commissions.

What this study adds

This review outlines the major effects of cannabis in its use in the social context and in sport activities. It describes the difficulties in the interpretation of any result obtained in urine because of the protracted period of excretion of the main metabolite. This review recommends that sports authorities should make a clear distinction between social drugs and performance enhancing substances.

hemp seed and oil in food products has increased considerably in some Western countries since the mid-1990s. The authorities have acted to impose limits on THC levels such that the consumption of these commercial products will not bring about positive urine results.

It should be noted that the elimination of THC metabolites from urine is a slow process and depends on individual physiology. In this way, a simple quantification of the urinary concentration of carboxy-THC reveals little information on the time elapsed since consumption. The quantity discovered in urine depends on various factors:

- dosage of the most recent consumption
- time elapsed between the most recent consumption and taking the urine sample
- manner of consumption (single dose or regular consumption)
- individual metabolism.

When these factors are taken into account, it is extremely difficult to establish a relation between urinary concentration and the effects on an individual's psychomotor skills.

Despite these considerations, some scientific studies have shown that on the occasional consumption of a normal dose (a ''joint''), the user will have a positive result for carboxy-THC for three, four or even five days, depending on the smoker's body mass. In this way consuming marijuana with friends a few days before a match could be disastrous for a football player as there would be a considerable risk of failing a doping test. The pretext of recreational use is no longer valid. Even if cannabis is taken without the intention of improving performance, the outcome will be a positive result if the urinary level exceeds the authorised threshold.

For regular users—for example, those who smoke cannabis several times a week—urine samples would remain positive for a much longer time after the most recent consumption. Scientific research published on this subject has shown that the time until urine samples return negative outcomes can be as much as four weeks (two weeks on average) after the most recent consumption.

Authors' affiliations

M Saugy, L Avois, C Saudan, N Robinson, Swiss Laboratory for Doping Analyses, Institute of Legal Medicine, Lausanne, Switzerland
C Giroud, P Mangin, Institute of Legal Medicine, Lausanne, Switzerland
J Dvorak, Chairman, FIFA Medical Assessment and Research Centre, Department of Neurology, Schulthess Clinic, Zurich, Switzerland

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