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Does "Hotboxing" Get You High and Can You Test Positive? - A Brief Review of Second-Hand Cannabis Exposure, Intoxication and Urine Drug Screens

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Abstract

Cannabis use is on the rise with higher and higher potencies of marijuana being cultivated. Current legislatures make it easier, and legal, for users to use, especially around nonusers. When such second-hand smoke occurs in poorly ventilated confinements, nonusers may inhale some of the smoke, resulting in absorption of cannabinoids. Some degree of intoxication may occur but most importantly, detectable levels of the drug in blood and urine. Often screening is used by employers, law enforcement agencies, physicians and substance abuse providers. Clinicians hence need to be mindful of such factors when patients deny use despite positive tests. Here we review available evidence, with emphasis on current data based on today's trends.

Clinical background: "I have not smoked marijuana since before I was drafted" 23 year-old NFL player Josh Gordon stated as his explanation for testing positive above the 15 ng/mL THC threshold the NFL considers a failed test. In his appeal he stated he was around individuals using marijuana. His "A" sample tested at 16 ng/mL and his "B" sample tested at 13.63 ng/mL. The two should be consistent since it comes from the same specimen. His legal team was able to dispute the results and reduce his sentence to 8 months as he was the "victim of breathing second hand smoke" (ESPN, 2014).

Keywords: Cannabis; Intoxication; Urine drug screens

Introduction

Cannabis has come a long way since the first reports of its use 12,000 years ago in Central Asia as a source of fibre for production of clothing, rope and parchments. It is now the world's most widely cultivated, trafficked, and used illicit drug and plays a central role in our culture with over 147 million users worldwide-2.5% of the world's population [1-3]. The age of initiation of use is the lowest out of all illicit substances [2]. The annual Monitoring The Future (MTF) survey tracking use of substances in 8th, 10th and 12th graders in the US indicates this is on the rise with 0.7%, 2.5% and 6.0% respectively reporting daily use in 2016 [4]. The major psychoactive constituent in cannabis is delta-9-tetrahydrocannabinol (THC) and the "potency" of cannabis is defined as the percentage of THC it contains. This varies depending on the strain of the plant, genetic manipulations, cultivation techniques, and methods of processing and storage [3], over the past decades, in response to consumer demand and policies in states that have legalized marijuana for medicinal and recreational purposes in the US, growers have been cultivating plants with higher and higher THC potency [5]. In the 1970s, THC content of regular, street, marijuana was <1% and this slowly increased to 4% on average in the 1990s and later, in 2012, analyses of samples seized by law enforcement agencies reached >12% [3,5-8]. Acute intoxication has been recognized and leads to impairment in cognitive capabilities such as learning, as well as psychomotor performance including coordination, divided attention and operative tasks and this can last up to 24 hours [9]. With the cultural perception changing and more people viewing it as being harmless, states have begun to legalize it [6]. Of note, in such states prevalence of cannabis use is on the rise [10]. Despite this, many employers and law enforcement agencies use drug screening to rule out impairment, with cannabis being one of the substances screened for. With increasing prevalence [11], individuals may be incidentally exposed to second-hand cannabis smoke. There is little in current literature documenting the effects of such exposure from the standpoint of intoxicating effects and also urine test results.

Pharmacokinetic and Pharmacodynamic Considerations

Cannabis can be administered orally, mixed in with food or drinks and smoked. The latter is the most common. The great majority of recreational use involves smoking it in rolled cigarettes "joints" or "spliffs", in pipes "bongs" and in hollowed out cigars "blunts". It can also be vaporized [12]. THC is present in smoke inhaled by the user but also in the smoke dispersed in the environment [13-15]. This is especially true if the user is using joints and blunts where the smoke billows out of it directly. THC is rapidly absorbed by inhalation through the lung and the gastrointestinal tract. It is almost completely metabolized with the main psychoactive metabolite being 11-hydroxy-delta-9-tetrahydrocannabinol (11-OH-THC). This is readily detectable in plasma, faeces and urine of users and even non-users that are exposed [16,17]. 11-OH-THC levels peak later than THC levels after cannabis exposure [16,18-21]. Metabolism of 11-OH-THC yields 11-*nor*-9-carboxy-delta-9-tetrahydrocannabinol (THC-COOH) which is non-psychoactive, but its long half-life of about 140 hours makes it a common biomarker in urine testing for cannabis use.

Can second-hand smoke produce intoxicating and physiological effects?

Cannabis use often occurs in small enclosed spaces such as a room or vehicle, with poor ventilation, a practice termed "hotboxing". In addition to the primary smoke from the chosen smoking device, second-hand smoke is repeatedly inhaled and exhaled by both users and nonuser participants [22]. Participants often refer to this secondary intoxication as "contact high". Being "high" is a subjective measure while the physiological effect of the substance and amount of THC in one's system is quantifiable. Early correlations between plasma THC concentrations and drug "high" were not significant, with increased heart rate and conjunctiva injection being better correlated to plasma THC concentrations [23]. There is evidence supporting the intoxicating effects of second-hand smoke under extreme, poorly ventilated conditions [24-26]. An early study in 1986 by Cone and Johnson exposed subjects to 4 or 16 cannabis cigarettes of 2.8% THC potency in a closed room for one hour each day, six consecutive days. Second-hand exposure had no systematic effects on heart rate or blood pressure, and participant's ratings of subjective drug effects increased significantly after exposure to smoke from 16 cannabis cigarettes relative to placebo ratings. These effects were most pronounced during the first hour after exposure, and resolved within 3 hours [25]. Current cannabis THC levels are much higher with seizure reports from 2002 to 2008 by federal and state law enforcement agencies in the U.S. averaged 11.1% to 11.9% THC [5]. Some strains approach 30% [27]. A recent study conducted at Johns Hopkins used a similar design, with a THC potency that mimics today's, and better controlled for room ventilation. Non-users were exposed to second-hand smoke from 6 individuals in a sealed chamber for 3 sessions lasing one hour [24]. Under conditions of poor ventilation, physiological (increases in heart rate) and behavioural (self-reported sedative drug effects and impaired performance on the digit symbol substitution test) symptoms were noted. Not only did this show second-hand cannabis smoke of today's potency can have physiological effects, but also intoxication can occur as demonstrated by changes in behavioural/cognitive performance [24].

Cannabis Drug Screens

THC is one of the SAMHSA-5 drugs tested for in standard National Institute on Drug Abuse (NIDA) approved urine drug screens. Qualitative immunoassays (ELISA) detect tetrahydrocannabinol compounds. A single use may be detected for 1-6 days depending on amount smoked, individual metabolism rate and the cut-off level of the test [22]. There are four cut off values-15 ng/mL, 20 ng/mL, 50 ng/mL and 100 ng/mL. With chronic daily use, a drug screen may test positive for up to 7-30 days depending on the same factors [22]. Lower levels remain in adipose tissues however not likely detectable by the cut-off levels [28]. In the US, the cut-off concentration recommended by SAMHSA for a positive result on the immunoassay test is 50 ng/mL. Various organizations have different cut-offs. The cut-off for quantitative GC/MS confirmatory testing is 15 ng/mL.

Along with urine testing, blood testing is also possible. Cannabis is detectable in blood for approximately 2-3 days after use in infrequent users. Frequent and chronic use can be detectable in the blood for up to 2 weeks.

Cannabis use is also detectable with hair tests in the standard hair test. Here, the most recent 1.5 inches of growth is used for testing. This provides a detection period of 90 days. If an individual's hair is shorter than 1.5 inches, the detection period will be shorter.

In recent years new technologies have been developed to allow for saliva THC testing. Detection can occur up to 72 hours since last use. [29].

Individuals have tried to evade testing positive by experimenting with various agents and techniques in attempt to mask detection [26]. Dilution by drinking excess water and cranberry juices or supplements are some of the popular attempts however research shows these have no impact on detection. Papain (from papaya plant and also found in meat tenderizers) has some evidence in reducing the detection of THC in urine in both immunoassay as well as with GC/MS although the evidence is scant [30]. Visine has also been reported in one paper to mask and blunt detection of THC and benzodiazepines [31] but again the evidence is scant.

False positive results are possible under certain conditions. These include pharmaceuticals such as NSAIDs, PPIs, Promethazine, Riboflavin, conditions such as kidney and liver diseases and certain agents such as baby shampoos and soaps [26,32].

Can second-hand smoke produce positive urine drug screens despite no use?

Several studies since the 1980s have attempted to evaluate the intoxicating effects of second hand smoke as well as the potential for these individuals to produce positive tests. The 1986 study by Cone and Johnson previously mentioned exposed subjects to 4 or 16 cannabis cigarettes of 2.8% THC potency in a closed room for one hour each day, six consecutive days [25]. This produced detectable levels of cannabinoids in urine and plasma, which varied linearly according to number of cigarettes smoke. This was a replication of earlier studies with similar results [33-36]. Similar studies at higher THC levels 10.4% also reproduce the results [37,38]. In the recent Johns Hopkins study previously mentioned, to examine how second hand smoke might impact screening, researchers exposed non-users to second-hand smoke from 6 individuals in a sealed chamber for 3 sessions lasing one hour [37]. During first sessions, chamber had no ventilation and users smoked cannabis of 5.3% as often as possible. Second, which occurred 1 week after first involved also an unventilated chamber but THC was 11.3%. Third occurred 1 week after second again with a THC of 11.3% but with ventilation similar to home air conditioning. Urine was collected from nonusers prior to each session and at regular intervals during a 34 hour period after end of each session. Urine immunoassays of second hand exposed individuals for each of the three sessions were negative for THC when the two highest cut-off levels (75 ng/mL and 100) were used. The recommended cut-off for federal workplace drug testing programs is 50 mg [39]. One nonuser tested positive at this level 4 hour post exposure. If the lowest level (20 ngmL) is used, 3 in the first session and 4 in the second tested positive. Here they were collected 1-4 hour and subjects continued to test positive 2-22 hours following first positive result. Ventilation is clearly a deciding factor but THC positive urines seem possible in non-smokers exposed to second hand THC of high potency when ventilation is low at a cut-off of up to 50 ng/mL [26,37].

Worthy of noting, despite a consensus between the two studies mentioned [25,37], there are several methodological differences between them as described above. There is considerable variation in duration of exposure, frequency of exposure, ventilation and size of

exposed area as well as the "dose" of exposure. Furthermore, the number of subjects in each of the studies is quite modest.

Discussion and Conclusion

The potency of marijuana is on the rise and with current legislations being more lenient, use in our culture is becoming more acceptable and common. Exposure to second-hand smoke, results in absorption of cannabinoids. Room ventilation plays a significant role in the degree of cannabinoid absorption and on resultant pharmacodynamic effects. If used in unventilated containments this can result in subjective "high" effects and detectable levels of THC in blood and urine (depending on cut-off), particularly in the hours following exposure. If the potency of the marijuana is high enough, physiological symptoms (increases in heart rate) and minor impairment on a task requiring psychomotor ability and working memory can also be noted. As clinicians, we need to be mindful when interpreting positive tests and considering the circumstances when patients deny use.

Worthy of mention, in this review we utilized some information reported on social networks. Use of such information is an emerging trend and has support and evidence of being able to bring real time information from actual users to clinicians, bridging the current gap in our scientific knowledge [40-42]. Here we supplemented existing literature with real-time information from social media to provide the most up-to-date coverage of the topic and extend beyond our existing clinical knowledge.

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