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Review article

Treatment of marijuana dependence: a review of the literature

Aimee L. McRae, Pharm.D.[a,*], Alan J. Budney, Ph.D.[b], Kathleen T. Brady, M.D., Ph.D.[a]

[a] *Ralph H. Johnson VAMC, 109 Bee Street, MUSC/CTN, Charleston, SC 29401, USA*
[b] *Treatment Research Center, 54 West Twin Oaks Terrace, Suite 12, S. Burlington, VT 05403, USA*

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Abstract

Until recently, relatively little research has focused on the treatment of marijuana abuse or dependence; however, marijuana use disorders are now receiving increased attention. This paper reviews the initial clinical trials evaluating the efficacy of outpatient treatments for adult marijuana dependence. Findings from five controlled trials of psychotherapeutic interventions suggest that this disorder appears responsive to the same types of treatment as other substance dependencies. Moreover, these initial studies suggest that many patients do not show a positive treatment response, indicating that marijuana dependence is not easily treated. Strengths and weaknesses of the data are presented. Preliminary data from less controlled studies relevant to the treatment of marijuana dependence are discussed to suggest future research areas. Although very few studies on treatment for marijuana abuse and dependence have been completed, the initial reports identify promising treatment approaches and demonstrate a need for more research on the development of effective interventions.

Keywords: Marijuana; Substance use disorders; Psychotherapy; Pharmacotherapy; Cannabinoid receptors

1. Introduction

Marijuana is the most commonly used illicit drug in the United States (Anthony et al., 1994), and unfortunately a trend towards greater use, especially among adolescents, has recently been observed (Monitoring the Future, 1999). The 2000 National Household Survey on Drug Abuse indicates that more than 76.3 million (34.2%) Americans 12 years of age or older have tried marijuana at least once in their lifetimes and almost 18.6 million (8.3%) have used marijuana in the past year (SAMHSA, 2000). It is estimated that approximately 10% of individuals who ever use marijuana become daily users (Johnston, O'Malley, & Bachman, 1995). Lifetime prevalence rates of marijuana dependence have been approximated at 4% of the population, which is the highest dependence rate of any illicit drug (Anthony & Helzer, 1991; Anthony, Warner, & Kessler, 1994). The much greater number of marijuana users compared to users of other substances of abuse is likely the cause of these relatively high rates of marijuana dependence. Thus, comparison of rates of conditional dependence, that is the risk of developing dependence among those who have ever used a particular substance, would perhaps more accurately estimate the relative dependence potential of marijuana. Anthony et al. (1994) report that marijuana has a substantial rate of conditional dependence (9%), albeit lower than substances such as alcohol (15%), cocaine (17%), heroin (23%), or tobacco (32%).

Until recently relatively little research has focused on the treatment of marijuana abuse or dependence. Two major factors may contribute to the lack of clinical research focused on this disorder. First, there had been a common belief that marijuana abuse rarely occurred as a primary problem, but rather was observed only in the presence of concurrent alcohol or other drug abuse. Second, many believed that marijuana use did not produce a true dependence syndrome; thus treatment to assist with quitting was not desired or needed. Data contrary to these beliefs first appeared in the late 1980s. Media advertisements for an anonymous telephone survey for adults who used marijuana and were concerned about their use prompted 225 responses, and 74% of these stated that they were adversely involved only with marijuana (Roffman & Barnhart, 1987). More than 68% of respondents were interested in participating in treatment if it were available. Since that

* Corresponding author. Tel.: +1-843-792-5215; fax: +1-843-792-3982.
E-mail address: mcraeal@musc.edu (A.L. McRae).

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study, other reports confirm that individuals with marijuana-related problems readily respond to advertisements for treatment, and the majority do not abuse other substances (Stephens, Roffman, & Simpson, 1993; Budney, Radonovich, Higgins, & Wong, 1998; Copeland et al., 2001a). Such respondents report significant psychosocial and psychiatric impairments and multiple signs of dependence. Indeed, the demand for treatment of marijuana-related problems at substance abuse programs doubled between 1992 and 1998 across the United States (SAMHSA, 1999), such that the percentage of illicit drug abuse treatment admissions for marijuana (23%) approximated that for cocaine (27%) and heroin (23%).

Concurrently, treatment development and efficacy studies targeting marijuana dependence began to appear in the scientific literature during the 1990s. This paper reviews the existing literature on the treatment of marijuana abuse or dependence in adults that has been published to date, including both psychotherapeutic and pharmacotherapeutic advances. Information included in this review was drawn from comprehensive MEDLINE (1966–2002) searches (keywords: marijuana, cannabis, treatment, psychotherapy, drug therapy) and frequently cited references in research articles. Five controlled studies, defined as those using random assignment to at least two groups with pre- and post-treatment assessment, were identified. These studies will be described in detail, with emphasis placed on their strengths and weaknesses. Other treatment approaches, including the use of pharmacological agents, described in the literature but not evaluated in a controlled trial will be briefly presented. It should be noted that this review will not address treatments for adolescent marijuana dependence. Although much has been written about adolescent substance abuse, there are few well-controlled studies focused on marijuana. Ongoing adolescent studies promise to provide important information. Overviews of existing literature on marijuana abuse among adolescents have been published recently (Dennis, Babor, Roebuck, & Donaldson, 2002; Gruber & Pope, 2002).

2. Randomized controlled trials

All the controlled treatment studies for marijuana dependence or abuse published to date have evaluated psychotherapies. Most interventions tested were adapted from those used with other substance dependence disorders. A summary of the method and results of the controlled studies are reported in Table 1.

The first controlled study to appear in the literature was a comparison of a 10-week social support group treatment and a 10-week cognitive-behavioral relapse prevention group treatment (Stephens, Roffman, & Simpson, 1994). The authors hypothesized that the skills training components of the relapse prevention treatment would lead to superior reductions in marijuana use compared with the social support intervention. The relapse prevention treatment actively helped participants problem-solve regarding relapse vulnerabilities by discussing topics such as lifestyle balance and handling of high-risk situations. It was adapted from a therapist manual for a cigarette smoking-cessation program (Gordon & Curry, 1984), and was based on interventions described by Marlatt and Gordon (1985). Components of the treatment included creating formalized quit contracts, debriefing by therapists after encounters with high-risk situations, planned exercises and handouts emphasizing coping strategies, and homework assignments reinforcing skills discussed during sessions. The social support intervention emphasized the usefulness of group support for change. Topics discussed in the group setting included getting and giving support, dealing with denial and mood swings, and interacting with peers who continued to use marijuana. Therapists facilitated discussion but avoided providing direct input or didactic training.

Two hundred and twelve adults were recruited through media announcements and were randomized to one of the two treatments. Both treatment groups met weekly for the first 8 weeks and then every other week for 4 additional weeks. Drug use and drug-related problems were assessed before treatment, at the final treatment session, and periodically for 12 months post-treatment. Subjects were primarily males ($n = 161$), the mean age was 31.9 (range 18–65) years, and 95% of the sample was Caucasian. Subjects averaged 15.4 years ($\pm$ 5.1 *SD*) of marijuana use and used marijuana on 80.7 ($\pm$ 15.5 *SD*) of the 90 days prior to study entry. Nearly two thirds (63%) of subjects reported abstinence during the last 2 weeks of the treatment period; analyses showed no significant differences between treatment conditions. Both interventions were associated with a reduction in marijuana use throughout the post-treatment followup period, but again there was no difference in outcome between treatment groups. At 12 months, approximately 17% of participants reported abstinence from marijuana use and an additional 19% of participants were considered to have an improved outcome (i.e., marijuana use at 50% or less of their pretreatment levels or reporting no problems related to marijuana use). This study suggests that these two group counseling approaches might have beneficial effects for the treatment of marijuana dependence. However, the lack of between-group differences limits conclusions regarding the causal role of treatment. As noted by the authors, one can not rule out the possibility that the decrease in marijuana use may have been the result of having a motivated, self-referred treatment sample. For example, subjects were required to pay a $50 deposit in order to participate in the study. Such an entrance requirement may have deterred less motivated participants, as well as created a sample with a higher socioeconomic status than is representative of some marijuana users. Further limitations of this study include a lack of ethnic diversity in the sample, recruitment from only one geographic location, and collection of urine samples for drug screening at only two

Table 1
Controlled psychotherapy trials

Author	*N*	Study design	Intervention	Outcome
Budney et al., 2000	60	Randomized	4-session MET vs. 14-session MET plus coping-skills therapy vs. MET plus coping-skills therapy plus voucher incentives	No differences in abstinence between 4-session and 14-session groups. Voucher group had greater durations of abstinence and had more abstinent subjects at end of treatment than other two groups.
Copeland, Swift, Roffman, & Stephens, 2001	229	Randomized, delayed treatment control	6-session MI vs. 1-session MI vs. delayed treatment control group	Both treatment groups reported better outcomes (greater abstinence rates, fewer marijuana-use related problems, less concerned about marijuana use) than the delayed-treatment control group.
Stephens et al., 1994	212	Randomized	Relapse prevention vs. social support group discussion intervention	Both groups had significant reductions in marijuana use compared to baseline. No significant differences between groups in days of marijuana use, marijuana-related problems, or abstinence rates.
Stephens et al., 2000	291	Randomized, delayed treatment controlled	14-session relapse prevention support group vs. 2-session individual treatment vs. delayed treatment control group	Both treatment groups showed greater improvement than delayed treatment group. No significant difference in outcomes between 14-session and 2-session groups.
Stephens, 1999	450	Randomized, multi-site, delayed treatment controlled	9-session MET vs. 2-session MET vs. delayed treatment control group	More subjects in extended treatment group abstinent at 4 months than in the brief treatment or delayed treatment group.

MET = motivational enhancement therapy; MI = motivational interviewing.

time points (see Buchan, Dennis, Tims, & Diamond, 2002). Finally, subjects were not required to meet criteria for marijuana dependence to participate in the study.

The Stephens group conducted a second trial with adult marijuana users to replicate and extend the findings of the first study (Stephens, Roffman, & Curtin, 2000). A three-group design compared an enhanced 14-session, cognitive-behavioral, relapse-prevention group (RPG) treatment and a brief, 2-session, motivational individualized assessment and intervention (IAI) with a delayed-treatment control condition (DTC). Subjects randomized to the DTC group were able to participate in either the RPG or IAI interventions after a 4-month wait. The enhanced relapse prevention intervention was developed because the authors hypothesized that the version used in the first study might not have been long enough for acquisition of the skills needed to avoid relapse, and they therefore wanted to evaluate a more comprehensive treatment derived from the same theoretical model. The brief treatment was included because of recent evidence supporting the efficacy of brief interventions with alcohol abuse and dependence (Fleming, Barry, Manwell, Johnson, & London, 1997). Importantly, the addition of the delayed-treatment control condition allowed for an assessment of change associated with the two active interventions with what occurs when no intervention is provided.

The relapse prevention intervention involved 14 weekly group sessions delivered over a 4-month period. Sessions focused on building motivation to change, handling high-risk situations, entering into quit contracts, and conducting self-help sessions. Homework intended to encourage practice of specific skills was assigned and reviewed each week during the first ten sessions. The brief motivational condition was adapted from Miller's Drinking Check-Up developed for alcohol problems (Miller, Benefield, & Tonigan, 1993). During two individual 90-min sessions, subjects met with a therapist who provided feedback from a comprehensive assessment using motivational interviewing techniques, and instructed subjects on cognitive-behavioral techniques (CBT) that could be used to abstain from marijuana use. Days of use per month, times used per day, number of marijuana dependence symptoms, and number of marijuana-related problems were assessed prior to subjects entering treatment and during a 16-month followup period.

Two hundred and ninety-one adult marijuana users were recruited via newspaper advertisements. The sample characteristics were similar to that of the first study. Participants were predominantly male (77%) and Caucasian (95%), with an average age of 34.0 years (*SD* = 6.8). The majority of participants used marijuana daily (average 74.64 days of use in past 90 days) and typically used multiple times each day. Both active treatments produced greater reductions in marijuana use than observed in the delayed treatment group; however, no differences in outcome were observed between the active treatments. At a 4-month post-intake assessment, participants in the RPG and IAI groups reported reduced marijuana use compared to participants in the delayed treatment group (6.7 days of use per month with RPG vs. 7.9 days with IAI vs. 17.1 days with DTC). Subjects in the active treatment groups also reported fewer times used per day (1.15 with RPG vs. 1.19 with IAI vs. 1.97 with DTC), a lower number of dependence symptoms (1.96 with RPG vs. 1.94 with IAI vs. 4.63 with DTC), and fewer problems related to marijuana use (3.50 with RPG vs. 3.26 with IAI vs. 7.89 with DTC) than

subjects in the delayed treatment group. Abstinence rates for the 90 days preceding the 4-month assessment were identical between the RPG and IAI groups (37%) and significantly greater than the DTC (9%). At the 16-month assessment, marijuana use had increased in both the RPG and IAI groups but was lower than pretreatment levels (12.29 days of use per month with RPG; 12.99 with IAI). The abstinence rate at the 16-month followup was 29% for the RPG intervention and 28% for the IAI condition. These results support the findings of the initial study indicating that a group CBT/relapse prevention treatment has efficacy for the treatment of marijuana dependence and associated problems. It also provides initial evidence for the efficacy of a brief, motivational interviewing treatment with this population. Interestingly, a recent large-scale clinical trial for alcohol dependence also failed to detect differences between a brief motivational intervention and more extensive cognitive-behavioral treatment (Project MATCH Group, 1997).

As with the initial study, there are several limitations of this trial that warrant consideration. The sample was not ethnically diverse as the vast majority of subjects were Caucasian and all subjects were recruited from one geographic location. A monetary deposit was required for participation, which may have excluded less motivated or financially stable subjects. Urine drug screens were not obtained; therefore all drug use data is based on self-report and collateral verification. The individual therapy (IAI) was provided by therapists with more experience than the therapists conducting the group (RPG) sessions, which might have contributed to the comparable outcomes between groups. Finally, as in the previous study, no standardized diagnosis of marijuana dependence for subjects was obtained.

The Stephens research group collaborated on a large multi-site study, The Marijuana Treatment Project, which compared outcomes from three interventions: a 9-session cognitive behavioral treatment with motivational enhancement therapy and case management components, a 2-session MET intervention, or a delayed treatment control (Stephens, Babor, Kadden, Miller, & The Marijuana Treatment Research Group, 2002). Both treatment conditions were delivered in individual sessions. The main goals of the study were to evaluate the efficacy of treatments of different duration in a more diverse patient population than had been previously studied and to improve upon the methodology of previous studies.

A total of 450 subjects were recruited from three sites through the use of local media announcements. To participate, individuals had to meet DSM-IV criteria for marijuana dependence during the preceding 90 days. The average age of participants was 36 years, and 69% were Caucasian (Stephens et al., 2002). Final results have not yet been published, but preliminary results indicate that at 4 months, 22.6% of subjects in the 9-session intervention had been abstinent for the previous 90 days, compared to 8.6% of subjects in the brief treatment and 3.6% in the delayed treatment control group (Stephens, 1999). These outcome differences between the brief and extended interventions were maintained at 9 months and 15 months, indicating that unlike the prior study (Stephens, Roffman, & Curtin, 2000), CBT produced better outcomes than a brief intervention.

This multi-site study addressed many of the aforementioned limitations of the previous trials. A more ethnically diverse sample was obtained. A monetary deposit prior to enrollment was not required; nonetheless, participants were still mostly well-educated and financially stable. A standardized diagnosis of marijuana dependence was obtained by structured interview and used as an inclusion criteria. Urine drug screens and collateral verification of subjects' reports or marijuana use were obtained, although only for one third of participants. One important difference between this multi-site study and the prior study (Stephens et al., 2000) was that the CBT intervention was delivered via individual therapy rather than group sessions. Hence, the comparisons of contrasting results across studies regarding CBT vs. brief intervention outcome are confounded by mode of treatment delivery.

A study conducted in Australia used compared a 6-session intervention incorporating components of motivational interviewing and relapse prevention (n = 78), a brief 1-session version of the intervention with a self-help booklet (n = 82), and a delayed-treatment control group (n = 69) (Copeland, Swift, Roffman, & Stephens, 2001). The aim of this study was to compare the efficacy of varying lengths of a CBT hybrid intervention rather than to compare different models of intervention that also vary by length, as had been previously done.

Two hundred and twenty-nine adult marijuana-dependent patients were recruited through advertisements and randomly assigned to one of the three groups. Approximately two thirds of participants were males, and subjects were primarily Caucasian (Copeland, Swift, & Rees, 2001). The average age of participants was 32.3 years. Although participants were not required to meet DSM-IV criteria for a marijuana use disorder, 96.4% of subjects met current criteria for dependence.

Outcomes were assessed at a 24-week followup interview. Measures included percentage of subjects reporting abstinence, number of marijuana-use related problems, and measures of psychological distress. Abstinence rates were confirmed by urinary cannabinoid levels. Subjects in both treatment groups reported superior outcomes (fewer marijuana-use related problems and less concerned over their control over marijuana use) than subjects in the delayed-treatment control group. However, there were no significant differences between groups in reported percent days abstinent (delayed-treatment group 29.7%; 1-session CBT 44.8%; 6-session CBT 35.9%), although there was a trend (p = .09) for the 1-session CBT group to have a greater percentage of days abstinent than the delayed-treatment group. Few participants across groups reported continuous abstinence throughout the followup period (delayed treatment group, 0%; 1-session CBT, 4.9%; 6-session CBT,

15.1%). There was a trend towards fewer marijuana-related problems in the 6-session therapy than the 1-session intervention. Limitations of this study included the use of therapists with relatively little experience. Also, there was a wide range for the time of the followup interview (median 237 days; range 102–533 days), which might have affected the reliability of the findings. Overall, this study was consistent with prior studies in demonstrating that both brief and extended cognitive-behavioral type interventions were effective in reducing marijuana use compared to no treatment controls, although response rates, particularly regarding abstinence from marijuana, leave much room for improvement.

Another study of three outpatient treatments for marijuana dependence examined two clinical strategies designed to enhance outcomes achieved with standard CBT-type interventions (Budney et al., 2000). First, the study examined whether combining standard CBT with a motivational intervention might produce superior outcomes to the motivational treatment alone. Second, the trial tested whether adding a voucher-based incentive program to the combined CBT/motivational intervention would further improve outcomes during treatment. Incentive-based vouchers had previously been shown to improve cocaine abstinence rates when used in conjunction with behavioral interventions in cocaine-dependent patients (Higgins et al., 1994).

One group received motivational enhancement therapy, consisting of four 60–90 min therapy sessions during weeks 1, 2, 6, and 12. The second group received motivational enhancement plus behavioral coping-skills therapy, which involved 14 weekly 60-min individual sessions. Both the MET and CBT were adapted alcohol dependence treatments used in Project MATCH (National Institute on Alcohol Abuse and Alcoholism, 1992a, 1992b). The final group received the MET and CBT therapy combined with a contingency management intervention, i.e., abstinence-based vouchers. The program involved subjects receiving monetary-based vouchers for each cannabinoid-free urine sample provided during weeks 3–14 of the study, with participants providing two samples weekly. These vouchers could be exchanged for retail items or services that were congruent with treatment goals and approved by the therapist.

Sixty treatment-seeking marijuana-dependent adults were randomly assigned to one of the three 14-week treatment interventions. The primary outcome measure assessed was continuous marijuana abstinence. The participants were primarily Caucasian men (83%) and were an average of 32.0 ($\pm$ 8.7 *SD*) years of age. The group receiving vouchers achieved significantly longer periods of marijuana abstinence throughout the study, and a greater percentage of these voucher subjects were abstinent during the last week of treatment compared with the other two treatment groups (CBT/MET with vouchers, 35%; CBT/MET, 10%; MET, 5%). No significant differences were found between the MET and the CBT/MET combined groups, although there were trends toward better efficacy with the combined treatment. Self-reported marijuana use for the prior 30 days post-treatment was significantly reduced for all groups compared to pretreatment reports (CBT/MET with vouchers, pretreatment 24.1 days vs. post-treatment 6.6 days; CBT/MET, pretreatment 20.4 days vs. post-treatment 7.4 days; MET, pretreatment 23.2 days vs. post-treatment 13.0 days).

This study suggests that adding voucher-based incentives may enhance treatment outcomes when used in combination with other effective psychotherapeutic interventions. However, the study did not clearly show an advantage to adding CBT to the motivational intervention. The small sample size (n = 20 for each treatment group) may have limited the power to detect a significant difference. A further limitation of this study is lack of posttreatment followup data; hence, it is not known whether the improvements observed in the incentive-based voucher group were sustained.

3. Non-controlled trials

Several non-controlled trials of treatments for marijuana dependence have been conducted. Although interpretation of the results is limited by lack of comparison groups, these studies provide preliminary data relevant to the treatment of this disorder.

3.1. Psychotherapeutic interventions

Two reports have been published examining the use of aversive therapy for marijuana dependence. A study conducted in Nigeria described the treatment of 9 young men characterized as ‘‘heavy’’ marijuana smokers by giving intramuscular injections of an emetic to induce nausea while being shown pictures of themselves preparing and using marijuana (Morakinyo, 1983). Each subject received this treatment three times over a period of 3 to 4 days. After completion of the treatment, subjects were followed on an outpatient basis for an unspecified amount of time. Abstinence self-reports were collected from the subjects and family members, with a mean length of reported abstinence of 9 months (range 6–14 months). A second study evaluating the efficacy of aversion therapy utilized THC-free marijuana and faradic stimuli combined with self-management counseling in 22 chronic marijuana smokers (Smith, Schmeling, & Knowles, 1988). Subjects underwent 5 consecutive days of aversion therapy, and then participated in three 1-hour self-management group sessions over a 3-week period. Subjects were also seen privately before or after the group session by an investigator to review treatment progress and to discuss remaining treatment problems. Self-report of marijuana use indicated a 75% abstinence rate at the 6-month followup, and 84.2% at the 12-month followup. Although the results of these aversion therapy studies seem promising, interpretation is limited because no control group

was used and only self-report data were available. Also, patients willing to take aversive therapy may be particularly motivated to stop using. Similar criticisms have been made of the majority of the literature evaluating aversion therapy as a treatment for alcohol and nicotine dependence (Elkins, 1991; Howard & Jenson, 1990; Hajek & Stead, 2000; American Medical Association Council on Scientific Affairs, 1987).

A report on a brief intervention based on the concept of accelerated empathic therapy combined with a self-help booklet suggested a marked reduction in frequency and quantity of marijuana used in 33 self-defined problem marijuana users (Lang, Engelander, & Brooke, 2000). During a single session intervention, therapists addressed coping strategies, lifestyle modification, and goal setting. This study lacked a control group, and the authors mention the possibilty that the positive results may have been attributable to the participant making a decision to reduce their marijuana use before seeking help.

3.2. Pharmacologic interventions

To date, there have been no published medication studies evaluating the treatment of marijuana dependence as a primary outcome. However, there is limited data examining the effects of pharmacological treatment on marijuana dependence via secondary analyses of studies examining other dependencies. For example, a decrease in marijuana use in a subgroup of depressed alcoholics receiving fluoxetine has been reported (Cornelius et al., 1998). Subjects receiving placebo used nearly 20 times as many marijuana cigarettes compared to subjects receiving fluoxetine, and the number of days of marijuana use was five times higher in the placebo group. Similarly, a study examining buspirone for the treatment of anxiety in opioid-dependent patients found that although buspirone treatment did not significantly reduce anxiety symptoms, subjects receiving buspirone had a statistically significant reduction in marijuana use as compared to subjects receiving placebo (McRae, Sonne, & Brady, 2000). These studies suggest that antidepressant or anxiolytic medications may have a role in treating marijuana dependence.

Some recent research has focused on the potential use of medications to treat the symptoms associated with marijuana withdrawal. A valid and reliable marijuana withdrawal syndrome has recently been documented in controlled laboratory and clinical studies (Budney, Novy, & Hughes, 1999; Budney, Hughes, Moore, & Novy, 2001; Kouri & Pope, 2000). This intervention approach presumes that withdrawal symptoms may contribute to difficulty in maintaining abstinence, and therefore minimizing withdrawal symptoms could be useful in treating marijuana dependence. An initial controlled laboratory study evaluated the effects of sustained-release bupropion in non-treatment seeking, heavy marijuana smokers. During a 12-day abstinence period, participants receiving bupropion reported more irritability and depressed mood than participants receiving placebo (Haney et al., 2001). Hypothesizing that the stimulant effects of bupropion may have worsened marijuana withdrawal symptoms, this same group examined the effects of nefazodone, an antidepressant associated with minimal activation, using the same experimental model (Haney, Hart, Ward, & Foltin, 2003). Nefazodone decreased reports of anxiety and muscle pain during withdrawal, but did not reduce feelings of irritability or improve sleep quality. These initial studies were limited by the use of restricted dose ranges of the medications and the evaluation of non-treatment seekers. Nonetheless, such studies reflect the growing recognition of the validity and severity of the marijuana dependence syndrome, and are likely to be followed by additional efforts targeting marijuana withdrawal.

For example, another pharmacological approach likely to receive attention is the use of a cannabinoid antagonist to block the effects of marijuana. Recent research indicates that the CB1 receptor is involved in the behavioral, psychomotor, cardiovascular, and cognitive effects of marijuana (Ledent et al., 1999; Matsuda, Lolait, Brownstein, Young, & Bonner, 1990; Munro, Thomas, & Abu-Shaar, 1993). The CB1-selective antagonist SR141716 has been shown to block the acute psychological and physiological effects of marijuana in human volunteers (Huestis et al., 2001); thus, this compound or a similar antagonist may have important implications for future pharmacological research in the treatment of marijuana dependence.

A further underexplored area that may prove beneficial in the treatment of marijuana dependence is the combination of psychotherapy with pharmacotherapy. Alcohol research has suggested that the therapeutic effects of pharmacotherapy and psychotherapy may be synergistic, with the greatest treatment efficacy seen when medications such as naltrexone are combined with psychotherapy (Anton et al., 1999). Similar combinations may prove optimal in the treatment of marijuana dependence.

4. Discussion

Marijuana dependence continues to be a significant problem. Cognitive behavioral, motivational enhancement, and contingency management therapies have each been demonstrated to be efficacious for reducing marijuana use in the limited number of studies conducted to date. Several studies have failed to demonstrate differences in outcome between brief interventions and more intensive CBT interventions; however, the most recent and largest controlled trial, the Marijuana Treatment Project, found an extended CBT intervention to be more effective than brief motivational therapy. The one study on contingency-management treatments suggests that such approaches are likely to be effective when used in combination with more traditional psychotherapies and may enhance outcomes when combined with other approaches. Important methodological

differences across the studies leave many questions regarding comparative efficacy unanswered. Studies differed in diagnostic criteria used, length of treatment and followup, ethnic diversity of the study population, mode of treatment delivery, and the use of urine drug screens to verify marijuana abstinence. Clinical research on pharmacotherapies for marijuana dependence is just in its infancy. Potential appears to exist for antidepressant and anxiolytic medications to be useful in the treatment of marijuana dependence. However, controlled studies are necessary before any conclusions or recommendation can be made. Agents targeting the cannabinoid receptors may also prove useful, but again have not been explored.

Although the marijuana treatment literature is young and few studies have been published, the trends across this literature suggest that the types of treatments effective with other substances of abuse are likely to be effective with marijuana dependence. The magnitude of the treatment response might also be similar to that observed with other drug dependence treatments. Unfortunately, this means that there are many individuals who do not do well with these therapies. As marijuana abuse and dependence becomes better recognized as a significant public health concern, hopefully more research will be focused on the development of effective treatments for this disorder.

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