Medical Research Archives

European Society of Medicine

OPEN ACCESS

Published: November 30, 2023

Citation: Millin PM, Klace F, et al., 2023. A Cross Sectional Study Comparing the Frequency and Motivations for Cannabis Use in College Students with and Without an Autoimmune Disease, Medical Research Archives, [online] 11(11). https://doi.org/10.18103/mra.v11i11.4674

Copyright: © 2023 European Society of Medicine. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI
https://doi.org/10.18103/mra.v11i11.4674

ISSN: 2375-1924

RESEARCH ARTICLE

A Comparative Analysis of the Frequency and Motivations for Cannabis Use in College Students with and Without an Autoimmune Disease

Paula M. Millin*, Flynn Klace, Dana Balsink Krieg

Department of Psychology, Kenyon College, Gambier, OH 43022

***Corresponding author:** millinp@kenyon.edu

ABSTRACT

The therapeutic effects of cannabis and its derivatives have been well established for a narrow number of conditions, including syndrome-related seizures, cancer-related nausea, and AIDS-related anorexia. Research progress in the United States has been slowed by restrictions related to cannabis' status as a highly controlled substance. Despite the sluggish pace of empirical research, there is a high level of interest among both scientists and patients regarding cannabis' possible efficacy for a much wider range of diseases and conditions. Studies indicate that many people are self-medicating with cannabis for both physical and psychological ailments. New evidence suggests that cannabinoids may be beneficial to those who have an autoimmune disease; this may be due to cannabis' modulatory effects on the immune system. The current study, in an attempt to determine if college students with autoimmune diseases are self-medicating their symptoms with cannabis, surveyed students (5.8% of whom reported a diagnosed autoimmune disease) about their frequency, route of administration, and motivations for cannabis use. Independent samples t-tests and chi-squared tests revealed that while those with an autoimmune disease were significantly more likely to report having used cannabis in the past 30 days than their peers without an autoimmune disease, the frequency of use in the past 30 days did not differ. Participants with autoimmune disease were significantly more likely to endorse therapeutic motives for cannabis consumption, including pain and nausea control and to improve sleep and appetite. This study is one of the first to investigate self-medication motives for cannabis use in young adults with an autoimmune disease. Potential mechanisms, as well as benefits and drawbacks of cannabis use as medicine in this population are discussed.

Introduction

In response to considerable research indicating beneficial effects,[1] the United States (US) Food and Drug Administration (FDA) has approved several cannabis-derived and synthetic cannabis-related drugs for the treatment of a small number of conditions, including seizures related to certain syndromes, nausea related to cancer treatment, and AIDS-related anorexia.[2] The list of ailments approved by the FDA for treatment with cannabis medicines has remained small, at least partly because cannabis is a Schedule I drug in the US (federally illegal and highly controlled), making it difficult for researchers to obtain the drug and the necessary approvals to administer it in research studies. While obstacles to scientific research on cannabis have delayed our understanding of its potential medicinal effects, recent legalization of cannabis for medical and/or recreational use in the majority of US states has increased the availability and use of cannabis by the public.[3] The internet abounds with anecdotal evidence from people who self-medicate with cannabis, touting its benefits for ailments from chronic pain to anxiety to insomnia. Despite recent easing of restrictions on the use of cannabis in research,[4] scientific exploration of its therapeutic effects continues to lag behind public interest, leaving many people who are seeking relief from various ailments to experiment with its effects on their own. One group of ailments that causes a great deal of suffering is autoimmune disease (AD).

Autoimmune Disease: Symptoms & Etiology

ADs, which occur when the body's immune system destroys or damages healthy cells, tissues, and organs, cause wide ranging pathology to virtually any bodily system, depending on the particular disease.[5] Common ADs include type 1 diabetes, lupus, multiple sclerosis (MS), thyroid diseases, scleroderma, rheumatoid arthritis, Crohn's disease, and ulcerative colitis.[5] It is estimated that 23.5 million Americans (about 5% of the population) suffer from an AD, and a recent large scale study that examined the health records of 22 million citizens in the UK showed that 10.2% of the population had been newly diagnosed with (at least) one of the nineteen most common ADs between 2000 and 2019.[6] Importantly, that study showed a 4% increase in the incidence of ADs across the study period, even when age was standardized. Studies that have tracked statistics globally and in the US have similarly reported that incidence rates are increasing, especially for certain ADs.[7-8]

ADs present with a myriad of diverse symptoms; however, many are characterized by chronic inflammation,[9] joint pain and swelling, fatigue, swollen glands, and digestive complications.[10] According to Pisetsky,[11] despite their wide ranging symptoms, ADs are uniformly "characterized by immune disturbances that cause aberrant B cell and T cell reactivity to normal constituents of the host". Several, as yet unproven, theories have been posited to explain the etiology of ADs. One idea, which stems from the finding that the onset of AD often follows an acute illness or infection (such as strep), is that healthy cells become collateral damage in the immune system's attempt to fight a virus or other infection.[12] There is also evidence of a genetic link, as ADs tend to run in families; however, predisposing genetics are neither a necessary nor sufficient condition for the development of AD.[12] The rise in incidence over the past several decades, along with other evidence points to a role for environmental exposures in the pathogenesis of ADs, with some experts speculating that environmental factors account for up to 70% of all new ADs.[13] Despite some disagreement regarding the relative contributions of each, most experts agree that ADs are almost certainly due to a combination of genetic and environmental factors.

At present, ADs are incurable, and most individuals experience life-long symptoms, some of which are debilitating and wreak havoc on patients' quality of life. Although the specific symptoms depend on the organs and systems that are affected, pain and swelling in the joints, inflammation, fatigue, skin rashes, and digestive problems are common.[12] Research indicates that in addition to debilitating physical symptoms, people with ADs suffer from comorbid psychological disorders, such as anxiety and depression, at higher rates than the general population.[14] At least part of this relationship can be attributed to AD patients' painful symptoms,[10] making effective treatment of ADs an important goal related to both mental & physical health.

Common Treatments for AD Symptom Management

Although treatment varies depending on the AD, patients commonly take immunosuppressant medication aimed at tamping down the overall vigor of the immune system, which can stabilize symptoms and slow the progression of disease.[15] Unfortunately, using immunosuppressant drugs for long periods leaves patients vulnerable to dangerous infections and other serious side effects, including an increased risk of developing liver and kidney damage, as well as cancer.[16] Common milder side effects include gastrointestinal issues,

vomiting, and rashes.[17] Ongoing research offers the hope of newer immunosuppressants that selectively target only those aspects of the immune system that are misbehaving,[15] however, these newer drugs are still under development.

A second type of medication utilized by a majority of AD patients are anti-inflammatories. These medications, which include steroids, such as prednisolone, and non-steroidal anti-inflammatory drugs (NSAIDs), such as Advil and Aleve, temporarily reduce the pain and inflammation associated with many ADs.[18] Concerningly, long term use of anti-inflammatories increases the risk for high blood pressure, stroke, heart attack, peptic ulcers, and acute renal failure. NSAIDs can also interfere with blood thinning drugs, such as warfarin[19]. For those who experience severe chronic pain related to their AD who cannot take NSAIDs, opioids may be prescribed; however, tolerance develops rapidly to opioids, requiring escalating doses that can leave patients feeling sedated and at high risk for compulsive use; Long term use also results, through an opponent process mechanism, in hyperalgesia,[20] which is clearly counterproductive from a pain management perspective. Although immunosuppressants and anti-inflammatory drugs reduce symptoms for many AD patients, they don't work for everyone and have serious drawbacks; Alternatives are desperately needed.

A Role for Cannabinoids in the Treatment of AD

In recent decades, scientists have discovered that humans and other mammals have an endocannabinoid system, which includes specialized receptors throughout the brain and spinal cord, that bind both endogenous cannabinoids, such as anandamide, and exogenous cannabinoids, such as cannabidiol (CBD) and delta 9 tetrahydrocannabinol (THC), both of which are abundant in the cannabis plant. Although in its early stages, there is emerging science showing that cannabinoids may provide relief for chronic pain sufferers, suggesting a potential role in the treatment of pain associated with ADs. A review of clinical studies investigating the effects of cannabinoids on many different types of pain reported little improvement in acute pain, but significant improvements in cancer-related pain, as well as chronic pain due to a number of different ailments, including MS.[21] A more recent review and meta-analysis examining the effects of four cannabinoid-containing medications concluded that there was moderate evidence that dronabinol (an FDA-approved synthetic THC-containing medication) improved chronic pain and appetite, as well as moderate evidence that nabiximols (a THC and CBD combination oral spray) improved chronic pain, sleep, and MS-related spasticity.[22] Moreover, a recent cross-sectional survey study of 1661 adults with chronic pain found that 23.2% reported using medical cannabis in the past 30 days to control their pain. Importantly, over half of those people reported that they had been able to reduce their use of prescription opioids, as well as nonopioid prescription and over the counter pain medicines.[23] While these studies support a role for medical cannabis in chronic pain management, research also indicates that pain sufferers, including young adults, smoke cannabis to self-medicate.[24]

In addition to pain relief, cannabis and its constituents (most especially, THC & CBD) have been found to reduce inflammation in patients suffering from inflammatory diseases, such as Alzheimer's Disease, Parkinson's Disease, inflammatory bowel disease (IBS) and psoriasis.[25] Moreover, research has demonstrated that cannabinoids exert anti-inflammatory effects in animal models of MS, type I Diabetes, arthritis, and neuropathic pain.[26] Interestingly, a recent study of adult cannabis users found that those who reported using cannabis in the past 30 days had lower levels of three inflammatory biomarkers than never users (although the differences were not statistically significant).[27] While it is beyond the scope of this article to discuss in detail the mechanisms by which cannabinoids exert anti-inflammatory effects (there are excellent reviews on the topic[28-29]), research suggests that CB1 and CB2 endocannabinoid receptor activation regulates anti-inflammatory responses, perhaps through inhibition of pro-inflammatory cytokines.[29]

Cannabinoid Modulation of the Immune System

There is growing evidence that endocannabinoids play an important role in the modulation of the immune system. According to a review by Katchan et al.[26] CB1 and CB2 cannabinoid receptors are plentiful on immune cells (B cells, natural killer cells, monocytes, neutrophils, CD8 lymphocytes and CD4 leukocytes), which can make, release, transport, and catabolize cannabinoids. They reviewed studies with mice that showed that when levels of the endocannabinoid, anandamide, were increased, inflammatory responses were attenuated. This finding suggests that exogenous cannabinoids (such as THC & CBD) might also suppress the immune system.[26] In support of that hypothesis, a 2014 study showed that THC suppressed immune responses in human patients, resulting in a decrease in inflammation.[30] Other studies have found that CBD, another phytochemical found in cannabis, minimized the production of T-cells, which are

implicated in the etiology of autoimmune disorders. It was also determined that CBD could impair immune system memory, which decreases the possibility of autoimmune flare-ups.[31] Katchan et al.[26] presented evidence from *in vivo* and *in vitro* studies that cannabinoids, "exert their immunosuppressive properties through 4 main pathways: induction of apoptosis, inhibition of cell proliferation, inhibition of cytokines and chemokine production and induction of regulatory T cells".

Present Study

Taken together, the foregoing evidence suggests that cannabis and its constituents have the potential to alleviate some AD symptoms; however, with the exception of MS-related spasticity, the FDA has not approved cannabis medicines for the treatment of ADs. A growing body of research on motivations for non-medical cannabis use in young adults shows that a substantial percentage are using cannabis to cope with distressing psychiatric symptoms, such as anxiety and depression; Others report using cannabis to cope with pain or difficulty sleeping.[24] We are unaware of any studies specifically examining cannabis use motivations with respect to coping with AD symptoms in young adults (ages 18-26). This is an especially important group to study because they are a population that consumes higher levels of cannabis compared to other age cohorts[32] and because many of the most prevalent ADs are developed in either childhood or young adulthood, with teenage individuals at a ten times higher rate of disease development.[33] The most frequently diagnosed diseases during this time period include diabetes mellitus (type 1 diabetes), systemic lupus erythematosus, Crohn's disease, vasculitis, thyroiditis, Grave's disease, rheumatoid arthritis, and MS.[34-35]

The present investigation is a study comparing the frequency and motivations for cannabis use in college students with and without a diagnosed AD. Participants completed an online survey in which they answered questions about their frequency of cannabis use, motivations for cannabis use, and method of cannabis ingestion. Given past research, we hypothesized that students with an AD would report more frequent use of cannabis and that they would report more coping motives, such as pain and nausea relief and help sleeping, relative to their peers, who we hypothesized would report more social motives.

Methods

PARTICIPANTS

The sample consisted of 318 students from a small midwestern selective liberal arts college, 20 of whom identified as having an AD diagnosis. This represented 5.8% of the participants, which closely reflects the current 5% rate of AD in the United States. The majority of the sample identified as female (67%). Participants ranged in age from 18-23 (M = 19.87, SD = 1.28) and represented the four classes: first-year (27.1%), sophomore (35.6%), junior (18%), and senior (19.2%). Participants were recruited via emails sent to all enrolled students describing the study. Follow up emails were sent to members of a student organization for people with chronic illness to recruit additional students with AD. Interested participants could link to the survey directly from the emails, ensuring anonymity of responses. Participants selected course credit or raffle entry as incentive.

MATERIALS

Participants were asked a series of demographic questions, including whether they have ever been diagnosed with an AD. Participants were given a list of the twenty-five most common ADs and asked to respond "Yes", "No", or "Prefer Not to Say" as to whether they had been diagnosed with any AD, listed or otherwise. The list was provided to clarify and educate participants (both with and without disorder) on what is considered an AD. Even those with a diagnosis may not conceptualize their disorder (e.g., type 1 diabetes) as autoimmune. The distinction between autoimmune and other types of diseases was important for maintaining the quality of the comparison group. To further ensure the anonymity of participants, they were not asked to share specifics about their AD.

To evaluate the participants' use of cannabis, they were asked to report how long it has been since their last use of cannabis. They were given the options via a drop-down menu: "within the last 48 hours", "within the last week", "within the last month", or "none in the past month". Then, participants indicated the approximate number of days in the previous month they have used cannabis.

Participants were then asked to report their motivations for cannabis use. They were given a list of nine potential motivations for consuming cannabis and were asked to select three of the motivations that resonated most with their reasons for cannabis use. The nine options they were given were "physical pain", "insomnia/sleep aid", "anxiety/stress relief", "relieve nausea", "increase appetite", "to get high", "to party with friends", "to relax", and "to fit in with friends". Participants were also asked whether they ingest cannabis to alleviate symptoms of an AD and were given the option to answer "yes", "no", or "I do not have an autoimmune disease".

Lastly, to determine the route of administration participants employed when consuming cannabis, they were shown eight different modes of cannabis use, including "smoke flower (joint, bowl, bong, etc,)", "vape flower, vape oil/pen vaporizer concentrates (e.g. wax, shatter)", "sublingual & oral oil solution/tincture", "edible", "capsule", "topical", "other" in a drop-down list. They were instructed to select the mode of use that is most common for them. This information did not serve an analytical purpose, but it provided descriptive information that aided our understanding of cannabis ingestion behaviors on campus. In addition to the list of usage options, participants were asked whether they possess a medical marijuana card in the state, as the recreational use of cannabis in this state is currently illegal.

PROCEDURE

Participants accessed the survey through Qualtrics (https://www.qualtrics.com). Participants were presented with information regarding the purpose of the study, potential risks or benefits of one's participation, assurance of confidentiality, and asked to consent to participate. After giving informed consent, participants answered the demographic questions and the questions on cannabis use, frequency, and motivation. While participants may have been hesitant to share information regarding the frequency of or motivations for use of an illegal substance, the majority of participants reported consuming cannabis in the last month. We hope that the anonymous nature of the online survey contributed to honest responding.

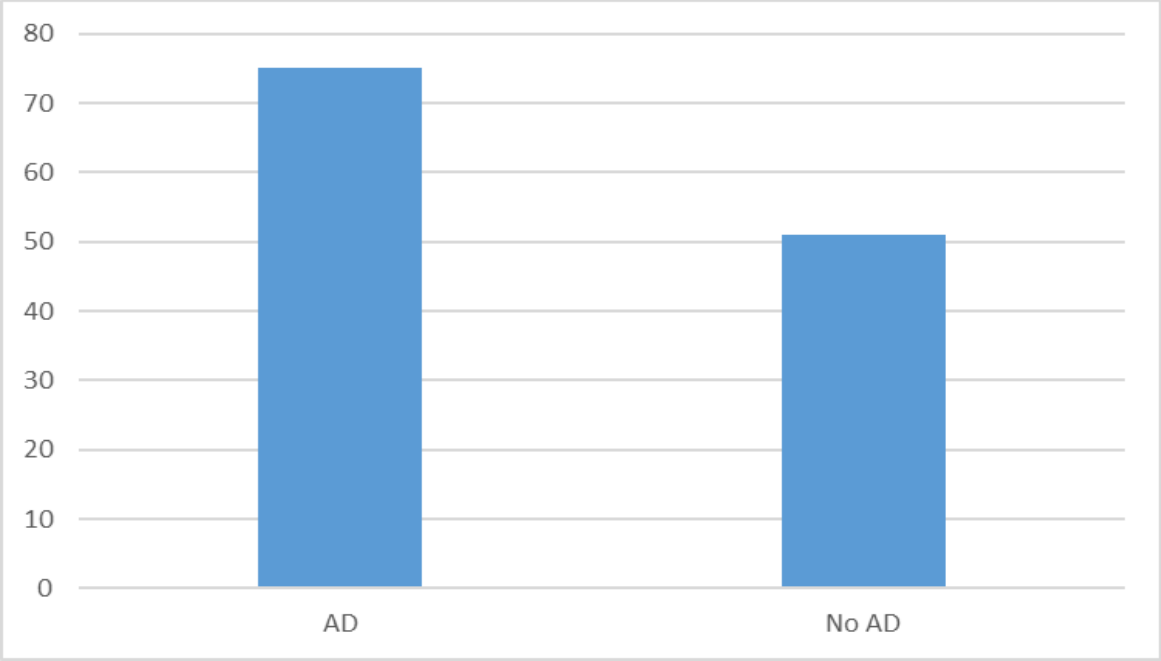
Results

AUTOIMMUNE DIAGNOSIS AND FREQUENCY OF CANNABIS USE

Among the full sample of respondents (N = 318), 52.5% of participants reported having used cannabis in the past 30 days. Using chi-square to compare those with AD to those without AD, we found that a larger proportion of those with AD reported using cannabis in the past 30 days, X^2 (1, N = 316) = 4.32, p = .038 (see Figure 1).

Of all the participants (AD and no AD) who used cannabis in the last month, 22.5% reported use in the last 48 hours, 14.2% used in the past week, and 15.8% in the past month. There were no significant differences between participants with and without AD on these finer categorical frequencies, X^2 (3, N = 316) = 4.44, p = .22.

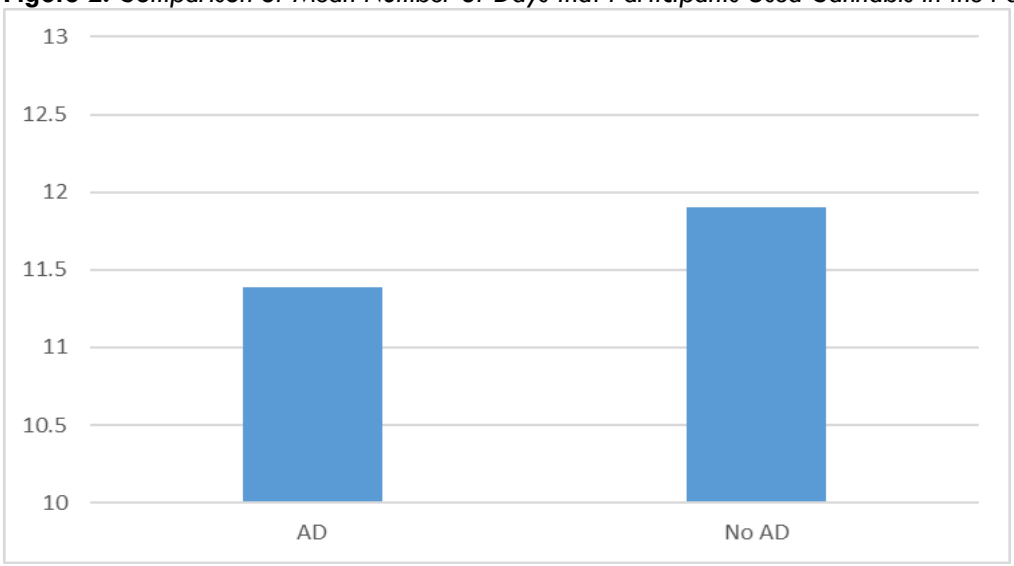
Figure 1: *Comparison of Percent of Participants who Reported Using Cannabis in the Past Month*



**Note:* This represents a statistically significant difference.

An independent samples t-test t indicated no significant difference in the number of days of cannabis use per month between the AD group (M = 11.93, SD = 12.93) and the no AD group (M = 11.90, SD = 10.18), t(119) = 2.46, p = .86 (see Figure 2). While there is a difference in whether or not participants used cannabis in the last month based on AD status, there is not a significant difference among users in the frequency of cannabis use between the AD and no AD groups.

Figure 2: *Comparison of Mean Number of Days that Participants Used Cannabis in the Past Month*

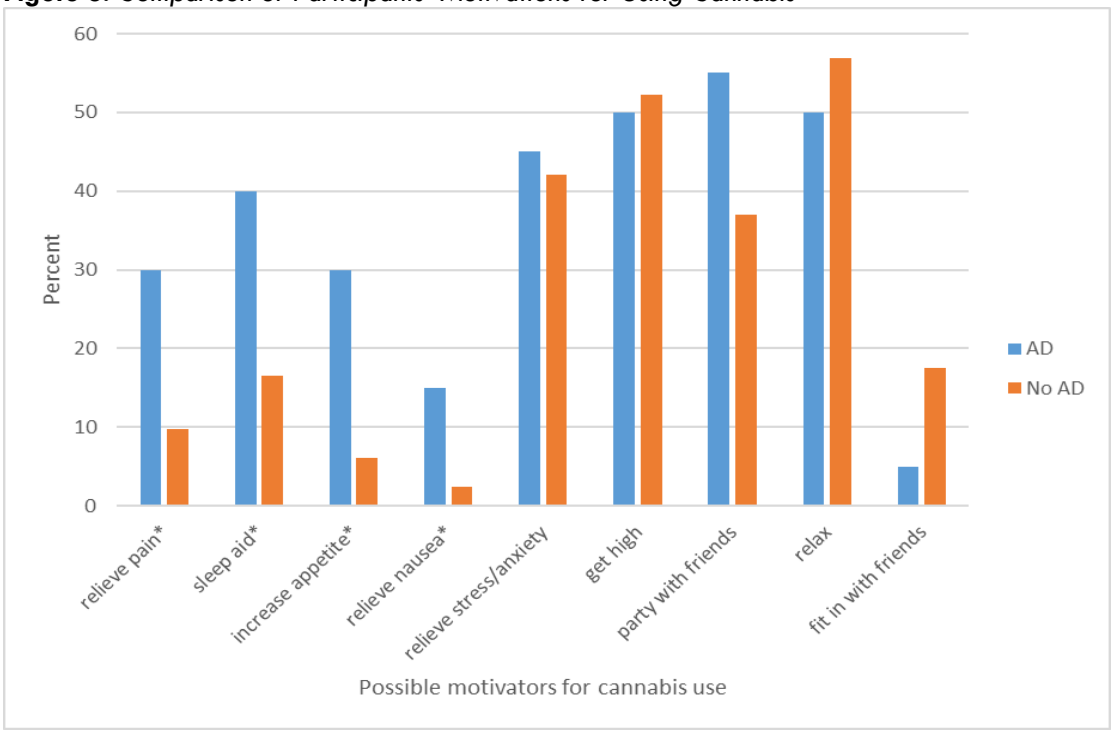


Note: This is not a statistically significant difference.

AUTOIMMUNE DIAGNOSIS AND MOTIVATIONS FOR CANNABIS USE

Participants were asked to select the top three reasons they use cannabis. Chi-square tests were conducted to determine if there was a difference in motivations for cannabis use between participants with or without an AD. First, we analyzed motivations related to symptom reduction. Respondents with AD were significantly more likely to report using cannabis to relieve physical pain, X^2 (1, N=262) = 6.66, p = .01, relieve nausea, X^2 (1, N = 262) = 8.69, p = .003, increase appetite, X^2 (1, N = 262) = 13.57, p < .001, and improve sleep/insomnia, X^2 (1, N = 262) = 5.85, p = .016, than those with no AD (see Figure 3). Those with AD chose relieving physical pain, relieving nausea, increasing appetite, and improving sleep/insomnia at a higher frequency than those without AD.

Figure 3: *Comparison of Participants' Motivations for Using Cannabis*



Note: Comparing the percentage of autoimmune and non-autoimmune participants that chose each as one of their top 3 reasons for using cannabis.
* indicates significant difference between groups at p < .05.

A second series of chi-square analyses was conducted to examine social motivations. Participants with AD were no more or less likely than participants without AD to be motivated to use cannabis to get high, X^2 (1, N = 262) = .46, p = .49, to party with friends, X^2 (1, N = 262) = 1.73, p = .19, to relax, X^2 (1, N = 262) = 1.46, p = .23, to fit in with friends, X^2 (1, N = 262) = 2.58, p = .11, or to alleviate anxiety, X^2 (1, N = 262) = .01, p = .92.

Participants were also asked specifically if they use cannabis to relieve symptoms of an AD. As would be expected, significantly more participants with AD (25%) agreed that they used cannabis for symptom relief than those without AD (.03%), X^2 (2, N = 309) = 68.58, p < .001. While this is clearly a meaningful difference, it is interesting to note that only 25% of the students with AD claim that they use cannabis to manage symptoms. However, among those with AD, 30% claim to use cannabis to alleviate pain, 40% use it as a sleep aid, 15% use it to relieve nausea, and 30% use it to increase appetite. This suggests that more participants may be using cannabis to alleviate symptoms than are aware that they are doing so. In addition, 10% of those without AD reported using cannabis to alleviate pain and 15% used as a sleep aid, further suggesting that other physical and mental health issues may be motivating cannabis use.

EXPLORATORY ANALYSES

There were no gender differences found in the number of participants reporting AD. In addition, there were no gender differences in whether participants reported using cannabis in the past month or in the frequency of use. Likewise, there were no differences in AD diagnosis across class year, use of cannabis, or frequency of use. Only 2 participants reported possessing a medical marijuana card in the state where they attend college, neither of whom reported having an AD diagnosis

There was no significant difference in the preferred methods of ingestion of cannabis across AD and no AD groups. Among all cannabis users, the highest proportion of participants reported smoking flower (60%), followed by consuming edibles (28%) and vaping oil (12%). Even when focusing on these most popular methods, there was no significant difference in preferred method between those with and without AD, X^2 (2, N = 221) = 3.15, p = .21.

Discussion

Despite widespread public interest, the therapeutic effects of cannabis and its derivatives on both mental and physical ailments remain understudied in the US on account of federal restrictions related to cannabis' status as a highly controlled substance. A review of research studies, as well as chat room and blog post content on the internet, suggests that millions of people worldwide are self-medicating with cannabis and believe enthusiastically in its restorative and curative properties for a wide range of diseases and pain syndromes, including ADs. ADs are debilitating and often difficult to manage, even for adults with strong social and medical support systems. Symptoms can make everyday functioning a challenge, and current treatments are inadequate. The purpose of this study was to explore whether the frequency of and motivations for cannabis use differed in college students with and without an AD. Given that ADs cause significant pain and inflammation and that new neurobiological research suggests that cannabis has anti-inflammatory, analgesic, and immune-modulating properties, we hypothesized that students with AD would report using cannabis at a higher frequency than those without AD. We also hypothesized that those with an AD would more frequently report therapeutic and coping motives than their peers without an AD (who we expected to report social motives more frequently). College students are an especially relevant population to study because ADs are diagnosed at a relatively high rate in young adults and because college students consume cannabis at higher rates than other cohorts. Moreover, college students often lack access to high quality healthcare while living on campus, making non-prescription treatment options all the more attractive. Our results indicated that while those with an AD were significantly more likely to report having used cannabis in the past 30 days than their peers without an AD, their frequency of use in the past 30 days did not differ from other cannabis-using respondents. Supporting our hypotheses, participants with an AD were significantly more likely to endorse therapeutic or coping motives for cannabis consumption, including pain and nausea control and to improve sleep and appetite, than students without an AD.

Many of the students in our sample reported using cannabis to alleviate distressing psychological and somatic symptoms, and those with an AD did so at a higher rate than those without. Approximately 30% of the students with an AD, as compared to only 10% without, reported pain alleviation as a central motive for consuming cannabis. According to research by Feingold et al.,[36] individuals who use cannabis to manage chronic pain are significantly less likely to experience anxiety and depression than those using opioids. This is potentially important since rates of anxiety and depression are already

high in young adults, and especially so in those with ADs.[14] That such a large percentage of students with an AD (75%) are self medicating their AD symptoms with cannabis is perhaps not surprising given that, as a group, they experience frequent pain and other unpleasant symptoms in an environment where support from parents and medical professionals is low. On the other hand, cannabis is readily accessible on college campuses, and students can control when and how much they administer.

While cannabis may provide a safer alternative to traditional AD treatments, whose limitations and dangers have been well characterized; it is important to acknowledge that it is not without risks. Cannabis use is associated with both mild (dry mouth, dizziness, and dysphoria) and serious adverse events (impaired short-term memory, paranoia, & psychosis).[21,26,37] Moreover, unless a person has a medical card, they put themselves at risk for legal problems, and students risk disciplinary sanctions if they are caught using cannabis on campus. In the current study, none of the students with an AD reported having a medical card. This may change as laws continue to favor legalization of medical marijuana; however, at present, students are self-managing cannabis consumption for relief from a medical condition, which is not ideal, as they may not be aware of the risks of drug interactions or other conditions for which cannabis would be contraindicated (for example, heavy cannabis use is not advised in people predisposed to or currently living with schizophrenia or another psychotic condition). This study makes it clear that at the least, college students would benefit from psychoeducation on cannabis' medicinal and adverse effects.

While past research has shown that young adults report using cannabis to cope with psychiatric and somatic symptoms,[24] the current study is the first to demonstrate that those with an AD endorse somatic coping motivations at higher rates than their non-AD peers. This is important because past studies have revealed a positive relationship between psychological and somatic coping motives and the development of cannabis use disorder (CUD).[24] Our study raises the concern that young adults with an AD may be at increased risk for developing a CUD and suggests that colleges and universities ought to consider providing targeted support and interventions to students with AD.

Multiple methodological constraints could have impacted the results of this study. First is the small nature of the college (fewer than 2,000 students) where the data were collected. There may be something unique about students at or the cultural environment at a small institution that would cause these results to fail to generalize to the broader AD population or in other environments. A second limitation is that recreational cannabis is not legal in the state where this college is located. Only two students in the sample reported having a medical marijuana card, neither of whom reported an AD diagnosis. That cannabis is illegal in the state where the students took the survey may have deterred students from honest reporting, however, our results do not indicate underreporting, since a large percentage (52%) of the total sample reported past 30-day cannabis use. Finally, we did not directly assess anxiety. Those who have autoimmune disorders may suffer from anxiety at higher rates, which may deter them from using cannabis, with its potential to increase anxiety.[38] However, this seems an unlikely confound as alleviation of anxiety was one of the most endorsed motivations among people with AD and the rates of cannabis use reported were quite high.

Conclusion

This study represents an important first step in characterizing the frequency of and motivations for cannabis use in people with AD. ADs are debilitating, lifelong diseases that profoundly affect the patients quality of life. Current treatments are inadequate and have unacceptably dangerous side effects, so a clearer understanding of how AD patients are currently using cannabis to manage their symptoms is a worthwhile endeavor. Looking to the future, it will be important to further elucidate the use patterns, efficacy of symptom relief, and short and long-term health effects of cannabis use in people with AD. In college students, specifically, whose rates of alcohol consumption are high, an interesting future direction will be to compare health outcomes for individuals with AD who preferentially use alcohol or cannabis, since alcohol is inflammatory,[39] whereas cannabis has anti-inflammatory properties. It will also be important to explore how cannabis administered under the direction of a physician differs from patient-directed cannabis consumption in terms of efficacy and the likelihood of adverse reactions. We hope this study stimulates more research on cannabis use in people with AD.

Conflict of interest statement: All authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

References

1. Bilbao A, Spanagel R. Medical cannabinoids: a pharmacology-based systematic review and meta-analysis for all relevant medical indications. *BMC Med. 2022;* 20: 259. https://doi.org/10.1186/s12916-022-02459-1
2. FDA and Cannabis: Research and Drug Approval Process. US Food & Drug Administration. Updated February 2023. Accessed September 2023. https://www.fda.gov/news-events/public-health-focus/fda-and-cannabis-research-and-drug-approval-process
3. Hall W, Lynskey M. Assessing the public health impacts of legalizing recreational cannabis use: the US experience. *World Psychiatry*. 2020; 19(2):179-186. doi: 10.1002/wps.20735.
4. Jacobs, P. Researchers applaud health officials' push to ease cannabis restrictions. Science. September 2023. Accessed September 2023. doi: 10.1126/science.adk6391. https://www.science.org/content/article/researchers-applaud-hhs-push-ease-cannabis-restrictions#:~:text=A%202022%20law%20increased%20access,Rescheduling%20would%20streamline%20the%20process.
5. Autoimmune Diseases. National Institute of Health National Institute of Environmental Health Science. May 2022. Accessed September 2023. https://www.niehs.nih.gov/health/topics/conditions/autoimmune/index.cfm#:~:text=A%20healthy%20immune%20system%20defends,and%20even%20turning%20life%2Dthreatening.
6. Conrad N. Autoimmune diseases and cardiovascular risk: a population-based study on 19 autoimmune diseases and 12 cardiovascular diseases in 22 million individuals in the UK. *Lancet*. 2022;400(10354):733-743. doi: 10.1016/S0140-6736(22)01349-6.
7. Lerner A, Jeremias P, Matthias T. (2016). The world incidence and prevalence of autoimmune diseases is increasing. *Int. J. Celiac Dis. 2016*;3(4):151–155. https://doi.org/10.12691/ijcd-3-4-8
8. Mayer M. Autoimmunity on the rise. Global Autoimmune Institute. August 2022. Accessed September 2023. https://www.autoimmuneinstitute.org/articles/about-autoimmune/autoimmunity-on-the-rise/
9. Furman D, Campisi J, Verdin E, et al. Chronic inflammation in the etiology of disease across the life span. *Nat Med*. 2019;25(12):1822-1832. doi: 10.1038/s41591-019-0675-0.
10. Mifflin KA, Kerr BJ. Pain in autoimmune disorders. *J Neurosci Res*. 2016; 95(6): 1282-1294. https://doi.org/10.1002/jnr.23844
11. Pisetsky D. Pathogenesis of autoimmune disease. *Nat Rev Neph*. 2013;19:| 509-524. https://doi.org/10.1038/s41581-023-00720-1
12. Orbai A. What are common symptoms of autoimmune disease? Johns Hopkins. 2023. Accessed September 2023). https://www.hopkinsmedicine.org/health/wellness-and-prevention/what-are-common-symptoms-of-autoimmune-disease
13. Khan, MF, Wang, H. Environmental exposures and autoimmune diseases: contribution of gut microbiome. *Front Immunol*. 2020.;10. https://doi.org/10.3389/fimmu.2019.03094
14. Mehta D. The genetic double whammy – autoimmune and mental health disorders. *Brain Behav Immun*. 2020;89,7-8. https://doi.org/10.1016/j.bbi.2020.08.014
15. Parry W. The immunotherapy revolution for autoimmune diseases. Penn Medicine News. August 12 2023. Accessed September 2023. https://www.pennmedicine.org/news/publications-and-special-projects/penn-medicine-magazine/immune-health/the-immunotherapy-revolution-for-autoimmune-diseases
16. Rosenblum MD, Gratz IK, Paw JS, & Abbas AK. Treating human autoimmunity: current practice and future prospects. *Sci Transl Med*. 2012;4(125). https://doi.org/10.1126/scitranslmed.3003504
17. Immunosuppressive medication for the treatment of autoimmune disease. American Academy of Allergy Asthma & Immunology. September 28, 2020. Accessed May 2, 2023.https://www.aaaai.org/Conditions-Treatments/Related-Conditions/immunosuppressive
18. Brune K, Patrignani P. New insights into the use of currently available non-steroidal anti-inflammatory drugs. *J Pain Res*. 2015;*105*. https://doi.org/10.2147/jpr.s75160
19. Marcum ZA, Hanlon JT. Recognizing the risks of chronic nonsteroidal anti-inflammatory drug use in older adults. *Ann Longterm Care*. 2010;18(9):24-27. PMID: 21857795; PMCID: PMC3158445.
20. Mercadante S, Arcuri E, Santoni A. Opioid-induced tolerance and hyperalgesia. *CNS Drugs*. 2019;33(10):943-955. doi: 10.1007/s40263-019-00660-0.
21. Jensen B, Chen J, Furnish T, Wallace M. Medical marijuana and chronic pain: a review of basic science and clinical evidence. *Curr Pain and Headache Rep*. 2015;19(10).

https://doi.org/10.1007/s11916-015-0524-x

22. Bilbao A, Spanagel R. Medical cannabinoids: a pharmacology-based systematic review and meta-analysis for all relevant medical indications. *BMC Med.* 2022;20,259. https://doi.org/10.1186/s12916-022-02459-1
23. Bicket MC, Stone EM, McGinty EE. Use of cannabis and other pain treatments among adults with chronic pain in US states with medical cannabis programs. *JAMA Netw Open.* 2023;6(1):e2249797. doi:10.1001/jamanetworkopen.2022.49797
24. Wallis D, Coatsworth JD, Mennis J, et al. Predicting self-medication with cannabis in young adults with hazardous cannabis use. *Int J Environ Res Public Health.* 2022;19(3):1850. doi: 10.3390/ijerph19031850.
25. Pellati F, Borgonetti V, Brighenti V, Biagi M, Benvenuti S, Corsi L. *Cannabis sativa* L. and nonpsychoactive cannabinoids: their chemistry and role against oxidative stress, inflammation, and cancer. *BioMed research international*, *2018*, 1691428. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6304621/
26. Katchan V, David P, Shoenfeld Y. Cannabinoids and autoimmune diseases: a systematic review. *Autoimmun Rev.* 2016;15(6), 513-528. doi:10.1016/J.AUTREV.2016.02.008
27. Okafor CN, Li M, Paltzer J. Self-reported cannabis use and biomarkers of inflammation among adults in the United States. *BBI-Health.* 2020;7,100-109. https://www.sciencedirect.com/science/article/pii/S2666354620300740
28. Nagarkatti P, Pandey R, Rieder SA, Hegde VL, Nagarkatti M. Cannabinoids as novel anti-inflammatory drugs. *Future Med Chem.* 2009;1(7):1333-49. doi:10.4155/fmc.09.93. PMID: 20191092; PMCID: PMC2828614.
29. Anil SM, Peeri H, Koltai H. Medical Cannabis activity against inflammation: active compounds and modes of action. *Front Pharmacol.* 2022 May 9;13:908198. Doi: 10.3389/fphar.2022.908198. PMID: 35614947; PMCID: PMC9124761.
30. Marijuana shows potential in treating autoimmune disease. University of South Carolina. *ScienceDaily*. 2014. Retrieved November 29, 2022 www.sciencedaily.com/releases/2014/06/140602150914.htm
31. Kozela E, Juknat A, Gao F, Kaushansky N, Coppola G, Vogel Z. Pathways and gene networks mediating the regulatory effects of Cannabidiol, a nonpsychoactive cannabinoid, in autoimmune T cells. *Journal of Neuroinflammation.* 2016;13(1). https://doi.org/10.1186/s12974-016-0603-x
32. Key substance use and mental health indicators in the United States: Results from the 2021 National Survey on Drug Use and Health (HHS Publication No. PEP22-07-01-005, NSDUH Series H-57). Substance Abuse and Mental Health Services Administration. 2022. Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/report/2021-nsduh-annual-national-report
33. Smith DA, Germolec DR. Introduction to immunology and autoimmunity. *Environ Health Perspect.* 1999;*107*,661. https://doi.org/10.2307/3434323
34. Brogan PA, Dillon MJ. Autoimmune diseases in children. *Curr Paediat.* 2005;*15(1)*, 23–31. https://doi.org/10.1016/j.cupe.2004.10.011
35. Wang L, Wang FS, Gershwin ME. Human autoimmune diseases: a comprehensive update. *J Internal Med.* 2015; 278(4),369-395. https://doi.org/10.1111/joim.12395
36. Feingold D, Brill S, Goor-Aryeh I, Delayahu Y, Lev-Ran S. Depression and anxiety among chronic pain patients receiving prescription opioids and medical marijuana. *Journal of Affective Disorders. 2017;218,* 1–7. https://doi.org/10.1016/j.jad.2017.04.026
37. Volkow ND, Baler RD, Compton WM, Weiss SR. Adverse health effects of marijuana use. *N Engl J Med.* 2014;370(23):2219-27. doi: 10.1056/NEJMra1402309.
38. Pryce CR, Fontana A. Depression in autoimmune diseases. *Inflammation-Associated Depression: Evidence, Mechanisms and Implications.* 2016;139–154. https://doi.org/10.1007/7854_2016_7
39. Kelley KW, Dantzer R. Alcoholism and inflammation: Neuroimmunology of behavioral and mood disorders. *Brain, Behav, Immun.* 2011;25. https://doi.org/10.1016/j.bbi.2010.12.013