

Perceptions and Opinions on Cannabidiol in the Orthopaedic Sports Medicine Community

Zachary I. Li,^{*†} BA, Isabel Chalem,[†] BS, Emily Berzolla,[†] BS, Kinjal D. Vasavada,[†] BA, Brittany DeClouette,[†] MD, Kevin M. Kaplan,[‡] MD, and Michael J. Alaia,[†] MD

Investigation performed at the Department of Orthopedic Surgery, New York University Langone Health, New York, New York, USA

Background: Cannabidiol (CBD) is a known pain modulator that is garnering increased attention in the orthopaedic world. There may be a considerable knowledge gap among orthopaedic sports medicine providers and their perception of its therapeutic value.

Purpose: To (1) examine the knowledge and beliefs of sports medicine orthopaedic providers with respect to CBD, (2) deliver an educational component, and (3) elucidate potential barriers to its widespread application.

Study Design: Cross-sectional study.

Methods: A 3-component, 25-question online survey was distributed to members of the American Orthopaedic Society for Sports Medicine and the Arthroscopy Association of North America between July and October 2022. The first 20 questions assessed baseline knowledge and opinions regarding CBD, followed by an educational component, and then 5 questions assessing whether the respondents' opinions had changed after learning more about CBD. Responses were compared according to age, practice setting, and state's cannabinoid legalization status using the chi-square test, and changes in opinions from before to after the educational component were compared using the paired *t* test.

Results: There were 101 survey responses, for a response rate of approximately 1%. Most respondents believed that there is a role for CBD in postoperative pain management (76%), acute pain and inflammation after an injury (62%), and chronic pain (94%). Most respondents admitted that they were not knowledgeable about the mechanism of action (89%) or their state's laws (66%) concerning CBD. A minority (25%) believed that CBD has psychoactive properties. While most respondents (76%) did not believe that they would be stigmatized if they were to suggest CBD to a patient, only 48% had ever suggested CBD. Notably, 94% of respondents had encountered patients who reported trying CBD to treat pain. After reading the fact sheet, 51% of respondents stated that their opinion on CBD had changed, and 63% felt inclined to investigate the topic further.

Conclusion: Most survey respondents believed that CBD has a role in postoperative and chronic pain management. Although there was a relative familiarity with CBD, there was a knowledge gap, suggesting that increased attention, education, and research are necessary.

Keywords: cannabidiol; CBD; education; pain management

In recent years, both medical and nonmedical overuse of opioids have taken a toll on society, initiating an effort to diversify treatment algorithms for patients in pain.²⁴ The *Cannabis sativa* plant is one promising alternative for pain control, with its derivative cannabinoids, namely, cannabidiol (CBD), which is the subject of growing investigation. The Agriculture Improvement Act of 2018 legalized industrial hemp (*Cannabis sativa* containing <0.3% tetrahydrocannabinol [THC] content on a dry weight basis) and its derivative compounds in the United States (US), thereby removing CBD from the purview of the Controlled Substances Act.^{1,3,17} Concurrently, the US Food and Drug Administration (FDA) approved the first CBD medication,

Epidiolex (Jazz Pharmaceuticals), as an adjunct therapy to anticonvulsant medications in the treatment of 2 severe forms of childhood epilepsy.²⁵

As a commercial product, CBD has gained increasing media attention and mass appeal, with a current global market size estimated at US\$5.18 billion and a projected market size of US\$22.05 billion by 2030.⁸ Within the realm of sports medicine, a recent study found 19% of all sports orthopaedic patients who attended a single clinic in the span of 1 year to have utilized CBD.¹⁰

While there is promising evidence from *in vitro*^{4,28} and animal studies^{11,14,18,42,44} for CBD as a pain modulator, there remains a lack of high-quality evidence within orthopaedics and particularly sports medicine with respect to CBD.^{27,31} In combination with providers' unfamiliarity with CBD regulation and available formulations as well as potential patient or surgeon stigmatization, there may

The Orthopaedic Journal of Sports Medicine, 11(9), 23259671231191766

DOI: 10.1177/23259671231191766

© The Author(s) 2023

This open-access article is published and distributed under the Creative Commons Attribution - NonCommercial - No Derivatives License (<https://creativecommons.org/licenses/by-nc-nd/4.0/>), which permits the noncommercial use, distribution, and reproduction of the article in any medium, provided the original author and source are credited. You may not alter, transform, or build upon this article without the permission of the Author(s). For article reuse guidelines, please visit SAGE's website at <http://www.sagepub.com/journals-permissions>.

be numerous barriers to the use of this treatment modality.^{25,27} Investigating additional pain treatment methods is especially important with respect to orthopaedics, as orthopaedic surgeons are the third highest prescribers of opioids among physicians in the US, accounting for 7.7% of all opioid prescriptions nationally.²⁹ Despite the emerging popularity of CBD as a synergistic pain treatment option,² there remains a reluctance among orthopaedic surgeons to adopt it.⁹

The purpose of this study was to (1) examine the existing knowledge and beliefs of the sports medicine community with respect to the role of CBD in a multimodal postoperative pain management regimen, (2) deliver an educational component on CBD, and (3) elucidate potential future barriers to the widespread use of this treatment modality by providing an anonymous forum to voice personal opinions. We hypothesized that while a majority of respondents would report having encountered patients who have utilized CBD, a minority would report familiarity with the mechanism of action, modes of administration, or legislation concerning cannabinoids.

METHODS

Study Design

Institutional review board approval was received for the study protocol. An anonymous 3-component, 25-question survey (Appendix Table A1) was collaboratively prepared by all authors and reviewed by the 2 senior authors (K.M.K. and M.J.A.). The study was conducted from July 1 to October 31, 2022.

The first part of the survey included 13 questions that assessed the baseline knowledge and opinions of sports medicine providers regarding CBD in clinical practice, particularly with respect to the existing literature that has investigated CBD and pain in orthopaedics, and their knowledge of the legal aspects of cannabinoids. The remainder of this section contained 3 questions assessing opinions on the effect of CBD on surgical outcomes and soft tissue or bony healing, 1 overall rating question, and 3 questions on respondent characteristics: practice setting (academic medical center [major involvement in graduate medical education, federally funded research, affiliation with a medical school], private practice [single or group-owned practice], or nonacademic hospital [community medical center, minimal involvement in graduate medical education, no federally funded research]), US state (or country if international), and decade of age.

The first portion of the survey was followed by a 1-page summary sheet detailing the current legal status of CBD and a brief literature review of existing studies that have investigated CBD for pain management within orthopaedics (available separately as supplemental material). This included an overview of CBD as a chemical compound, with distinctions emphasized between CBD, THC, and marijuana. It also included some of the known and hypothesized mechanisms of action of cannabinoids in pain sensation, inflammation, and healing within animal and in vitro models. Legal status was briefly addressed with the Agriculture Improvement Act of 2018. Lastly, it provided a brief review of the most recent studies with respect to CBD in the sports medicine literature.

The last portion of the survey contained 5 questions that assessed whether the respondents' opinions had shifted after learning more about CBD. One overall rating question ("Please indicate the likelihood you would recommend CBD as part of a pain management regimen.") was repeated before and after the educational component. This was measured on a visual analog scale (VAS) from 0 ("would never recommend") to 100 ("would definitely recommend"), with 50 being neutral.

The proposal and survey were submitted to the research committee of the American Orthopaedic Society for Sports Medicine (AOSSM) and the Arthroscopy Association of North America (AANA). After its approval, the survey was posted to each website for a 4-month period. The survey was publicized a single time by the AOSSM and AANA via email to their members, included as part of a periodic update, as well as by word of mouth from us. Survey participation was voluntary and could be terminated at any time. Study data were collected and managed using REDCap (Research Electronic Data Capture), a secure, web-based software platform.¹⁵ REDCap does not have the capability to monitor for the duplication of survey responses.

Statistical Analysis

Statistical analysis was performed using SAS (Version 9.3; SAS Institute). The chi-square test was performed to compare answers by age (<40 vs ≥40 years), practice setting, and state's CBD and marijuana legalization status. After assessing for normal distribution, the paired *t* test was performed to analyze changes in respondents' opinions from before to after the educational component of the survey, while the independent *t* test was used to compare the likelihood of recommending CBD between respondents living in states with fully versus conditionally legal cannabinoids. A *P* value ≤.05 was considered statistically significant.

*Address correspondence to Zachary I. Li, BA, Department of Orthopedic Surgery, New York University Langone Health, 333 East 38th Street, New York, NY 10016, USA (email: Zachary.li@nyulangone.org).

†Department of Orthopedic Surgery, New York University Langone Health, New York, New York, USA.

‡Jacksonville Orthopaedic Institute, Jacksonville, Florida, USA.

Final revision submitted April 7, 2023; accepted May 3, 2023.

One or more of the authors has declared the following potential conflict of interest or source of funding: K.M.K. has received education payments from Team 1 Orthopedics and consulting fees from Arthrex. M.J.A. has received education payments from Arthrex, consulting fees from DePuy Synthes, and nonconsulting fees from Arthrex. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was obtained from New York University Langone Health (protocol No. 22-00827).

RESULTS

Characteristics of Survey Respondents

In total, 101 responses were collected, for a response rate of approximately 1% of the overall AOSSM and AANA membership. The characteristics of the survey respondents are summarized in Table 1. Most respondents (58.4%) practiced in an academic setting. Approximately half of respondents

TABLE 1
Characteristics of Survey Respondents (n = 101)^a

	n (%)
Age-group, y	
18-29	0 (0.0)
30-39	23 (23.2)
40-49	51 (51.5)
50-59	18 (18.2)
60-69	7 (7.1)
≥70	0 (0.0)
Practice setting	
Private practice	29 (28.7)
Academic medical center	59 (58.4)
Nonacademic hospital	13 (12.9)
Legalization status in state of residence	
Legal marijuana	66 (66.7)
Medically legal marijuana	28 (28.3)
No legal marijuana	2 (2.0)
Non-US resident	3 (3.0)
Type of state-regulated cannabis program	
Adult and medical use	66 (68.8)
Medical use	23 (24.0)
CBD/low THC	7 (7.3)
No public access	0 (0.0)

^aCBD, cannabidiol; THC, tetrahydrocannabinol; US, United States.

(51.5%) were between the ages of 40 to 49 years, ranging from 30 to 69 years. There were 2 respondents (2.0%) who did not identify their age-group, location, or practice setting.

International respondents comprised 3.0% of the survey group (Canada: n = 2; Mexico: n = 1). There were 25 unique states represented (Figure 1). A majority of respondents (68.8%) lived in states in which cannabis products, including CBD, are fully legalized. There were 23 respondents (24.0%) who resided in states with medical-use cannabis programs and 7 (7.3%) who lived in states with CBD/low-THC programs. No respondents resided in states in which either cannabis or CBD is illegal.

Baseline Knowledge and Opinions of CBD

Responses to the 13 survey questions regarding baseline knowledge of CBD and perceptions of its use in clinical practice are summarized in Figure 2. Notably, 94.1% of respondents had encountered patients who reported trying CBD to treat pain. The survey responses demonstrated little confidence in baseline knowledge of CBD. Most respondents (89.2%) were not knowledgeable about the mechanism of action of CBD, while 73.3% of respondents were unfamiliar with its modes of administration (eg, oral, inhaled, topical). One-third of respondents (33.7%) were familiar with their respective state laws that govern CBD use. A minority (24.8%) believed that CBD has psychoactive properties, and 18.8% believed that CBD has addictive potential.

Most respondents (69.3%) utilized a multimodal postoperative pain management regimen, defined as ≥3 pain medications. A majority of respondents (76.2%) believed that there is a role for CBD products in managing postoperative pain. Regarding acute versus chronic pain management, 62.4% of respondents believed that there is a role for CBD in addressing acute pain and inflammation after an

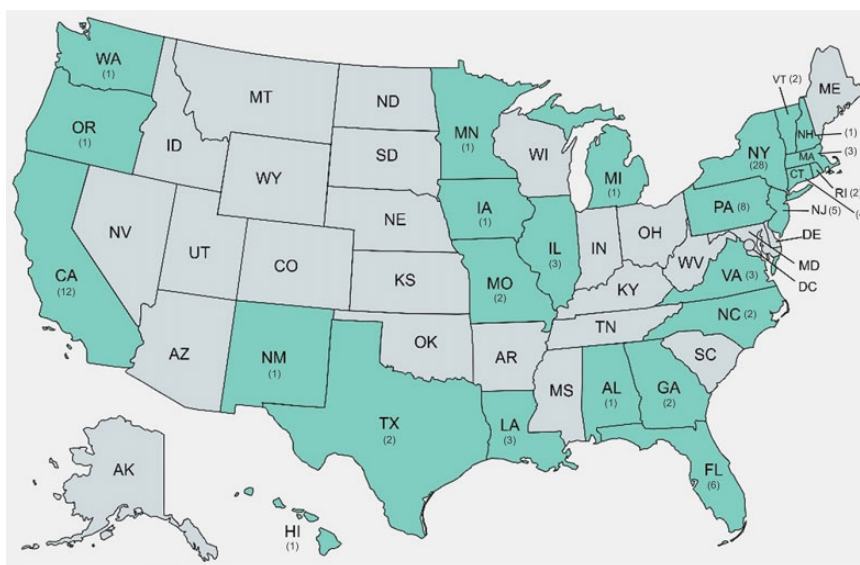


Figure 1. States represented by survey respondents are indicated in blue, with the number of respondents in parentheses.

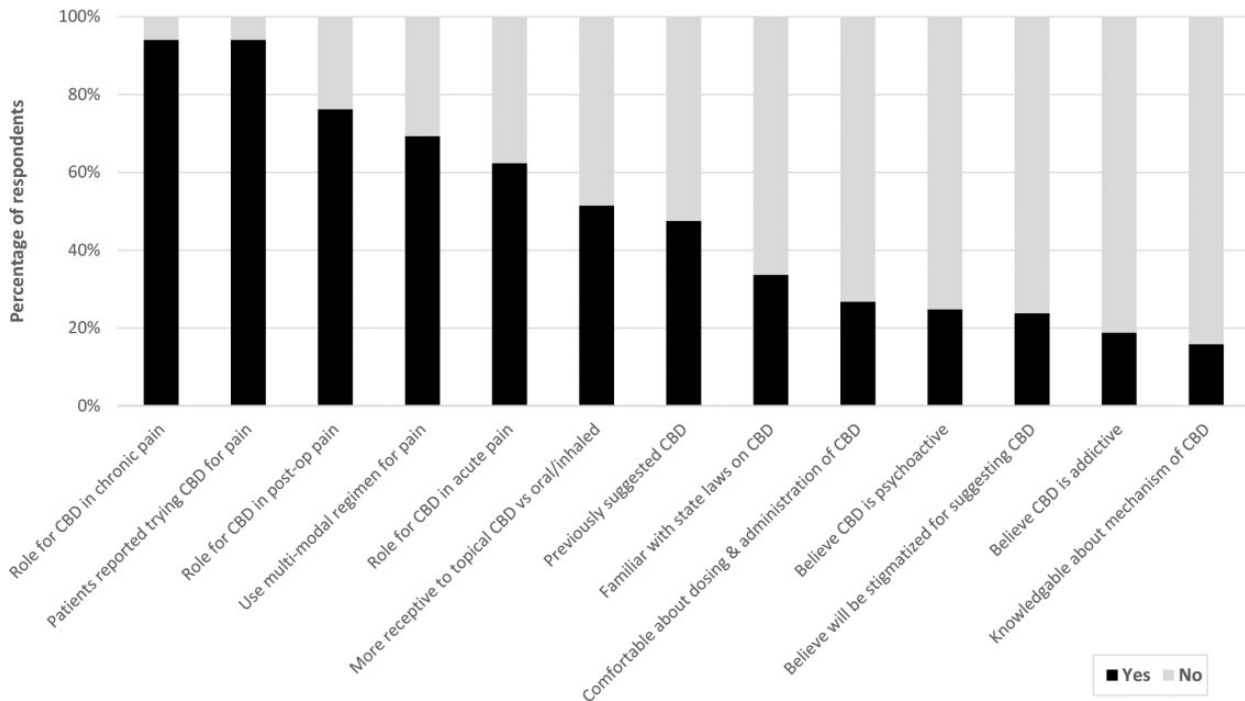


Figure 2. Summary of responses to the 13 survey questions regarding baseline knowledge and opinions of cannabidiol (CBD), arranged according to the percentage of positive responses. post-op, postoperative.

injury, while almost all respondents (94.1%) believed that CBD could play a role in managing chronic pain. While most respondents (76.2%) did not believe that they would be stigmatized if they were to suggest CBD to a patient, only 47.5% had ever suggested it themselves. When asked whether they felt more receptive to a topical form of CBD, compared to an oral or inhaled mode of administration, 51.5% of respondents agreed, while 44.6% had no preference.

When the survey responses were stratified by decade of age, practice setting, and type of state-regulated cannabis program, responses were largely similar (Table 2). A single exception was that respondents living in states with CBD/low-THC programs had encountered patients previously using CBD at a significantly lower rate compared to those living in states with adult-use cannabis programs or medical-use regulated programs ($P = .011$). Importantly, there were no significant differences among any of the stratified groups regarding whether respondents felt that they would experience stigma for suggesting a CBD product. No significant differences were identified among age-groups in the survey responses. In fact, the oldest group of respondents (60-69 years) had suggested CBD the most (85.7%) and believed that they would be stigmatized the least (14.3%).

Opinions of Effect of Cannabinoids on Healing and Surgical Outcomes

The survey contained 3 questions pertaining to the effect of CBD on bony and soft tissue healing as well as surgical outcomes. Most respondents (73.3%) believed that CBD has

no effect on surgical outcomes, 25.7% believed that there is some positive effect, and 1.0% believed that there is some negative effect. When asked specifically about the effect of CBD on soft tissue healing (eg, arthroscopic rotator cuff repair, soft tissue anterior cruciate ligament reconstruction, etc), a large majority (89.1%) believed that there is no effect, 7.9% believed that CBD could positively affect healing, and 3.0% believed that CBD could negatively affect healing. Lastly, when respondents were asked about the effect of CBD on bony healing (eg, anterior cruciate ligament reconstruction with bone–patellar tendon–bone autograft, osteotomy, Latarjet procedure or shoulder bone grafting), findings were similar, with 90.1% believing that there is no effect, 7.9% a positive effect, and 2.0% a negative effect.

Opinions Before and After Educational Component

There were 70 respondents (69.3%) who completed the 5 final questions of the survey, indicating that they proceeded through the educational component. There was 1 multiple-choice comprehension question (“What is the legal cut-off for THC content in CBD products?”) to approximate how many respondents performed a close reading of the educational component, to which 43.9% of respondents answered correctly. After reading the fact sheet, 51.4% of the survey respondents stated that their opinion of CBD had changed, and 62.9% stated that they felt inclined to investigate the topic further on their own.

Before the educational component, there were 54 respondents (54.5%) who answered with a score >50, while 42

TABLE 2
Heat Map of Positive Responses to Survey Questions Regarding Baseline Knowledge and Opinions of CBD According to Respondent Characteristics^a

Survey Question	Age-Group, y				Practice Setting			Type of State-Regulated Cannabis Program		
	30-39	40-49	50-59	60-69	Academic	Private	Nonacademic	Adult Use	Medical Use	CBD/ Low THC
1. Treat postoperative pain with multimodal regimen?	91%	61%	67%	71%	73%	57%	92%	68%	78%	71%
2. Role for CBD in postoperative pain?	78%	75%	78%	100%	80%	79%	62%	77%	83%	57%
3. Role for CBD in acute pain after injury?	70%	57%	61%	100%	64%	71%	46%	61%	78%	43%
4. Role for CBD in chronic pain?	91%	94%	100%	100%	96%	93%	92%	96%	96%	86%
5. Knowledgeable about CBD's mechanism of action?	13%	16%	6%	43%	12%	21%	17%	11%	26%	29%
6. Knowledgeable about CBD's modes of administration?	17%	28%	33%	43%	31%	31%	24%	30%	22%	29%
7. Does CBD have psychoactive effects?	22%	24%	33%	29%	31%	17%	17%	26%	22%	29%
8. Is CBD addictive?	13%	20%	28%	14%	27% ^b	7% ^b	8% ^b	21%	9%	0%
9. Have suggested CBD to patients?	48%	45%	44%	86%	50%	48%	42%	46%	61%	43%
10. Had patients who tried CBD for pain?	96%	90%	100%	100%	93%	97%	92%	96% ^b	100% ^b	71% ^b
11. Familiar with state's laws on CBD?	44%	28%	33%	43%	24%	46%	39%	32%	30%	43%
12. Felt you would experience stigma?	35%	24%	17%	14%	22%	24%	33%	27%	13%	29%
13. More receptive to topical CBD versus oral/ inhaled?	44%	59%	50%	29%	44%	41%	54%	42%	44%	57%

^aCBD, cannabidiol; THC, tetrahydrocannabinol.

^bStatistically significant difference between groups within demographic category ($P \leq .05$; chi-square test).

respondents (60.0%) answered with a score >50 afterward. Of the 65 respondents with complete responses to the VAS rating question, there was a small but statistically significant increase in the mean score from before the educational component (59.1 ± 26.5) to after the educational component (63.5 ± 25.6) ($P = .002$). Of the 65 respondents, 24 (36.9%) increased their VAS rating, 35 (53.9%) remained neutral, and 6 (9.2%) lowered their rating. In the optional open-response section, 32 respondents elaborated on their concerns, with most sentiments categorized as 3 predominant themes: (1) more evidence is required ($n = 10$ [31.3%]), (2) stigmatization from patients ($n = 8$ [25.0%]), and (3) more regulation is required ($n = 5$ [15.6%]). All 6 respondents who lowered their rating were included among those who expressed a concern in the open-response section. The 32 respondents had a significantly lower VAS rating before the educational component (50.7 ± 27.4 vs 64.9 ± 25.2 , respectively; $P = .031$) and after the educational component

(55.5 ± 24.6 vs 70.4 ± 24.5 , respectively; $P = .014$) when compared to the rest of the cohorts' VAS.

DISCUSSION

The results of the survey show that many members of the sports medicine community believed that CBD has a role in pain treatment, whether in the postoperative (76.2%) or chronic pain (94.1%) setting. Conversely, most respondents did not believe that they were familiar with the mechanism of action (89.2%), modes of administration (73.3%), or respective state laws (66.3%) concerning CBD, which affirmed the hypothesis. Many respondents were open-minded toward the inclusion of CBD in a multimodal pain management regimen, with mean VAS recommendation scores increasing significantly from before to after the educational component. Lastly, the open-response portion of

the survey highlighted concerns regarding the lack of high-quality evidence and regulation with respect to CBD.

Despite the lack of existing evidence regarding the efficacy of CBD for orthopaedic conditions, many respondents have become interested in learning more about the topic, especially as the use of unregulated CBD products expands rapidly. It is apparent that cannabinoids have become commercially mainstream, with vast (and unsubstantiated) claims of therapeutic benefits.²⁵ With 94.1% of respondents having encountered patients who have utilized CBD in some capacity to treat pain, on par with similar studies on provider surveys,^{9,37} it becomes imperative that this cannabinoid requires further investigation, especially with respect to its long-term safety profile.

Although there is high interest in CBD, there are clear gaps in knowledge in the sports medicine community. Most respondents believed that there is some role for CBD in the management of postoperative pain, acute pain after an injury, and chronic pain. Additionally, a majority of respondents were open-minded with respect to new evidence for the use of CBD, as shown by the demonstrated interest in learning more about the topic on their own time. There was additionally a small but statistically significant increase in the willingness to recommend CBD after the educational component of the survey. The majority of respondents did not believe that CBD has any effect on the healing process after soft tissue or bony procedures.

While there are currently some studies supporting a potential positive effect of CBD on fracture healing,²¹ osteoarthritis progression,^{22,32,39} and bone density,^{20,33,36} there are few high-quality prospective clinical studies that have investigated the effect of CBD on musculoskeletal pain, which are limited to hand osteoarthritis^{16,41} and total knee arthroplasty.¹³ To our knowledge, there is a single published level 1 evidence study within the field of sports medicine: Alaia et al² recently found in a double-blinded, placebo-controlled randomized trial that patients who received buccally absorbed CBD after arthroscopic rotator cuff repair experienced a reduction in acute pain (postoperative days 1 and 2), providing evidence of its potential therapeutic benefit for postoperative pain.

Beyond sports medicine, other clinical trials investigating CBD have demonstrated mixed results.^{13,41,43} Topical CBD was not found to significantly reduce pain, improve sleep quality, or decrease opioid consumption after total knee arthroplasty up to postoperative day 42; in fact, the placebo (essential oils) group experienced a significant decrease in pain on postoperative day 2.¹³ Another study found that the oral administration of a synthetic CBD tablet did not reduce VAS pain intensity for hand osteoarthritis and psoriatic arthritis significantly more than placebo.⁴¹ With respect to neuropathic pain, Xu et al⁴³ found a significant improvement in neuropathic pain scale scores compared to placebo after 4 weeks of topical CBD application. An ongoing clinical trial (NCT05020028) is investigating the oral administration of CBD capsules for pain related to knee osteoarthritis with an 84-day endpoint. It is important to note that the dosing and modes of administration of CBD are not uniform among these trials.

Because of known existing knowledge gaps within the orthopaedic community,⁹ a secondary purpose of this survey was to provide an educational component regarding these topics. It is important to reiterate differences between CBD, THC, and “marijuana” generally. A cannabinoid includes any of the hundreds of chemical compounds that can be found within the *Cannabis sativa* plant (phytocannabinoids), chemical compounds produced within the body (endocannabinoids), or laboratory-produced compounds designed to replicate organic versions (synthetic cannabinoids). Both CBD and THC are distinct cannabinoids that can be extracted from the cannabis plant or synthesized.

To review the mechanism of action of CBD, this cannabinoid exerts its pharmacological effects through the endocannabinoid system, primarily with endogenous cannabinoid type 1 (CB₁) and type 2 (CB₂) receptors. CB₁ receptors are primarily distributed throughout the central nervous system, particularly in regions of the midbrain and spinal cord that are responsible for pain perception.³⁴ CB₂ receptors occur mainly in immune cells and are therefore believed to be responsible for the regulation of inflammatory responses.^{6,30,34} As CBD exhibits affinity to both of these receptors, it has the potential to enhance pain control and regulate healing responses.^{26,28} Recently, Zhang and Bean⁴⁴ were able to isolate a specific mechanism by which CBD inhibits repetitive action potentials in nociceptive neurons in murine dorsal root ganglia.

While THC is psychoactive and capable of producing the euphoric effects associated with marijuana, CBD is not. Most respondents correctly believed that CBD is nonpsychoactive and nonaddictive. It should be noted that unregulated CBD products commonly have detectable levels of THC, with a recent study finding 52 of 80 unregulated samples to have detectable THC; the maximum positive test finding had a THC concentration nearly 94-fold that of Epidiolex, with many being labeled as “THC-free.”¹⁹ On the other hand, clinical trials investigating CBD must utilize FDA-approved formulations. There are currently 4 FDA-approved cannabinoids: Epidiolex (CBD; cannabis-derived), Marinol (dronabinol; synthetic) (Unimed Pharmaceuticals Inc.), Syndros (dronabinol; synthetic) (Benuvia Therapeutics Inc.), and Cesamet (nabilone; synthetic) (Valeant Pharmaceuticals International).¹² In Canada, Mexico, and several European countries, nabiximols, marketed as Sativex (Jazz Pharmaceuticals), is a 1-to-1 combination THC/CBD medication that is currently approved for spasticity-related pain (excluding neuropathic pain) related to multiple sclerosis and cancer-related pain.³⁵ The efficacy of nabiximols has been reviewed by the American Academy of Neurology.²³

Although previous studies have found patients who use cannabinoids to experience stigmatization,^{5,38} the results from this survey indicate that provider stigmatization may be a decreasing concern, especially with respect to CBD. A majority of respondents were not concerned about stigmatization by their patients, although far fewer were likely to recommend CBD, findings that corroborate previous provider surveys in dermatology and orthopaedic traumatology.^{9,37} These results suggest that resistance by providers to investigate and recommend CBD may be attributable to other factors. The most prominent barrier

to the adoption of CBD is the lack of high-quality clinical evidence, affirmed by this recurring theme within the open-response section of the survey. While respondents were justifiably concerned about limited evidence regarding the efficacy of CBD, public enthusiasm and commercial proliferation accelerate.

The enthusiasm for cannabinoid products has fueled rapid growth in commercial markets, while interventional research investigating cannabinoids lags far behind.⁷ One of the foremost contributing factors to the paucity of research is likely the convoluted landscape of state and federal legislation addressing marijuana and cannabinoids. This survey study found only one-third of respondents to be familiar with their respective state's laws governing CBD use, which is markedly lower than in the provider study by Chin et al.,⁹ suggesting that respondents may be even less familiar with CBD laws compared to cannabis legislation as a whole. Differences in cannabinoid legislation at the state and federal levels certainly pose a barrier to CBD research.

There are currently 37 states, 3 US territories, and the District of Columbia (Washington, DC) that allow the medical use of cannabis products, while 19 states, 2 territories, and Washington, DC, have passed measures to regulate cannabis for nonmedical use.⁴⁰ Although the Agriculture Improvement Act of 2018 legalized hemp derivatives with THC <0.3% nationally, state laws and legislative language are nonuniform; for example, there are approved measures in 10 states that allow the use of "low-THC, high-CBD" products for limited medical reasons or as a legal defense.⁴⁰ These discrepancies may contribute to both patient and provider confusion and apprehension. Moreover, this lack of clarity may stymie efforts to fund and promote research related to CBD. Furthermore, CBD formulations that are studied in one state may not be legally accessible in another, with uncertain external validity with respect to unregulated commercial products. There is now a sense of urgency with respect to the investigation of this nonpsychoactive, promising cannabinoid in the realm of musculoskeletal conditions and perioperative pain applications.

Limitations

This study was limited by selection bias and incompleteness within the data set. We were able to assess 101 responses; as the AANA and AOSSM membership approaches 6500 and 4000, respectively, the minimum response rate was approximately 1% (not accounting for those who are members of both societies). Because of the anonymity of the survey and the diverse composition of health-care providers who comprise the AANA and AOSSM, we were unable to account for potential duplicate responses or identify whether respondents were surgeons or other provider types. Additionally, the survey did not account for the respondent's number of years in practice, which could influence his or her perspective toward this subject. Another possible bias is that those who are more familiar with CBD or have interest in the topic would be more likely to complete the survey, thereby skewing the data. By being a member of an academic society, these respondents may have more favorable attitudes toward emerging and experimental therapies. Incompletion within the data set was most likely

caused by the nature of the study design; by utilizing a 3-section survey, only 70 of 101 respondents completed the entire survey. Lastly, this survey study focused specifically on CBD; thus, conclusions drawn from these opinions with respect to other cannabinoids are limited.

CONCLUSION

Most survey respondents believed that CBD has a role in postoperative and chronic pain management. There appeared to be a relative familiarity with CBD, in part, because of its remarkable prevalence among patients. However, there remains a knowledge gap, suggesting that increased attention, education, and research are necessary.

Supplemental Material for this article is available at <https://journals.sagepub.com/doi/full/10.1177/23259671231191766>.

REFERENCES

1. Agriculture Improvement Act of 2018 (2018 Farm Act). Pub. L. No. 115-334, 132 Stat. 4490 (2018). Accessed March 31, 2023. <https://www.congress.gov/115/plaws/publ334/PLAW-115publ334.pdf>
2. Alaia MJ, Hurley ET, Vasavada K, et al. Buccally absorbed cannabidiol shows significantly superior pain control and improved satisfaction immediately after arthroscopic rotator cuff repair: a placebo-controlled, double-blinded, randomized trial. *Am J Sports Med.* 2022;50(11):3056-3063.
3. Alharbi YN. Current legal status of medical marijuana and cannabidiol in the United States. *Epilepsy Behav.* 2020;112:107452.
4. Atalay S, Jarocka-Karpowicz I, Skrzydlewska E. Antioxidative and anti-inflammatory properties of cannabidiol. *Antioxidants.* 2019;9(1):21.
5. Bottorff JL, Bissell LJJ, Balneaves LG, Oliffe JL, Capler NR, Buxton J. Perceptions of cannabis as a stigmatized medicine: a qualitative descriptive study. *Harm Reduct J.* 2013;10:2.
6. Bouaboula M, Rinaldi M, Carayon P, et al. Cannabinoid-receptor expression in human leukocytes. *Eur J Biochem.* 1993;214(1):173-180.
7. Buck JS, Bloomer AK, Wally MK, Seymour RB, Hsu JR. The current evidence for marijuana as medical treatment. *J Bone Joint Surg Am.* 2020;102(23):2096-2105.
8. Cannabidiol market size to exceed \$56.2bn by 2028. Global Market Insights. Published April 8, 2022. Accessed September 23, 2023. <https://www.gminsights.com/pressrelease/cannabidiol-market>
9. Chin G, Etiz BAF, Nelson AM, Lim PK, Scolaro JA. Knowledge and opinion on cannabinoids among orthopaedic traumatologists. *J Am Acad Orthop Surg Glob Res Rev.* 2021;5(4):e21.00047.
10. Deckey DG, Doan M, Hassebrock JD. Prevalence of cannabidiol (CBD) use in orthopaedic sports medicine patients. *Orthop J Sports Med.* 2022;10(4):23259671221087628.
11. De Gregorio D, McLaughlin RJ, Posa L. Cannabidiol modulates serotonergic transmission and reverses both allodynia and anxiety-like behavior in a model of neuropathic pain. *Pain.* 2019;160(1):136-150.
12. FDA and cannabis: research and drug approval process. US Food and Drug Administration. Published February 27, 2023. Accessed March 31, 2023. <https://www.fda.gov/news-events/public-health-focus/fda-and-cannabis-research-and-drug-approval-process>
13. Haffar A, Khan IA, Abdelaal MS, Banerjee S, Sharkey PF, Lonner JH. Topical cannabidiol (CBD) after total knee arthroplasty does not decrease pain or opioid use: a prospective randomized double-blinded placebo-controlled trial. *J Arthroplasty.* 2022;37(9):1763-1770.

14. Hammell DC, Zhang LP, Ma F, et al. Transdermal cannabidiol reduces inflammation and pain-related behaviours in a rat model of arthritis. *Eur J Pain*. 2016;20(6):936-948.
15. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research Electronic Data Capture (REDCap): a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-381.
16. Heineman JT, Forster GL, Stephens KL, Cottler PS, Timko MP, DeGeorge BR. A randomized controlled trial of topical cannabidiol for the treatment of thumb basal joint arthritis. *J Hand Surg*. 2022;47(7):611-620.
17. Hemp production and the 2018 Farm Bill (testimony of Amy Abernethy, MD, PhD, Principal Deputy Commissioner, Office of the Commissioner, Food and Drug Administration, Department of Health and Human Services before the Senate Committee on Agriculture, Nutrition, and Forestry). US Food and Drug Administration. Published July 25, 2019. Accessed September 23, 2023. <https://www.fda.gov/news-events/congressional-testimony/hemp-production-and-2018-farm-bill-07252019>
18. Iffland K, Grotenhermen F. An update on safety and side effects of cannabidiol: a review of clinical data and relevant animal studies. *Cannabis Cannabinoid Res*. 2017;2(1):139-154.
19. Johnson E, Kilgore M, Babalonis S. Cannabidiol (CBD) product contamination: quantitative analysis of Δ^9 -tetrahydrocannabinol (Δ^9 -THC) concentrations found in commercially available CBD products. *Drug Alcohol Depend*. 2022;237:109522.
20. Karsak M, Cohen-Solal M, Freudenberg J, et al. Cannabinoid receptor type 2 gene is associated with human osteoporosis. *Hum Mol Genet*. 2005;14(22):3389-3396.
21. Kogan NM, Melamed E, Wasserman E, et al. Cannabidiol, a major non-psychoactive cannabis constituent enhances fracture healing and stimulates lysyl hydroxylase activity in osteoblasts. *J Bone Min Res*. 2015;30(10):1905-1913.
22. Kong Y, Wang W, Zhang C, Wu Y, Liu Y, Zhou X. Cannabinoid WIN-55,212-2 mesylate inhibits ADAMTS-4 activity in human osteoarthritic articular chondrocytes by inhibiting expression of syndecan-1. *Mol Med Rep*. 2016;13(6):4569-4576.
23. Koppel BS, Brust JCM, Fife T, et al. Systematic review: efficacy and safety of medical marijuana in selected neurologic disorders. Report of the Guideline Development Subcommittee of the American Academy of Neurology. *Neurology*. 2014;82(17):1556-1563.
24. Kroenke K, Cheville A. Management of chronic pain in the aftermath of the opioid backlash. *JAMA*. 2017;317(23):2365-2366.
25. Li J, Carvajal R, Bruner L, Kaminski NE. The current understanding of the benefits, safety, and regulation of cannabidiol in consumer products. *Food Chem Toxicol*. 2021;157:112600.
26. Manzanera J, Julian M, Carrascosa A. Role of the cannabinoid system in pain control and therapeutic implications for the management of acute and chronic pain episodes. *Curr Neuropharmacol*. 2006;4(3):239-257.
27. Maurer GE, Mathews NM, Schleich KT, Slayman TG, Marcussen BL. Understanding cannabis-based therapeutics in sports medicine. *Sports Health*. 2020;12(6):540-546.
28. Mlost J, Bryk M, Starowicz K. Cannabidiol for pain treatment: focus on pharmacology and mechanism of action. *Int J Mol Sci*. 2020;21(22):8870.
29. Morris BJ, Mir HR. The opioid epidemic: impact on orthopaedic surgery. *J Am Acad Orthop Surg*. 2015;23(5):267-271.
30. Munro S, Thomas KL, Abu-Shaar M. Molecular characterization of a peripheral receptor for cannabinoids. *Nature*. 1993;365(6441):61-65.
31. Naik H, Trojian TH. Therapeutic potential for cannabinoids in sports medicine: current literature review. *Curr Sports Med Rep*. 2021;20(7):345-350.
32. O'Brien M, McDougall JJ. Cannabis and joints: scientific evidence for the alleviation of osteoarthritis pain by cannabinoids. *Curr Opin Pharmacol*. 2018;40:104-109.
33. Ofek O, Karsak M, Leclerc N, et al. Peripheral cannabinoid receptor, CB2, regulates bone mass. *Proc Natl Acad Sci U S A*. 2006;103(3):696-701.
34. Pertwee RG. Cannabinoid pharmacology: the first 66 years. *Br J Pharmacol*. 2006;147(S1):S163-S171.
35. PubChem. Nabiximols. Accessed February 2, 2023. <https://pubchem.ncbi.nlm.nih.gov/compound/9852188>
36. Raphael-Mizrahi B, Gabet Y. The cannabinoids effect on bone formation and bone healing. *Curr Osteoporos Rep*. 2020;18(5):433-438.
37. Robinson E, Murphy E, Friedman A. Knowledge, attitudes, and perceptions of cannabinoids in the dermatology community. *J Drugs Dermatol*. 2018;17(12):1273-1278.
38. Satterlund TD, Lee JP, Moore RS. Stigma among California's medical marijuana patients. *J Psychoactive Drugs*. 2015;47(1):10-17.
39. Sophocleous A, Börjesson AE, Salter DM, Ralston SH. The type 2 cannabinoid receptor regulates susceptibility to osteoarthritis in mice. *Osteoarthritis Cartilage*. 2015;23(9):1586-1594.
40. State medical cannabis laws. National Conference of State Legislatures. Accessed September 12, 2022. <https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx>
41. Vela J, Dreyer L, Petersen KK, Arendt-Nielsen L, Duch KS, Kristensen S. Cannabidiol treatment in hand osteoarthritis and psoriatic arthritis: a randomized, double-blind, placebo-controlled trial. *Pain*. 2022;163(6):1206-1214.
42. Verrico CD, Wesson S, Konduri V, et al. A randomized, double-blind, placebo-controlled study of daily cannabidiol for the treatment of canine osteoarthritis pain. *Pain*. 2020;161(9):2191-2202.
43. Xu DH, Cullen BD, Tang M, Fang Y. The effectiveness of topical cannabidiol oil in symptomatic relief of peripheral neuropathy of the lower extremities. *Curr Pharm Biotechnol*. 2020;21(5):390-402.
44. Zhang HXB, Bean BP. Cannabidiol inhibition of murine primary nociceptors: tight binding to slow inactivated states of Nav1.8 channels. *J Neurosci*. 2021;41(30):6371-6387.

APPENDIX

TABLE A1
Survey Questions^a

Part 1: Baseline knowledge and opinions as well as demographic characteristics

1. Do you treat postoperative pain with a multimodal (≥ 3 pain medications) regimen?
2. Do you believe there is a role for any CBD product in managing postoperative pain?
3. Do you believe there is a role for CBD in managing acute pain and inflammation after an injury?
4. Do you believe there is a role for CBD in managing chronic pain?
5. Do you believe you are knowledgeable about the mechanism of action of CBD?
6. Do you believe you are knowledgeable about the modes of administration of CBD (eg, oral, inhaled, topical)?

(continued)

TABLE A1 (continued)

-
7. Do you believe CBD has psychoactive effects?
 8. Do you believe CBD is addictive?
 9. Have you suggested CBD to any of your patients?
 10. Have your patients reported trying CBD to treat pain?
 11. Are you familiar with your state's laws that govern CBD use?
 12. Do you believe you will be stigmatized if you suggest CBD to patients?
 13. Do you feel more receptive to topical CBD forms compared to oral/inhaled administration?
 14. Do you believe prescribing CBD could affect your surgical outcomes?
 15. Do you think CBD may affect soft tissue healing (eg, rotator cuff repair, soft tissue ACL reconstruction)?
 16. Do you think CBD may affect bony healing (eg, bone-tendon-bone ACL reconstruction, osteotomy, Latarjet, or shoulder bone grafting)?
 17. Please indicate the likelihood you would recommend CBD as part of a pain management regimen.
 18. How would you describe your practice setting?
 19. In what state do you practice?
 20. Please select your age-group.

Part 2: Questions after the educational portion of the survey^b

21. Has your opinion of CBD changed after having read the fact sheet?
 22. If you have concerns regarding CBD, what are they?
 23. Do you feel inclined to investigate this topic further on your own?
 24. What is the legal cut-off for THC content in CBD products?
 25. Please indicate the likelihood you would recommend CBD as part of a pain management regimen.
-

^aACL, anterior cruciate ligament; CBD, cannabidiol; THC, tetrahydrocannabinol.

^bThe educational component is available separately as supplemental material.