

CANNABIS RESEARCH IN WASHINGTON STATE

A report for the Washington State Department of Commerce

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INTRODUCTION

As the legal cannabis market expands across the country and in Washington state, there is a growing need to engage diverse perspectives to further enhance research on the effects of cannabis use on individuals, communities and society. In addition, there is a need to inform the development of equitable and inclusive public policies and programs that maximize the benefits of legalization while minimizing the harms. Moreover, the surge in cannabis availability and the decline in perceived risk have contributed to greater use among many populations, increasing the urgency to better understand the public health consequences of cannabis use as well as creating new opportunities to investigate its potential therapeutic benefits. The result is a rich research landscape with lots of questions in need of researchers to investigate them.

A diverse cannabis research community would expand the range of perspectives and expertise available to design and carry out innovative research that could help answer pressing questions and address information gaps related to cannabis in the state. While there is limited information on the demographics of the cannabis research community in the state, it is well established that Black, Indigenous and people of color (BIPOC) populations are underrepresented in science, technology, engineering and mathematics (STEM) fields compared to their proportion in the overall U.S. population¹. These gaps have persisted despite substantial investments in programs aimed at helping underrepresented groups enter, persevere and thrive in STEM.

In recognition of the severe and detrimental impacts of the disproportionate enforcement of laws related to the use, possession and sale of cannabis on historically marginalized communities, the Washington State Legislature established a cannabis social equity program in 2020 through HB 2870². This initiative included funds for the Washington State Department of Commerce to administer a competitive technical assistance grant program to help those harmed by cannabis criminalization to benefit financially from the legal market. In 2022, the legislature authorized a community reinvestment account, also administered by Commerce, aimed at supporting BIPOC individuals in entering the retail, producer, and processor sectors of the cannabis industry. Commerce recognizes that there is also a need and an opportunity to explore how they might increase representation of BIPOC individuals in cannabis research.

INTERPRETATION OF CHARGE AND APPROACH

The Washington State Department of Commerce (DOC) engaged the Washington State Academy of Sciences (WSAS) to help them better understand how they might increase Black, Indigenous and people of color (BIPOC) participation in research that informs the cannabis industry.

WSAS was asked to:

- Prepare a description of the current landscape of cannabis research in Washington state.
- Convene meetings between the primary research organizations that conduct research on cannabis (Washington State University and the University of Washington) to identify potential synergies for both research and training, with a particular focus on BIPOC individuals.
- Present ideas about how research can better inform the cannabis industry in Washington state.
- Provide ideas about how to diversify the cannabis research community for Commerce to consider.

WSAS convened a committee consisting of leaders in the University of Washington (UW) and Washington State University (WSU) cannabis research communities to provide input on the current landscape of cannabis research and to discuss opportunities to diversify and advance cannabis research in the state. The committee

explored potential ways to support and grow the community of BIPOC researchers. The committee focused on the recruitment and retention of diverse researchers, from undergraduate and graduate students to postdocs and early career professionals. Although not covered in this work, interventions targeting K-12 audiences are also critical to increasing representation of BIPOC individuals in STEM.

To get a sense of the breadth of cannabis research taking place across Washington state, in addition to input from the committee, WSAS recruited two students connected to the Washington cannabis research communities – a UW graduate student and WSU medical student – who scanned the literature and federal grant databases for academic research that has taken place in the state following the legalization of cannabis, with a particular focus on the past five years.

With respect to ideas about how research can better inform the cannabis industry, WSAS focused on how expanding and diversifying the cannabis research community could create opportunities to better inform and work with the cannabis industry.

WSAS took a broad approach to generating ideas about how to diversify the cannabis research community. While the focus was on how to increase BIPOC representation within the cannabis research community, options or strategies to consider in diversifying the cannabis research community could be applied not only to BIPOC populations but also to other underrepresented groups. There was also a recognition that the field would greatly benefit from further engagement and collaboration with disciplines beyond health or basic biological sciences, which are this committee's primary areas of expertise.

LANDSCAPE OF CANNABIS RESEARCH

WSAS previously explored cannabis research as part of its 11th annual symposium in 2018 on *The highs and lows of conducting research on cannabis in Washington state*³. The symposium looked at two broad topics: research into the effects of cannabis on individuals and society, and the regulatory measures that both advance and hinder research. These topics are similarly addressed and updated here, along with additional information about diversity in the STEM workforce, funding for cannabis research, and centers and programs that provide infrastructure for cannabis research. Taken together, these provide a sense of the landscape that affects and reflects current research on cannabis in Washington.

Impact of regulation on cannabis research

In the case of cannabis, regulation and research are closely intertwined. Regulation has a profound influence on what research can be undertaken and how that research can be done. At the federal level, cannabis has long been categorized under the Controlled Substances Act (CSA) as a Schedule I drug, which are highly controlled substances with high abuse potential and no accepted medical use. Research involving cannabis possession, distribution, or cultivation may be done if it is conducted under a Schedule I registration from the Drug Enforcement Agency (DEA), uses cannabis obtained from the National Institute on Drug Abuse, and complies with all applicable federal and state rules. Despite the recreational use and sale of cannabis being legal in Washington state since 2012, these federal regulations make it difficult to conduct research on cannabis, limiting understanding of its effects. As an additional barrier compared to other research areas, this may discourage emerging researchers, particularly those who identify as BIPOC, from pursuing this area of research.

Fortunately, the regulatory environment appears to be changing. In May 2024, the DEA proposed a rule that would shift cannabis from Schedule I to Schedule III, which is defined as having moderate abuse potential and a

currently accepted medical use. While rescheduling would reduce barriers to conducting research on cannabis, cannabis would remain illegal under federal law⁴. Therefore, strong institutional support and research funding will continue to be critical to overcoming regulatory barriers to conducting cannabis research, especially with respect to attracting BIPOC researchers to this area of research given the many other challenges they already face in STEM.

Diversity of STEM workforce in Washington state

A lack of diversity in the workforce can impact innovation, productivity and entrepreneurship⁵⁻⁷. With respect to cannabis research specifically, a lack of diversity can impede progress towards understanding the effects of cannabis use on individuals, communities and society and the creation of programs, policies or treatments that address the unique needs of underrepresented minorities.

To our knowledge, there has never been an analysis done to describe the demographics of the cannabis research community across the country or within Washington state. Demographics in STEM more broadly can provide some useful context for likely patterns in cannabis research specifically.

In the U.S. overall, the diversity of the STEM workforce has increased, but BIPOC populations remain underrepresented compared to their proportions in the U.S. population. According to the National Science Foundation's 2023 report on Diversity and STEM¹:

- Collectively, Hispanics, Blacks, and American Indians or Alaska Natives made up 31% of the total population and 24% of STEM workers in 2021. This was an increase from 18% in 2011, with the proportion of Hispanics increasing the most, from 11% in 2011 to 15% in 2021. In 2021, Black workers made up 9% of the total STEM workforce and American Indians and Alaska Natives together made up less than 1% of the U.S. population and STEM workforce.
- Compared with their proportions of the college-age population, Hispanics, Blacks, and American Indians or Alaska Natives account for a disproportionately low share of science and engineering (S&E) degree recipients at the bachelor's level and above. This gap becomes increasingly pronounced at higher degree levels. Hispanic, Black, and American Indian or Alaska Native persons collectively account for 37% of the U.S. population ages 18–34 years in 2021 and 26% of S&E bachelor's, 24% of S&E master's, and 16% of S&E doctoral degrees earned by U.S. citizens and permanent residents in 2020.
- Racial and ethnic disparities in S&E graduate enrollment parallel disparities among S&E degree recipients. In 2021, Hispanic, Black, and American Indian or Alaska Native persons made up 37% of the college-age population but 25% of S&E master's students and 19% of S&E doctoral students.

It is important to note that the demographic data and trends above on enrollment and degree attainment reflect individuals who stay in the system. There is far less data available about individuals who leave STEM and higher education. It is also worth noting that while there have been increases in the representation of underrepresented minorities, there continue to be specific areas in STEM where significant disparities persist.

In Washington state, non-white racial groups, including Asian, represent 22.7% of Washington's population in 2024⁸. Black Washingtonians made up 4.3% of the total population in the state and American Indian Alaska Native Washingtonians made up for 1.8%. WSAS did not have access to the raw data to further break down populations by race and age as was done in NSF's report referred to above.

Within Washington state, demographic data from the two primary research universities with cannabis research programs provide some proxy information about diversity in the pipeline for potential cannabis researchers, with the limitation that there may be other institutions in the state conducting cannabis research that work with more diverse student populations. While we acknowledge all of the institutions of higher education in the state, we focus on demographics of these two research-intensive universities as examples of the future research workforce.

According to publicly available data from WSU, 38% of undergraduates and 24% of graduate students enrolled for fall of 2024 self-identify as students of color which includes persons who identify as Asian, Black, American Indian or Alaska Native, Hispanic, Native Hawaiian or Pacific Islander and two or more races⁹. In 2024, 32% of bachelor’s degrees, 27% master’s degrees, and 12% doctoral degrees were awarded to students of color at WSU. With respect to STEM degrees specifically, BIPOC individuals received 20% of STEM bachelor’s degrees, 6% of STEM master’s degrees and 7% of STEM doctoral degrees.

According to publicly available data from UW for fall 2024, underrepresented minorities – which include African Americans, American Indians/Alaska Natives, Hawaiian/Pacific Islanders, and Latinos/Hispanics – account for 15% of STEM undergraduate students and 12% of STEM graduate students¹⁰. Publicly available data about degrees awarded could not be broken down by underrepresented status or race/ethnicity.

Funding for cannabis research in Washington state

Cannabis was legalized in Washington state for medical use in 1998. In 2012, Washington state became the first U.S. state to legalize the recreational use and sale of cannabis via Initiative 502 (I-502). I-502 created a dedicated fund that was originally intended to be used for public health, prevention, treatment and research. Between 2015 - 2023, state and local agencies spent roughly \$3.3 billion from the fund, of which 0.3% or \$8,600,000 was appropriated for research at the Department of Social & Health Services; Health Care Authority, UW, and WSU¹¹. In fiscal year 2024, the two largest research institutions in the state, UW and WSU, received \$346,399 and \$189,000 respectively from the fund for cannabis research activities¹².

With respect to federal funding for cannabis research in Washington state, between 2012 and 2024 UW received the vast majority of federally funded “cannabis or cannabinoid” projects totaling over \$41 million¹³. For this same time period, WSU received about \$2.7 million in federal funds for cannabis or cannabinoid projects. Consumer Wellness Solutions, Inc., University of Puget Sound, Northwest Indian College, and VA Puget Sound Healthcare System also had some federally funded cannabis or cannabinoid projects (Fig. 1). Compared to other states, Washington received the 10th most funding from the NIH for “cannabis or cannabinoid” projects between 2012 and 2024. Over that same time period, California received the largest amount of funds from NIH by far, followed by New York and Massachusetts.

Breakdown of federally funded cannabis projects in Washington state

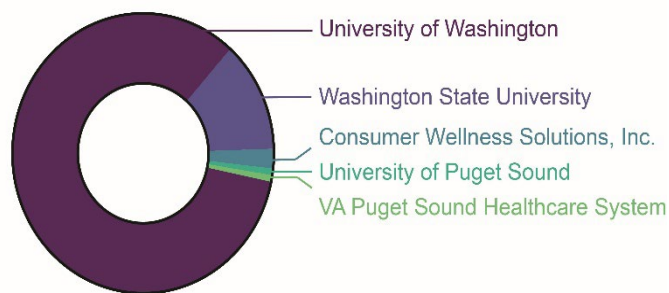


Figure 1. NIH RePORTER project results by organization for “cannabis or cannabinoid” in Washington state from 2012-2024.

Growth of the cannabis research community in Washington state

Post-legalization, the cannabis research community in the state has grown significantly. For example, a PubMed search for “cannabis or cannabinoid” with an affiliation from either UW or WSU, the top two organizations that receive funding for cannabis research in the state, reveals that after 2012, the number of publications increased nearly 7-fold (Fig. 2a-b) and is on trajectory to continue upward.

Major areas of research

Cannabis research in Washington state spans a wide spectrum, from foundational studies on the molecular structure and function of cannabinoids and their receptors, to applied research on the demographics of cannabis use patterns and the effects of marketing strategies. Over the past five years, this research has grown to include: impact of high-potency cannabis products, agricultural techniques influencing potency and yield, and health implications of both recreational and medicinal cannabis use. Additionally, studies have explored the societal and political impacts of cannabis legalization, such as shifting social norms, racial disparities in law enforcement, and the economic effects of the legal cannabis market.

The description below of cannabis research in Washington state is largely based on a review of published literature.* Some effort was made to capture current ongoing research, either by searching through funder databases or via knowledge of committee members and their institutions. However, there is currently no comprehensive source that captures all ongoing research being conducted in this area. Examples of research studies are highlighted to help provide an overall sense of cannabis research in the state.

Basic Research

Cannabis contains two main psychoactive phytocannabinoid compounds: cannabidiol (CBD) and delta⁹-tetrahydrocannabinol (THC). The human body contains an endogenous cannabinoid system, the endocannabinoid (eCB) system, on which these compounds can act. Namely, G protein-coupled receptors (GPCRs) called cannabinoid receptor 1 (CB₁R) and cannabinoid receptor 2 (CB₂R) as well as other GPCRs and ion channels have been identified in the field. The human body produces endocannabinoids, including anandamide (AEA) and 2-arachidonoyl glycerol (2-AG), that also act within this system. All of the molecular,

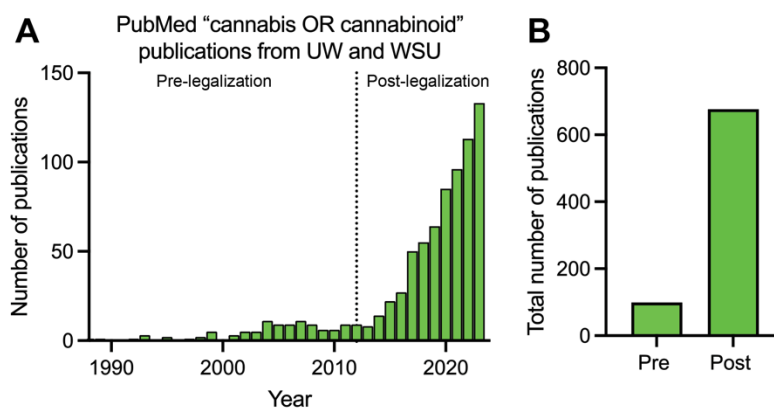


Figure 2. PubMed results for “cannabis or cannabinoid” publications from UW and WSU. **(A)** Number of publications shown prior to 2012 and 2012-2023. **(B)** The total number of publications pre and post 2012.

* PubMed, Google Scholar, and PubAg search engines were used to identify cannabis related research that was either conducted in Washington state or focuses on Washington state and published in peer reviewed journals after 2012, the year cannabis was legalized in the state. Websites of Washington-based research centers, including the Center for Cannabis Research (CCR)¹⁴ at the University of Washington (UW), and the Center for Cannabis Policy, Research, and Outreach (CCPRO)¹⁵ at Washington State University (WSU), also served as resources for identifying cannabis researchers within the state. Information about ongoing projects was provided by committee members and staff at CCPRO and WSU’s Alcohol and Drug Abuse Research Program.

cellular and physiological components within this system are important to understanding how cannabis affects physiology.

Since the legalization of cannabis in Washington state in 2012, preclinical work studying its mechanisms in rodent and cellular models has greatly increased. Until about five years ago, 33 studies were published^{16–47}. Newer work since then has encompassed:

- 1) Cannabinoid metabolism and pharmacokinetics using therapeutically relevant routes of administration^{48–56}
- 2) Therapeutic effects of cannabinoids and related compounds^{57,58} for pain^{59–67} and seizure disorders^{68–70}
- 3) Impact of cannabis exposure on brain development in utero and during adolescence^{52,53,71–76}
- 4) Fundamental biological function of cannabinoid receptors^{72,77–81} and endocannabinoid signaling^{59,70,77,82–86},
- 5) Neurocircuitry regulated by cannabinoid receptors and endocannabinoids^{59,78,87,87–90}
- 6) Development of innovative tools and/or methods^{49,91–95}.

In the last five years, nearly all the preclinical research concerning cannabis in WA was published from laboratories at UW and WSU. Some, but not the majority, of these studies were led by principal investigators located at universities outside of Washington in collaboration with scientists from WSU and/or UW.

A number of reviews on cannabis-related work that range from tool development to ideas regarding using cannabinoids therapeutically have been written by groups in Washington state^{93,93,96–101}. The body of cannabis-related work conducted at UW and WSU on related research topics highlights the strong potential for increased diversity within these institutions and increased collaboration across these institutions to further our understanding of cannabis effects.

Health Research

Since 2012, areas of health-related research have included acute and withdrawal effects of cannabis, the impact of neurocognitive processing, therapeutic and pain relief, pregnancy and postpartum use, and effects on mental health.

The acute effects of cannabis, particularly in the context of high-potency products, have been a focus of research in Washington state. Studies have documented the immediate effects of cannabis use, such as euphoria, a sense of calmness, improved sleep, and increased appetite^{102,103}. The issue of cannabis dependence and withdrawal has garnered attention given the increasing potency of available cannabis products. Other studies highlight that regular users of high-potency cannabis are more likely to experience withdrawal symptoms, including irritability, sleep disturbances, and anxiety, making cessation difficult^{102,104,105}. Though these symptoms vary depending on the frequency of use, method of cannabis administration, age of the user, and other individual factors^{104,106}. These findings point to the growing concern of cannabis dependence. Researchers are studying cannabis use disorder in healthcare settings^{107–109} and investigating potential interventions^{110,111}.

In recent years, research conducted in Washington state has provided critical insights into the neurocognitive effects of cannabis use, particularly in relation to its increasing potency. Studies have explored the effects of chronic cannabis use on cognitive functioning and found notable impairments in memory, executive function, and cerebellar functional connectivity with these deficits being more pronounced in users of high-potency cannabis^{112–115}. Research in Washington has also underscored the need to monitor and address these cognitive

deficits, particularly among adolescents, who are at greater risk of long-term cognitive impairment due to early exposure^{103,116}. Moreover, the acute cognitive effects of cannabis, including impaired concentration and slower cognitive processing speeds, have been recognized as significant concerns. Such psychomotor impairments have been documented by patients using the Driving Under the Influence of Drugs (DRUID) mobile application, and highlighted in recent research^{104,117}. These impairments have been found to affect daily functioning and increase the risk of accidents, particularly in high-stakes environments like driving or operating machinery.

State-based studies have documented that many patients report significant relief from chronic pain conditions, attributing their cannabis use to its efficacy in managing these symptoms^{102,118,119}. Therapeutic use of cannabis has received more attention, especially as more patients seek alternatives to traditional pain management methods. There have also been studies examining the role of cannabis use in psychiatric conditions such as psychosis and substance and alcohol use disorder¹²⁰⁻¹²³. However, the mental health implications of cannabis use remain a complex issue. While some patients in Washington report using cannabis in the form of CBD to alleviate symptoms of stress, anxiety, and depression^{117,124-126}, longitudinal studies conducted in the state suggest that prolonged use may worsen these mental health conditions over time^{125,127}. The potential for cannabis to both provide short-term relief and contribute to long-term mental health challenges highlights the dual-edged nature of its use.

Cannabis use during the pregnancy and postpartum period, particularly among breastfeeding individuals, has emerged as a significant area of research in Washington, driven by concerns over its potential effects on maternal and infant health. A recent study found detectable levels of THC in the breast milk of women who used cannabis¹²⁸. This finding raises concerns about the possible impact of THC in breast milk on infant development. The study also noted that higher levels of cannabis use correlated with increased THC concentrations in milk, emphasizing the need for a clearer understanding of how maternal cannabis use might affect infants during lactation. Researchers in Washington have also analyzed qualitative data regarding the perceptions of risks and benefits of cannabis use during pregnancy and postpartum among patients, healthcare providers, and cannabis retailers^{129,130}. A related study explored the decision-making processes among breastfeeding mothers who use cannabis¹³¹. Despite awareness of potential risks, many mothers continued cannabis use, often justifying it with perceived benefits like stress relief and pain management^{128-130,132}. This study highlights the complexity of risk perception and decision-making in this population, pointing to a gap in education and support for breastfeeding individuals regarding cannabis use.

Cannabis-tobacco as well as cannabis-alcohol co-use has grown in recent years and researchers are interested in understanding the behavioral affects these substances can have when combined. Recent studies have investigated how cannabis may impact people's ability to quit either tobacco or cannabis¹³³⁻¹³⁶ itself while others have looked at the intersection of cannabis and alcohol¹³⁷⁻¹³⁹ or relationship between tobacco and cannabis use over time¹⁴⁰.

Agriculture and the Environment

Recent agricultural cannabis research in Washington state explores cultivation practices and the health of industry workers. One area of research concerns ultraviolet (UV) light exposure in indoor cannabis-growing facilities, which may pose significant health risks to workers. Studies have measured UV levels and recommended protective measures to mitigate these risks¹⁴¹. In addition, researchers have developed non-ionizing radiation models to predict ambient irradiance levels in workspaces, contributing to safer working conditions in indoor cannabis farms¹⁴².

On the agricultural front, emerging diseases such as Beet Curly Top Virus, Citrus Yellow Vein-Associated Virus, and Hop Latent Viroid have been identified in industrial hemp (*Cannabis sativa*), raising concerns about cannabis plant health¹⁴³. Worker health risks are further highlighted by reports of respiratory diseases¹⁴⁴ and occupational safety issues¹⁴⁵, along with studies that link allergic and respiratory symptoms to the indoor growing environment¹⁴⁶. Research into the sociopolitical externalities of the industry revealed how regulatory hurdles and workplace conditions impact worker health and safety¹⁴⁷. Collectively, these studies highlight the importance of addressing environmental factors in cannabis cultivation and stress the need for improved safety regulations and disease management to protect both workers and crops in Washington's cannabis industry.

Social Science and Policy

Following the legalization of recreational cannabis in Washington, researchers have explored how legalization has impacted cannabis use and other social factors^{140,148–178}. Within the last five years, the landscape of cannabis research in social science has surged, including the study of adolescent cannabis consumption^{179–183}, unintentional pediatric exposure¹⁸⁴, and the intergenerational effects of cannabis use¹⁸⁵. Other studies examined parental concerns about adolescent exposure to cannabis^{150,186}, particularly in social settings where use might be normalized, highlighting shifts in both perception and behavior¹⁵⁰. For example, youth perceptions of cannabis are often shaped by social media. Exposure to pro- and anti-cannabis messages on social media influences intentions to use cannabis among adolescents and college students^{187–189}, highlighting the importance of effective digital public health interventions to counteract pro-cannabis marketing and messaging. These studies also underscore the need for age-appropriate prevention programs to mitigate the risks associated with early cannabis use and target public health campaigns to address cannabis use in vulnerable groups^{148–150}. A recent grant from the National Institutes of Health (NIH) is supporting work to address cannabis misuse among young adults, with a particular focus on the consumption of cannabis edibles¹⁹⁰.

Another important area of inquiry is around the impact of cannabis exposure and accessibility within marginalized communities. A spatial analysis found that cannabis outlets were more prevalent in socioeconomically-disadvantaged neighborhoods¹⁹¹. This study suggested that cannabis legalization may exacerbate existing inequalities, as marginalized communities may be more exposed to the negative effects of increased cannabis access^{191,192}. Researchers have also explored the link between cannabis legalization and crime and the effects of cannabis legalization on policing^{193–200}. Furthermore, racial disparities in cannabis-related arrests have persisted despite legalization¹⁹⁴. Although overall arrests have decreased, Black and Hispanic individuals continued to be disproportionately affected by cannabis-related law enforcement¹⁹⁴. This persistent inequality highlights the complex relationship between cannabis policy and social justice, indicating that legalization alone may not be sufficient to address longstanding racial disparities in the criminal justice system.

The growing availability of high-potency cannabis products has also raised concerns about the public health risks associated with these products, particularly due to their high THC content. Studies have investigated the cannabis industry's resistance to regulations on high-potency products, finding that industry rhetoric often downplayed the health risks of these products while framing regulatory efforts as unnecessary^{201–203}. Analysis of cannabis marketing violations in Washington state from 2014 to 2019 found that cannabis businesses frequently violated regulations designed to protect vulnerable populations, such as minors, from exposure to marketing²⁰⁴. As a result, additional studies have explored policy options, including imposing potency limits, increasing public education efforts to mitigate health risks²⁰², and vendor programs aimed at ensuring compliance with state regulations^{154,205,206}. An analysis of the United States national poison center data showed

that as access to legal cannabis increased, so did the prevalence of synthetic cannabinoid-related health emergencies²⁰⁷. These findings suggest that despite the availability of legal cannabis, people may seek synthetic alternatives, often with harmful consequences.

The body of research on cannabis legalization in Washington reflects a growing understanding of the complex social, public health, and economic implications of legal cannabis. Moving forward, continued research is needed to inform policies that promote public health, ensure the equitable implementation of cannabis laws across diverse communities and rapidly foster the commercialization of innovative and safe cannabis-based products in Washington.

Cannabis research infrastructure in Washington state

The two largest research universities in the state both have research centers/institutes/programs dedicated to the study of cannabis.

The Addictions, Drug & Alcohol Institute (ADAI)²⁰⁸, a multidisciplinary research center in the UW's Department of Psychiatry and Behavioral Sciences, has been the recipient of the Washington State Dedicated Cannabis Fund for Research at the UW (Dedicated Cannabis Fund) since 2015. These funds have been used to promote cannabis research and education by providing support for UW researchers across multiple disciplines, including Neuroscience, Psychology, Sociology, Pharmacology, Radiology, and Social Work, to conduct pilot studies focused on the short and long-term effects of cannabis through the ADAI Small Grants Program. These funds have also been used to establish and sustain ADAI's Cannabis Education and Research Program (CERP)²⁰⁹. CERP conducts public health-oriented research projects that inform policies, practices and regulations related to cannabis, disseminates cannabis-related science-based information, and fosters collaborative cannabis-related research opportunities with researchers at UW, state and county agencies, and the legislature. CERP research and dissemination efforts focus on cannabis health and social risks, including cannabis use disorder and potential treatments or interventions, risks of high potency cannabis, cannabis hyperemesis syndrome, and the relationship between cannabis and psychosis. Reports detailing recent or ongoing CERP research projects can be found on their website.

ADAI has funded UW researchers to conduct a variety of cannabinoid-focused pilot projects to validate methods for vaporized cannabinoid access, map eCB neurocircuitry involved in pain, reward, and aversion, and identify functional interactions between the opioid and cannabinoid systems.

The UW Center for Cannabis Research¹⁴ was created in 2017 to help coordinate cannabis research across disciplines. Researchers affiliated with the center come from the School of Medicine, School of Social Work, School of Public Health, School of Law, College of the Environment, College of Arts and Sciences and School of Pharmacy.

The Alcohol and Drug Abuse Research Program (ADARP)²¹⁰ is a multidisciplinary research center at WSU that promotes scientific research on substance abuse within Washington state. ADARP managed the biennial Washington State Dedicated Cannabis Fund for Research (DCFR) grant competition at WSU between 2015 and 2018 in addition to biannual substance use (including cannabis) research grant competitions funded by State of Washington Proposition I-171 since 2014. With the establishment of Center for Cannabis Policy, Research, and Outreach (CCPRO)¹⁵, WSU's allocation of DCFR has been reallocated to CCPRO. CCPRO consists of more than 70 affiliated faculty whose research ranges from the impact of cannabis on health, agricultural research on industrial hemp, public policy and safety and research on economic issues relevant to the cannabis industry. CCPRO also provides guidance on the status and limitations of conducting cannabis research at WSU.

ADARP I-171 funds have supported a variety of pilot projects across the major research areas described above. Some basic science examples include projects examining the effects of genetic factors, biological sex, and stress on vaporized cannabis use in rodent models; the effects of chronic pain on THC tolerance; the neural circuits underlying cannabis-seeking behaviors; mechanisms of cannabis-induced hyperphagia; the effects of prenatal, adolescent, and adult cannabis exposure on brain development, brain physiology, cognitive function, maternal behavior, anxiety-like behaviors; and transgenerational effects of cannabis on reproductive function and germ cell health. Pilot projects in humans investigated the effects of cannabis on resting brain activity, pain sensitivity, stress reactivity, and emotional pain perception.

DCFR funds have also supported both basic science and clinical research projects. Some of these projects established cannabinoid tissue analytical methods; developed a murine model of vaporized cannabis exposure; studied cannabis-induced anti-nociception and hyperphagia, cannabis-drug interactions and predictors of co-use; the effects of chronic vaporized cannabis regimens on brain and cognitive development in neurotypical populations and individuals with attention-deficit hyperactivity disorder; the impacts of dietary CBD on gut inflammation; and the behavioral and biological predictors of problematic cannabis use. In human subjects, pilot studies examined sex differences in the perceived medical efficacy of cannabis, the impact of cannabis on stress-induced cognitive inflexibility, maternal and child health, cannabinoid levels in breast-feeding infants, cannabis potency and use during daily life, the perceived risks and benefits of cannabis in Native Americans and in pregnant or postpartum women.

Additional ADARP I-171 and DCFR pilot research has been conducted in anthropology, health communication, human development, and nursing. Some of these studies have characterized historical trends in cannabis use based on drug residue in dental calculus in ancient and modern humans; the effects of cannabis legalization; developed cannabis-induced driving risk prevention and intervention approaches; studied the effects of health communication on youth beliefs and on health care provider beliefs about cannabis-induced risk and on cannabis use; and surveyed health care providers about medical cannabis.

In addition to the academic programs described above are research centers outside of academia whose work includes cannabis research, although is not necessarily dedicated entirely to the study of cannabis. For example, the Washington State Liquor and Cannabis Board recently established a new in-house research program focused on the public health and safety outcomes related to the products, policy, and regulation of alcohol, cannabis, tobacco, and vapor²¹¹. Staff conduct research briefs, surveys, and statistical analysis among other research-related activities. They often work in collaboration with other state agencies and academic partners. Researchers at the Kaiser Permanente Washington Health Research Institute – a non-proprietary public-interest research center within Kaiser Permanente Washington – have studied the impact of cannabis on health care¹⁰⁸, screening tools²¹², and the prevalence of cannabis use^{109,172}.

OPTIONS FOR DIVERSIFYING THE CANNABIS RESEARCH COMMUNITY IN WASHINGTON STATE

While there is a solid body of research related to cannabis being carried out in the state, more researchers with diverse backgrounds would bring new perspectives and expertise to bear on research that can inform state cannabis policies and programs and the cannabis industry. Although there are some unique factors and/or barriers at play with respect to conducting cannabis research, many common barriers persist across STEM fields that make it difficult for BIPOC individuals to join and thrive in the STEM workforce. A recent National Academies report describes and provides context for some of these barriers with recommendations for how

individuals and organizations may work to address them²¹³. To expand the breadth of the cannabis research community, actions are needed to remove barriers for entry and participation while also implementing practices that foster belonging through an inclusive culture where BIPOC individuals can be successful. The following are options that could be considered by the Department of Commerce as well as other agencies, institutions, and funders in the state.

Characterize the diversity of the cannabis research community in the state

Although it is known that BIPOC individuals are generally underrepresented in STEM fields¹, there is not readily available information specifically about the cannabis research community, and a robust analysis of the diversity, or lack thereof, within the cannabis research community in Washington state was beyond the scope of this report.

Understanding the diversity of the cannabis community would require the collection of additional data to shed light on both the current demographics and the factors that affect entry into and participation in this area of research:

- How many BIPOC individuals in Washington State are conducting research on cannabis?
- What institutions or organizations currently have BIPOC researchers who are conducting cannabis research?
- What aspects of cannabis are studied by BIPOC researchers?
- What disciplines are engaged in cannabis research?
- How many students (undergraduate and graduate) and postdocs are being trained to conduct cannabis research?
- What BIPOC researchers in the state may be interested in studying cannabis and its effects as part of their research portfolio? What would need to be in place for them to do so?
- What would draw BIPOC graduate students and postdocs in the state to pursue the study of cannabis and its effects as part of their research career?
- How have cannabis regulations impacted the diversity of the cannabis research community?
- How have cannabis researchers been impacted by either legal or illegal cannabis use?

The number of cannabis researchers in Washington from underrepresented backgrounds is currently small and would therefore be well suited to conduct not only survey data collection with robust qualitative inquiry but also interviews or focus groups that would provide insight as well as opportunities to shape future actions

Improve tracking of cannabis research conducted in the state

The description of cannabis research in Washington state included above was generated largely via searches of published literature, federal NIH grant databases, and input from committee members. It was especially challenging to capture ongoing research happening in the state that was not funded by federal sources or published in peer reviewed journals. These projects and/or reports are important to capture. A publicly available, centralized database that documents state grants toward research, including cannabis research, would make research funded by the state more apparent and accessible. Such a database may also help to elevate and make more visible the work of BIPOC researchers.

Understand research needs and interests related to the cannabis industry

Additional outreach via surveys or interviews would elicit the cannabis industry's information gaps and research needs. This could also be an opportunity to probe how the cannabis industry uses science or incorporates research into product development or training while protecting the safety and health of consumers and non-consumers.

Convene cannabis researchers to discuss both research and growing the pipeline of researchers

Bringing together cannabis researchers, policymakers, and industry representatives from across the state through a dedicated event would help clarify the current cannabis research landscape in the state. A convening of this sort would provide interested parties with an opportunity to discuss the state's cannabis research agenda and explore:

- What research questions are policymakers or representatives from the cannabis industry interested in?
- What disciplines that aren't currently engaged could contribute more to the cannabis research agenda?
- What organizations or institutions that aren't currently engaged could participate more in the cannabis research community?
- What research questions require engaging with communities that have been disproportionately impacted by cannabis criminalization?
- What research questions would help the state to better understand the cannabis industry?
- What opportunities are there to seed new collaborations between universities, service providers, nonprofits, community colleges, other disciplines to advance the cannabis research agenda and diversify the cannabis research community?

Academic researchers at UW and WSU previously held joint symposia on cannabis, the last one of which took place in 2018. Convening the broader cannabis community, including researchers from other institutions, policymakers and industry leaders, would strengthen and potentially help shape cannabis research in the state. It would also provide an opportunity to showcase ongoing cannabis research, especially research that is being done by BIPOC researchers or that engages communities who have been disproportionately impacted by cannabis criminalization. Funds could also be made available to support travel for BIPOC researchers in cannabis to present their work and network.

Support educational and career pathways for cannabis researchers in the state

Over the last 20 years the National Academies has issued a number of reports looking at how to make STEM more equitable, diverse and inclusive. A recurring theme in those reports is the need to support and increase pathway programs that focus on underrepresented individuals. Funding research experiences from high school to the faculty level would support research careers and enhance participation for individuals from diverse backgrounds, including BIPOC individuals. These funds would allow recipients to conduct research, receive additional training or expand their network.

Summer research experiences

Summer research experiences focused on cannabis research could help attract young students from diverse backgrounds to careers in science and stimulate their interest in cannabis research. These programs are critical for providing underrepresented high school or college students with authentic research experiences and providing opportunities for college students to gain valuable experience in preparation for graduate school. A 2019 National Academies report on minority institutions identified undergraduate research experiences as an effective way of supporting the success of underrepresented minorities in STEM education²¹⁴. Moreover, exposure to undergraduate research experiences is a predictor of successful outcomes for students of color in STEM, including the pursuit of postgraduate STEM education and careers²¹⁵. There may also be an opportunity here to collaborate with and draw from minority serving institutions across the country to engage young students in cannabis research.

Stipends for graduate students

Providing funds for graduate student stipends for underrepresented students would also support the diversification of the cannabis research community. Recipients of these funds could be required to have a

mentor from outside of their home institution to further increase and strengthen the connectivity of the cannabis research community. DOC could similarly consider supporting diverse early career faculty in pursuing cannabis research, reducing barriers to establishing a career in cannabis research.

Mentorship

Mentorship is a key component of effectively supporting the sustainable diversification of the cannabis research pipeline. A 2011 National Academy of Sciences Report on Expanding Underrepresented Minority Participation²¹⁶ stated, “even if trainees are prepared, have adequate information, and are ambitious and talented enough to succeed in STEM fields, success may also hinge on the extent to which students feel socially and intellectually integrated.” Programs designed to increase diversity in the cannabis research pipeline should look for ways to connect BIPOC individuals to ingroup peers, institutional resources and professional networks.

Given that there are a limited number of diverse faculty to serve as mentors in the cannabis research community, funds could be made available to enable students/trainees/faculty to find mentors within national-level affinity societies (e.g., Society for the Advancement of Chicanos and Native Americans in STEM, National Society for Black Engineers, American Indian Science and Engineering Society, etc.). These groups provide refuge, support, mentorship, professional development and ingroup role models for emerging scholars. In addition, any program created to diversify the research workforce should also consider helping to facilitate working relationships between minoritized individuals and well-established faculty. Collaborations between these groups can help to elevate underrepresented researchers, increasing the visibility of their work.

Implementation Considerations

In establishing these programs, there are several important considerations to keep in mind:

- How will data be collected and tracked so that the career progression and outcomes of awardees can be followed and the impact of the award on diversifying the workforce can be evaluated? Would be worthwhile to compare outcomes of awardees with those who applied for but did not receive the award.
- How will the diversity of the cannabis research community in Washington state be assessed?
- How can the programs be designed to create meaningful networks and supportive communities that will help to attract more BIPOC individuals to the field?

Incentivize research collaborations

Funding research collaborations is another approach to diversifying the cannabis research community. This might include collaborations that bring in disciplines with relevant expertise that could be newly applied to questions related to cannabis or collaborations to increase the participation of more with institutions, especially minority serving institutions in the state such as Northwest Indian College. Institutions that foster a diverse student body offer broad access to higher education for students who might otherwise have limited postsecondary opportunities. There are some promising examples of such collaborative research around cannabis happening already in the state including a federally funded project to look at the association between cannabis and pain outcomes in a tribally operated clinic²¹⁷.

CONCLUSION

Cannabis researchers can inform the many public and private decisions being made about cannabis. It follows that a larger and more diverse pool of researchers will bring a wider array of perspectives and ideas to inform research that is conducted. A more robust community of researchers will further advance the exploration needed to answer important questions such as under what conditions is cannabis harmful or beneficial, how do individual reactions to cannabis vary, what factors contribute to cannabis addiction, what are the most effective

treatments for cannabis use disorder, how do different cannabis policies impact public health, crime rates and economic outcomes, what are the safety and efficacy of various cannabis products, among many others. A diverse research workforce holds to potential to have a significant positive impact on the focus of the research questions and how the studies to investigate those research questions are carried out.

PROJECT TEAM

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All committee members serve as individuals with recognized expertise, and not as representatives of their employer, affiliated organizations, or interest groups. Committee members also receive funding to conduct cannabis research from Washington state.

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