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## A Pilot Study of Respiratory and Dermal Symptoms in California Cannabis Cultivation Workers

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### ABSTRACT

Cannabis (*Cannabis sativa*, marijuana) is the largest cash crop in California. While it is difficult to characterize the size of the industry, the total production is estimated at 15 to 16 million pounds per year, with total revenues exceeding \$10 billion per year. Despite the huge size and rapid growth of the industry, there has been little research on the health and safety of cannabis workers. The goal of this pilot study was to explore the feasibility of collecting cannabis worker health data with a self-administered survey and to analyze the first systematically collected data on occupational health symptoms among California cannabis cultivation workers. We performed a cross-sectional survey of demographic and job characteristics as well as eye, nasal, respiratory, and dermal symptoms among 29 workers at two cannabis farms in the Sacramento area, California. Most participants were men aged less than 30 years, with 48% of participants self-identifying as non-Hispanic white and 58% reporting at least some college education. The most frequently reported work-related symptom was nasal irritation, and 38% of the participants reported symptoms suggestive of asthma. The participants had a demographic makeup distinct from traditional California agricultural workers, and a very high prevalence of current use of cannabis (93%). The high proportion of respondents with symptoms suggestive of asthma raises concern; sensitization to the cannabis plant has been reported among cannabis workers and users and there are many well-documented agricultural exposures causing asthma and asthma-like syndrome.

### KEYWORDS

Cannabis; respiratory health; epidemiology; emerging issues

### Introduction

Cannabis (*Cannabis sativa*, marijuana) is the largest cash crop in California, and following legalization of adult recreational use in 2016, legally grown cannabis became the fifth most valuable agricultural product in California with \$1.66 billion worth of production in 2020.<sup>1</sup> While it is difficult to characterize the total production of the industry due to a lack of systematically collected data, combined licensed and illicit production is estimated at 15 to 16 million pounds per year and total annual revenues are estimated to exceed \$10 billion per year.<sup>2</sup> Estimates of the number of cannabis workers are unavailable; even employees of licensed and regulated cannabis businesses are not enumerated by state or federal agencies. An econometric model developed by cannabis industry experts estimated 321,000 full-time equivalent (FTE) jobs in

the US legal cannabis industry in 2021, with California having the largest number of workers at 57,970 FTE.<sup>3</sup> Given that approximately 90% of the cannabis grown in California is sold outside of regulated markets,<sup>2</sup> the true number of cannabis workers is certain to be much larger.

Despite the huge size of the industry as a whole and growth within the legal industry, there has been very little research on the health and safety of cannabis workers. Although legal commercial cultivation in California is expanding rapidly, cannabis remains illegal at the federal level and the industry is regulated by an often-confusing patchwork of laws within the state. These gray areas, as well as the stigma resulting from the legacy of criminalization, have made it difficult to identify representative populations of workers to perform rigorous research on health and safety risks.

Assessments of cultivation facilities have revealed many potential hazards including ergonomic stressors, injuries, exposure to chemicals and UV light, use of machinery, psychosocial stress, and workplace violence.<sup>4,5</sup> Numerous respiratory and dermal exposures have been identified including organic dust, raw cannabis plant material such as delta-9-tetrahydrocannabinol acid and other cannabinoids, microbes, endotoxins, and volatile organic compounds.<sup>6–8</sup>

In California, the majority of cannabis growing (58%) occurs on outdoor farms with 9% grown indoors and the balance in greenhouses.<sup>2</sup> Respiratory exposures differ between the different grow types,<sup>4</sup> and the work environment can differ greatly in terms of general setup, presence of engineering controls for exposures, and the types of work that are performed on-site. Post-harvest cannabis processing steps including trimming (cutting small leaves and stems away from flowers to prepare them for further processing or sale) often occur at the cultivation site. Cultivators care for plants and are more likely to be full-time, year-round, or longer-term workers, whereas trimmers typically work temporarily during the harvest season.<sup>6</sup> While job tasks and worker characteristics vary between cultivators and trimmers, there are many exposures in common such as mold and other respiratory and dermal hazards, ergonomic factors, injuries, and chemical exposures.<sup>5</sup>

We performed this pilot study to explore the feasibility of collecting cannabis cultivation worker health data via a self-administered survey and to analyze the first systematically collected data on occupational respiratory, nasal, and dermal symptoms from California cannabis cultivation workers.

## Methods

### Study design

We performed a cross-sectional survey of workers at two licensed cannabis cultivation facilities: one outdoor non-unionized grow and one indoor unionized grow in the Sacramento area, California, USA. These facilities were a convenience sample of two businesses with upper management who consented to us visiting the facilities to recruit workers and administer the questionnaire. All non-management

workers were eligible to participate. Workers in the California legal cannabis industry must be at least 21 years of age, and facility management confirmed in advance that all workers were fluent in written and spoken English. Workers provided verbal informed consent and could decline to participate or skip any questions. We provided a small incentive (\$30 gift card) to acknowledge the participants' time and effort. The University of California, Davis Institutional Review Board approved the study protocol and materials and deemed it exempt from review.

### Questionnaire

The questionnaire was modified with permission from that used by Sack et al.<sup>9</sup> We asked about participants' demographic characteristics, cannabis and tobacco use, job tasks, and use of personal protective equipment (PPE) on the job. We also asked a series of questions on respiratory, dermal, and eye symptoms adapted from the European Community Respiratory Health Survey (ECRHS).<sup>10</sup> The survey was self-completed in English on a paper form and took approximately 20 minutes to complete.

### Data analysis

Work-related symptoms were defined using responses to groups of related ECRHS questions regarding symptom onset while at work or lessening while away from work; response groupings are listed in [Appendix A](#). Symptoms suggestive of asthma were attacks of shortness of breath, attacks of asthma, or use of asthma medication.<sup>11</sup> More detailed categorical frequencies of cannabis use were collapsed to categories of daily or more, less than daily use, or never due to low response rates in the less frequent use categories.

## Results

Results from the two facilities combined are presented; the job tasks and demographic characteristics ([Table 1](#)) were similar between the sites. All eligible workers on-site chose to participate. Most participants were young men, and ethnicity was predominantly reported as being white (48.3%) or Hispanic/Latino (31.0%). All had completed high

**Table 1.** Participant demographics and job characteristics.

Facility (n, %)	
One (outdoor)	20 (69.0)
Two (indoor)	9 (31.0)
Male (n, %)	28 (96.6)
Age in years (median, IQR)	26 (23, 30)
Race/ethnicity (n, %)	
White, non-Hispanic/Latino	14 (48.3)
Hispanic/Latino	9 (31.0)
Black/African American	3 (10.3)
Other	3 (10.3)
Education (n, %)	
Completed high school	12 (41.4)
Some college or Associates degree	14 (48.3)
Bachelor's degree	3 (10.3)
Tobacco use (n, %)	
Current	18 (62.1)
Past	2 (6.9)
Never	9 (31.0)
Cannabis use (n, %)	
Current	27 (93.1)
Past	2 (6.9)
Never	0
Duration at current job in months (median, IQR)	9 (5, 24)
Duration in cannabis industry, months (median, IQR)	26 (9, 78)
Regular occupational physical contact with plant (n, %)	29 (100)
Job title (n, %)	
Cultivation-related	25 (86.2)
Trimmer	1 (2.4)
Other	3 (10.3)
Personal protective equipment used (n, %)	
Gloves	29 (100)
Goggles (out of 27 responses)	20 (74.1)
Disposable respirator	26 (89.7)
Cartridge respirator (out of 26 responses)	6 (23.1)

school, and more than half had some college education or a college degree. Most of the workers (62.1%) reported current use of tobacco. All workers had daily physical contact with the cannabis plant, and 86.2% reported a job title related to cultivation such as field tech, cultivation tech, or gardener. Most workers used gloves, goggles, or a disposable face mask for at least one work task.

All workers used cannabis, either currently (93.1%) or in the past (6.9%) (Table 1). Current and past use of cannabis is summarized in Table 2. Most participants (86.2%) smoked cannabis daily or multiple times per day. Among those who

reported smoking cannabis, the median duration of use was 11 years (interquartile range (IQR): 8,14), and among the 25 respondents who reported the age they began smoking cannabis, the majority (92%) began before age 21 (data not shown).

Eleven workers (37.9%) reported symptoms suggestive of asthma (Table 3); two of these workers with reported a childhood asthma diagnosis and one worker with a childhood asthma diagnosis did not report symptoms suggestive of asthma (data not shown). Work-related symptoms of any

**Table 2.** Cannabis use characteristics.

	≥Daily (n, %)	<Daily (n, %)	Never (n, %)	Duration of use <sup>a</sup> (median years, IQR)
Smoke	25 (86.2)	2 (6.9)	2 (6.9)	11 (8, 14)
Dab <sup>b</sup>	17 (58.6)	6 (20.7)	6 (20.7)	5.5 (4.8, 10)
Vape	8 (27.6)	7 (24.1)	14 (48.3)	5 (3.3, 6)
Edibles	5 (17.2)	18 (62.1)	6 (20.7)	9.5 (6.3, 11.8)
Topical	4 (13.8)	6 (20.7)	19 (65.5)	7.5 (4.5, 14.3)

<sup>a</sup>Among those who report ever using that type of cannabis

<sup>b</sup>Cannabis concentrates vaporized on a heated glass or metal surface

**Table 3.** Dermal, eye, nasal, and respiratory diagnoses and symptoms.

Asthma (n, %)	
Asthma diagnosis	5 (17.2)
Asthma-like symptoms <sup>a</sup>	11 (37.9)
Work-related symptoms (n, %)	
Dermal	3 (10.3)
Eye	7 (24.1)
Nasal	9 (31.0)
Respiratory	7 (24.1)
Any symptoms	11 (37.9)

<sup>a</sup>Attack of shortness of breath, attack of asthma, or use of asthma medication

type were reported by 11 (37.9%) participants, most commonly nasal (N = 9, 31.0%).

## Discussion

Our pilot study of California cannabis cultivation workers identified characteristics that make this population unique among California agricultural workers. Agricultural workers in California outside of the cannabis industry are mostly Hispanic/Latino (99%), more than half report not speaking any English, and 90% have less than 12 years of education,<sup>12</sup> whereas the participants in this pilot were as likely to be non-Hispanic white as Hispanic/Latino, all were English-speaking and English-literate, and most had at least some college education. In other studies of cannabis cultivation workers at licensed businesses, the majority of the participants were white and more women participated compared to this study, but demographic differences between the cannabis workers and other agricultural workers similar to those seen in these data were present.<sup>4,9,13</sup>

While other farmworkers have lower rates of cigarette smoking than a demographically similar reference population,<sup>14</sup> we found high rates of tobacco consumption, with 62% of participants reporting current tobacco use. All pilot participants consumed cannabis within the past year, which is consistent with the findings of 84–97% cannabis users in other studies of cannabis workers.<sup>9,13,15</sup> In contrast, 19.4% of California residents older than 12 years reported cannabis use within the past year during 2017–2019.<sup>16</sup> Symptoms potentially suggestive of asthma were reported in nearly 38% of the participants, with

physician-diagnosed asthma in 17.2% of the participants. Rates of asthma among farmworkers are generally lower than those in the general population, with a 3.1% lifetime prevalence of asthma reported in the National Agricultural Workers Survey 2003–2014.<sup>17</sup> In the medical and recreational cannabis industry, respiratory, dermal, nasal, and eye symptoms as well as abnormal spirometry and asthma have been reported.<sup>9,18</sup> Allergic sensitization to the *C. sativa* plant has been reported among cannabis workers<sup>9</sup> and users,<sup>19,20</sup> with outcomes such as rhinitis, eczema, asthma, and even anaphylactic reactions.

The high rate of cannabis use by workers creates difficulty in determining whether any cannabis-related symptoms are due to occupational exposure or exposure via consumption. However, it is unlikely that even heavy cannabis use would generate the intensity and duration of exposure seen among workers who have contact with cannabis plant materials for many hours at a time. In addition, elevated levels of endotoxins and diverse fungal and bacterial species have been associated with specific locations and activities in the cannabis production process.<sup>21</sup> Exposure to endotoxin-producing bacteria may result in hypersensitivity pneumonitis, chronic bronchitis, organic dust toxic syndrome, asthma-like syndrome and asthma, and exposure to fungus is linked to airway inflammation, hypersensitivity pneumonitis, asthma, and chronic rhinosinusitis.<sup>6</sup> Our survey concluded by asking if there were occupational health concerns not addressed in the questions, and the most common response was exposure to mold (41%, data not shown).

In many respects, the hazards in cannabis cultivation are analogous to those in other crops, and because exposures in the cannabis industry are so poorly characterized, many hazards are inferred from their presence in other agricultural workplaces. There are many well-documented agricultural exposures causing asthma and asthma-like syndrome including inorganic and organic dusts, plant materials, and microorganisms.<sup>22</sup> The hops plant (*Humulus lupulus*) is a close relative of *C. sativa* in the small botanical family of Cannabaceae, and occupational asthma has been reported in hops workers<sup>23</sup> with a putative responsible agent (B-myrcene) that is one of the most

common terpenes found in cannabis. Respiratory symptoms and reduced lung function are also seen in industrial hemp (strains of *C sativa* cultivated for fiber) workers.<sup>24</sup> Musculoskeletal disorders, injuries, exposure to UV light, allergic sensitization, machinery use, and pesticide and chemical exposure are among the other agricultural hazards that are present in cannabis workplaces. Pesticide exposures have been reported,<sup>13,25,26</sup> and unlike other crops, there are no pesticides approved for use in cannabis. This makes it difficult to anticipate to which pesticide workers may be exposed; however, the most common reason for failure of legally grown cannabis during lab inspection is detection of pesticide residues exceeding tolerance.<sup>27</sup>

While there is an understandable desire among cannabis growers and workers for cannabis to be seen as just another crop rather than a dangerous drug,<sup>28</sup> there are elements of the work that are unique. Cannabis itself is an allergen, and there is evidence for occupational allergy and asthma resulting from worker exposure, with variability reported by cannabis plant strains.<sup>9</sup> Psychosocial stress and violence attributed to the stigmatized nature of cannabis work and large amounts of cash at worksites due to lack of bank services for both licensed and illegal cannabis businesses are other hazards unique to the cannabis industry. The remote and geographically isolated location of many cannabis grow operations is another factor that creates cannabis industry-specific hazards; for some grow facilities, the nearest emergency medical services may be hours away, and workplace inspections and enforcement by regulatory agencies are challenging.

There are limitations to this pilot; due to the small sample size, we were unable to perform subgroup analyses, and it is possible that there were differences in symptoms reported by the outdoor and indoor workers. In addition, the participants were all full-time, year-round employees of cannabis farms. Due to the timing of the study and the cannabis growing season, our participants were mostly cultivators who also engaged occasionally in trimming tasks rather than seasonal trimmers. Temporary or seasonal workers (particularly those who work as trimmers) are more likely to be women and immigrants; this pilot does not capture that

workforce, which is likely to differ in exposures. In addition, we visited licensed businesses with management who were willing to allow workers to participate in a health survey, which may reflect more confidence in their worker satisfaction and injury and illness prevention programs. There are also likely to be differences in terms of worker demographics and health hazards between farms located in the populated areas we visited versus remote and isolated areas, as well as between licensed businesses and those that operate illegally. We did not ask participants about exposures (other than cannabis consumption) outside of the workplace such as mold present in the home. As with most cross-sectional studies of worker health, our pilot may be impacted by the healthy worker effect: individuals who became ill and left work due to health effects would not have been captured by our study design, therefore the participating workers may be those who are least sensitive to any occupational health effects of cannabis.

This pilot is the first study of cannabis workers in California, and despite its small size, it provides new information about the characteristics of the licensed cannabis cultivation workforce. We also determined that a self-administered questionnaire was a feasible method for collecting data from these workers, which reduces the need for trained study personnel and indicates that an online survey may be feasible as well. Given the difficulty of contacting and in-person recruiting workers from numerous small and geographically isolated farms, online recruitment and survey administration may capture a larger and more representative sample in future research.

## Conclusion

The results of this pilot can be used to inform both future targeted research efforts and the design of appropriate interventions for health and safety in the industry. In addition to identifying and quantifying workplace hazards and worker health effects, research is needed to better describe the cannabis workforce. This analysis, in addition to the limited existing research, shows notable demographic and cultural differences between cannabis workers and other agricultural workers, but there are insufficient data to make robust comparisons.

In addition, there is a great need to identify vulnerable subgroups such as women, undocumented persons, and immigrant workers for further outreach and research. Even the basic epidemiologic need of a denominator, the number of cannabis workers, is unmet. It is clear there are many more cannabis workers than those accounted for in estimates from the legal industry, creating the potential for a significant public health impact from adverse health outcomes. The challenges in reaching workers in the illegal side of the industry will remain, but legalization is providing an opportunity to expand research, education, and outreach to workers.

While there are some commonalities with other agricultural workplaces, the demographic differences between cannabis and other agricultural workers indicate that different approaches to research and intervention may be necessary for cannabis workers. In conversations with workers, advocates, and businesses, we have learnt that evidence-based, appropriate educational materials specific to occupational safety and health risks in the cannabis industry are lacking. Industry stakeholders and occupational health experts are developing and evaluating cannabis-specific trainings,<sup>26,29</sup> but these have limited reach and may be less likely to be available to vulnerable workers due to lack of employer support, language barriers, or fear of criminal penalties for illicit work. As well as providing a new source of data, this pilot is a building block for ongoing research to elucidate the key risks as well as the perceptions and priorities of workers that will be needed to tailor interventions and training appropriate for the cannabis industry.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

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## Appendix A: Groupings of ECRHS questions used to create summary variables.

Summary variable	ECRHS Questions (summary variable = "Yes" if any question in grouping has response = "Yes")
Symptoms suggestive of asthma	<p>(If "Have you ever had wheezing or whistling in your chest, anytime in the last 12 months?" = Yes) Have you been at all breathless when the wheezing noise was present?</p> <p>Have you woken up with a feeling of tightness in your chest at any time in the last 12 months?</p> <p>Have you been awoken by an attack of shortness of breath at any time in the last 12 months?</p> <p>Have you had an attack of shortness of breath that came on during the day when you were at rest at any time in the last 12 months?</p> <p>Have you had an attack of shortness of breath that came on following strenuous activity at any time in the last 12 months?</p> <p>Have you ever had asthma?</p> <p>Have you had an attack of asthma any time in the last 12 months?</p> <p>Are you currently taking any medications (including inhalers, aerosols or tablets) for asthma?</p>
Work-related symptoms	
Respiratory	<p>Do you experience any of the following while you are at work:</p> <p>Start to cough?</p> <p>Start to produce phlegm?</p> <p>Start to wheeze?</p> <p>Start to feel short of breath or get chest tightness?</p> <p>Start to have a sore throat, hoarseness or loss of voice?</p> <p>If response to any question describing respiratory symptoms = "Yes"</p> <p>Does contact with certain materials, chemicals or anything else in your work make your symptoms worse?</p> <p>Do these respiratory symptoms lessen or disappear when you are away from work, including evenings, weekends or during holidays?</p>
Eye	<p>When you are at work, do you develop symptoms of itchy, red, or watery eyes?</p> <p>If response to any question describing eye symptoms = "Yes"</p> <p>Does contact with certain materials, chemicals or anything else in your work make your symptoms worse?</p> <p>Do these problems related to your work lessen or disappear during the weekend or during holidays?</p>
Nasal	<p>When you are at work, do you develop symptoms of nasal irritation, sneezing, a runny or a blocked nose?</p> <p>If response to any question describing nasal symptoms = "Yes"</p> <p>Does contact with certain materials, chemicals or anything else in your work make your symptoms worse?</p> <p>Do these problems related to your work lessen or disappear during the weekend or during holidays?</p>
Dermal	<p>If response to any question describing dermal symptoms = "Yes"</p> <p>Does contact with certain materials, chemicals or anything else in your work make this rash worse?</p> <p>Does the rash improve when you are away from your normal work?</p>