

RESEARCH ARTICLE

California cannabis cultivation and processing workers: A qualitative analysis of physiological exposures and health effects

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Abstract

Introduction: Cannabis is a multi-billion-dollar California industry, but little is known about the occupational hazards or health experiences of cannabis cultivation workers. Respiratory and dermal exposures, musculoskeletal hazards, and other agricultural hazards have been identified in previous research. Even in a post-legalization framework, cannabis work is stigmatized and most cannabis is still produced illegally. Qualitative research is essential for establishing rapport with cannabis workers to understand their experiences and concerns.

Methods: We conducted semi-structured discussions with four focus groups including 32 cannabis workers total, and 9 key informants who were workers, industry experts, and business owners or managers. Transcribed results were analyzed to identify key themes on physiological exposures and health effects.

Results: The majority (81.3%) of focus group participants were seasonal migrant cannabis trimmers. Themes emerged of respiratory and dermal exposures and outcomes, musculoskeletal disorders, and physical hazards including living conditions. Workers reported respiratory symptoms and rashes from exposure to cannabis, mold, and pesticides. Musculoskeletal pain was ubiquitous due to inadequate seating and long shifts performing repetitive tasks. Seasonal workers experienced chronic exposure to cold conditions and unsanitary housing. Management-level interviewees and other industry stakeholders described concerns and experiences that differed from those of workers.

Discussion: The results were consistent with existing research on cannabis worker health, with workers reporting respiratory and dermal exposure and symptoms, musculoskeletal hazards, and physical hazards associated with agricultural work. In addition, we found that workers were affected by substandard living conditions, remote and isolated work environments, and an absence of training.

KEYWORDS

agriculture, cannabis, migrant workers, occupational health

1 | INTRODUCTION

Cannabis sativa (cannabis, marijuana) access in the United States has expanded in recent years, with adult recreational use legal in 19 states and the District of Columbia, and medical use legal in 37 states and the District of Columbia.¹ The largest share of cannabis production in the US occurs within California, where legally produced cannabis is the fifth most valuable agricultural product and total production makes it the largest cash crop in the state with total annual revenues in excess of \$10 billion per year.² According to an econometric model produced by cannabis industry experts there are approximately 58,000 full-time equivalent legal cannabis jobs in California in 2021.³ However, approximately 90% of cannabis grown in California is still sold outside of the regulated market⁴ and estimates based on licensing and taxed revenues are certain to significantly undercount the true number of cannabis workers.

Despite cannabis cultivation and processing being labor intensive, occupational health hazards in workers who handle and process cannabis have not been sufficiently studied, and little is known about their exposures to work-related risks.⁵ Cultivation tasks are analogous to those in other agricultural crops, although fully climate- and light-controlled indoor grow accounting for approximately 9% of California cannabis production⁴ are unique. The most time-consuming step in cannabis processing is trimming, a labor-intensive and skilled task of manicuring the cannabis flowers for sale by removing leaves and stems with small scissors. In the limited number of workplace investigations and studies on cannabis worker health and safety, numerous potential health and safety hazards have been identified. These include ergonomic stressors, injuries, exposure to chemicals and UV light, and use of machinery.^{6,7} In addition, numerous respiratory and dermal exposures have been identified including organic dust, raw cannabis plant material such as delta-9-tetrahydrocannabinol acid (THC) and other cannabinoids, microbes, endotoxin, and volatile organic compounds.⁵ Respiratory, dermal, nasal, and eye symptoms as well as abnormal spirometry have been reported in cannabis workers at cultivation and processing facilities.⁸ Allergic sensitization to the *C. sativa* plant has been reported among workers and users, with outcomes such as rhinitis, eczema, asthma, and even anaphylactic reactions.^{9,10}

Most existing data on this topic has been gathered using workplace investigations, structured surveys, and biomedical evidence. Qualitative research methods are critical for research on stigmatized topics among hidden populations with whom trust is difficult to establish and rapport is challenging to develop; interviews and focus groups allow researchers to be sensitive to the emotional difficulty of describing experiences of discrimination, and for participants to control the depth and content of the discussion as well as provide desired context beyond what is possible in a structured survey.¹¹ Workers in the cannabis industry experience stigmatization of their work even within a licensed business environment due to the legacy of criminalization of cannabis and negative attitudes towards cannabis production and consumption. Some are further stigmatized due to working in illegal jobs or

discrimination by race, gender, and immigration/documentation status. In existing publications based on qualitative methods, participants have discussed safety issues and discrimination related to gender, concerns about respiratory exposures and ergonomic factors, insufficient or absent safety training, psychological stress, and concerns about violence.^{12–16}

We performed a study using qualitative methods based on focus group discussions (FGDs) and key informant interviews (KIIs) using online videoconferences (Zoom) from October 2021 to May 2022. Using semi-structured interview guides, participants were guided through describing their experiences, perceptions, attitudes, and knowledge of occupational health and safety topics. In this article, we present the results pertaining to physiological exposures and health effects, which are broken into three themes that emerged during the analysis: respiratory and dermal exposures, musculoskeletal risks, and other physical hazards and living conditions. In addition, all participants in the present study reported significant concerns about psychological stress from factors such as long working hours, substandard housing, social and geographic isolation, production pressure, as well as experiences of race and gender discrimination, violence, and intimidation both within the workplace and by outside actors. Due to the complexity and importance of these issues, these findings will be discussed in detail in forthcoming publications by the authors.

This article presents the first analysis describing firsthand knowledge of health and safety among California cannabis cultivation and processing workers, as well as the first cannabis worker health study focusing on seasonal migrant trimmers—the most marginalized and vulnerable worker subgroup in the industry. The results indicate that cannabis cultivation and processing workers are exposed to numerous occupational physiological hazards including plant and fungal materials, chemicals, ergonomic stressors, and geographic isolation and experience a range of health outcomes due to these exposures.

2 | METHODS

2.1 | Recruitment

Participants were recruited using two strategies. A peer recruiting approach was employed to recruit seasonal, mostly immigrant trimmers, beginning with individuals identified by study staff during previous communications with cannabis workers. Year-round cannabis cultivation and extraction workers were recruited by distributing an electronic flyer with study information to workers via existing contacts within the cannabis industry: business owners, occupational health specialists, labor organizers, growers, and workers.

2.2 | Interviews and discussions

Semi-structured KII and FGD interview guides were developed to prompt discussion of participants' perspectives, experiences,

observations, and concerns around workers' health and safety topics. The topics included in the guides were based on a comprehensive review of the existing literature on cannabis worker health and safety to identify the most important topics for discussion, as well as to pinpoint any subject areas that have been neglected in previous research efforts. These were used to inform collaborative, open-ended discussions. FGDs were performed in mixed-gender groups based on the preference of the participants. KIIs and FGDs lasted no more than 2 h and were performed using Zoom. Due to the highly sensitive nature of the discussion topics including immigration concerns and criminalized work, the sessions were not recorded; two or more trained study staff members transcribed the sessions independently, then combined the notes following guide topics to ensure that no responses were missed. No person or business names were transcribed, and references to geographic locations more specific than the name of a town were omitted. The FGD/KII principal investigator and facilitator (Xredacted) began each session with a description of the study, objectives, discussion dynamics, as well as potential risks and obtained verbal informed consent from each participant. Following each KII and FGD, participants were given a web link to an anonymous online survey of sociodemographic data. At the end of this survey, participants were directed to a separate form to enter an email address unlinked to the FGD/KII and demographic survey responses. Incentives were sent to these email addresses in the form of electronic gift cards.

2.3 | Qualitative analysis

The notes were combined by discussion guide topic, and responses were grouped using deductive thematic analysis.¹⁷ Because sessions were not recorded to protect participants' confidentiality, it was not possible to perform software-assisted coding or analysis. The research team compared and contrasted data from the FGDs and KIIs to avoid any contextual or perspectival bias and ultimately to ensure internal validity to more fully understand cannabis workers' workplace concerns. Overall, the data gathered on physiological exposures and health effects are clustered in themes of respiratory and dermal exposure and health effects, musculoskeletal disorders (MSDs), and other physical hazards and living conditions. We also discuss health and safety training; while participants did not typically discuss training without prompting, lack of training has been a key issue raised in other research and by cannabis industry worker health stakeholders.^{13,15,16}

3 | RESULTS

3.1 | Participant and job characteristics

We performed four focus groups, attended by 32 participants. Six participants were recruited by circulating a flyer to cannabis workers and the remaining 26 were recruited by three peer recruiters. Half of the FGD participants were women, and the majority (56.3%) self-

TABLE 1 Demographic characteristics of focus group discussion participants

	Median (IQR)
Age (years)	32.5 (29, 35)
Months worked in cannabis industry	9 (3, 39.5)
	N (%)
Gender	
Female	16 (50)
Male	15 (46.9)
Nonbinary	1 (3.1)
Race/ethnicity	
Latino ^a	18 (56.3)
White	5 (15.6)
Black	2 (6.3)
Other ^b	3 (9.4)
Missing	4 (12.5)
Country of origin	
Mexico	21 (65.6)
USA	7 (21.9)
Other ^b	3 (9.4)
Missing	1 (3.1)
Language spoken at home	
Spanish	20 (62.5)
Spanish/English	4 (12.5)
English	6 (18.8)
Other ^b	2 (6.3)
Years of education	
12	3 (9.4)
>12	24 (75)
Missing	5 (15.6)

^aCollapsed responses including Mexican, Latino/a/x, and specific South American countries.

^bUnique responses collapsed to protect confidentiality.

identified as Latino and speaking Spanish at home (75%) (Table 1). We performed KIIs with five cannabis workers, one cannabis worker health and safety consultant, one small-scale licensed farm owner, one manager of a medium-scale licensed farm, and one cannabis worker peer organizer.

The success of the peer recruiting strategy resulted in 26 (81.3%) of the participants being demographically similar: workers who migrate seasonally from Mexico or South America to the "Emerald Triangle" region of Mendocino, Humboldt, and Trinity counties in Northern California for cannabis jobs during the outdoor-grown cannabis harvest season (September through November) then return to their home at the end of the season. These migrant seasonal worker participants are

	Frequency of report by workers ^a	Reported by farm manager or owner ^b
Respiratory and dermal exposures and health effects		
Mold/fungus	All or most	
Cannabis plant materials (e.g., kief, resin)	All or most	Yes
Pesticide exposure	Some	
Wildfire smoke	All or most	Yes
Volatile organic chemicals or solvents (VOCs)	Few	
Respiratory symptoms (e.g., coughing, shortness of breath)	Some	
Rashes or skin problems	Few	Yes
Musculoskeletal disorders		
Back pain	All or most	Yes
Upper extremity pain	All or most	Yes
Repetitive movements	All or most	Yes
Other physical hazards and living conditions		
Cold temperatures or unsafe space heaters	Some	
Absent/unhygienic cooking/bathing facilities	All or most	
Electrical or machinery hazards	Few	Yes
Geographic isolation	All or most	Yes
Training		
Absence of health and safety training	All or most	

^aFrequency of report by workers is defined as all or most (more than 25 of the 37 worker participants), some (12–25 of worker participants) or few (less than 12 worker participants)—any semi-structured guide material (Supporting Information) not reported by workers was not included in dominant themes.

^bDescribed as a hazard that is present or an issue of concern by licensed medium-sized farm manager or licensed small farm owner.

undocumented and not eligible for legal work in the cannabis industry. All had worked as a trimmer, with six having additionally worked as a cultivator or field worker. They reported 8- to 13-h workdays, 6–7 days per week, and 1–4 months of the year. Method of pay for trimmers was by the pound of cannabis produced after trimming; trimmers process three to four pounds of high-quality cannabis per shift or 24 ounces to two pounds of lower-quality material. Typical rates were \$150 USD per pound of trimmed product in 2020 but recent events in the cannabis industry including overproduction within California resulted in pay in 2021 as low as \$100 per pound. Cultivation and field harvest work are paid at an hourly rate of \$10–20 per hour. All reported pay in cash with no tax documents. In some cases, the employer was described as a licensed business that paid seasonal trimmers under the table.

The six participants who were not seasonal migrant trimmers varied in demographics and most had worked in several different cannabis jobs: all had worked in the past as trimmers, one in cultivation, five as an extraction lab worker, five as a “budtender” (dispensary salesperson), and two as delivery drivers. Five reported working for licensed businesses and one had worked for both

licensed and illegal businesses. These workers reported the same rates for trimming as seasonal workers, and a minimum hourly wage of \$17–20 for jobs at licensed businesses and being paid by check or cash and receiving tax documents.

A semi-quantitative summary of the thematic analysis is presented in Table 2; one interviewee (a cannabis industry occupational safety and health consultant) was excluded to focus on the perceptions of workers and farmers. Notable contrasts between the perceptions of the workers and those of the owner/manager level interviewees are the hazards associated with mold/fungus, pesticides, and informal worker housing—these were reported as significant problems by workers, but not by the farm owner or manager.

3.2 | Respiratory and dermal exposures and health effects

Participants were prompted with examples of exposures and health outcomes and asked to describe their experiences and knowledge of

TABLE 2 Semi-quantitative assessment of themes and example subthemes reported by workers and owner/manager level interviewees by frequency of report

these. When asked about respiratory exposures, seasonal trimmers reported exposure to moldy plant material as a prime concern; in contrast worker participants working only in the legal industry were less concerned about mold but did confirm that mold exposure occurred during trimming. Among seasonal trimmers, symptoms attributed to exposure to mold included cough, allergic symptoms, and respiratory discomfort as well as skin rashes. All participants also experienced respiratory and dermal health effects due to exposure to the cannabis plant materials such as kief (cannabis flower trichomes), resin, and dust:

"Working with mold, working in plants with mold is super gross and it's not good because you are breathing it all the time. No matter if you feel it or not you are breathing it, you don't know if it is causing problems or not."

"I had an allergy on my face, arms, and body. I tried to cover my body, but it was not helpful, I am not sure if it was from weed or fungus... after that, I have long term allergies to weed that I didn't have before."

Several participants described using pesticides with no training or PPE and experiencing skin rashes as a result:

"I had a pretty bad rash on my legs and arms and face, because the first farm I worked there was a plague in the plant [insects or powdery mildew] and we had to use chemicals to clean the plants every day... they actually said that they were organic chemicals, and they were not going to hurt us... it was really hot because it was the summer and I used shorts and short sleeve t-shirts. The first day I started with a rash, but I didn't know what it was, the second day I realized it was the chemicals, the chemicals were hurting us but nobody [employer] said anything."

Workers in the legal industry and the manager/owner level interviewees were less concerned about pesticide exposure or confident that the pesticides used were organic and nontoxic:

"On our farm we are totally organic, and we always have been, we don't use anything on the cannabis we wouldn't use on our vegetable garden."

"[Cannabis] is the most highly regulated agricultural crop, we are barely allowed to use pesticides."

The outdoor cannabis harvest season coincides with the peak months for wildfire risk in California of September and October, and all seasonal trimmers had experienced exposure to wildfire smoke. Seasonal workers inconsistently reported using masks to protect against smoke exposure but universally experienced respiratory effects such as coughing and difficulty breathing due to wildfire smoke.

While volatile organic chemical exposure was not reported by other participants, extraction lab workers in licensed facilities experienced exposure to solvents resulting in headaches or light-headedness, and an absence of lab safety protocols or air monitoring. Cannabis extraction uses flammable solvents or compressed gases to extract cannabinoids and terpenes from cannabis:

"We didn't have ppm readers to know what level of solvent we are exposed to; you have to ask for monitoring. No talking in depth about safety, what can happen. They don't give out respirators, they make you go buy them. There are butane, ethanol, gases in the room—it's not well ventilated, if you don't have the right air system they just get trapped."

3.3 | Musculoskeletal disorders

MSDs were ubiquitously reported by workers, and described as a major concern by other key informants. While cultivation requires activities like reaching, bending, and heavy lifting, all of the complaints were attributed to trimming. Trimmers sit for extended periods of time, most commonly in folding camping chairs purchased by the worker. All seasonal trimmers described arm, back, and shoulder pain that was sometimes severe and persisted after the work shift. They also universally experienced hand and wrist pain from the repetitive movements of trimming. Musculoskeletal pain was also attributed to feelings of stress and production pressure in addition to repetitive movements and improper seating, and pain was described as worsening throughout the work season and sometimes resulting in long-term injuries:

"I try to get up every 1 to 2 h. I have been doing it for 8 years and I'm starting to see the toll on my body. I am starting to get a hunchback because of my position."

"I had tendonitis for almost a year and a half and it got worse when I was trimming. And it doesn't go away very easily or fast, and then doesn't allow you to work more."

When asked how they tried to prevent or cope with MSDs, trimmers described doing yoga or stretching before or after work and trying to take breaks during the work shift, but none were required or encouraged to take rest breaks or to take time off if they were injured.

3.4 | Other physical hazards and living conditions

Exposure to cold ambient temperatures and failure of employers to provide heated work environments were commonly described

problems. Few participants had exposure to excess heat, and it was largely described as a source of discomfort or annoyance rather than an acute health risk. Trimmers who work indoors within a warehouse or indoor “trim room” reported that the rooms are kept air conditioned and uncomfortably cold to protect the quality of the cannabis. Seasonal laborers live in cars, tents, or informal housing with little or no heating provided; in late autumn overnight temperatures in the mountains of Northern California can dip below freezing. Several seasonal workers described sleeping or working in a warehouse or tent with an outdoor-rated propane heater for warmth and becoming sleepy or disoriented during their work shift, which could indicate potential carbon monoxide exposure:

“Sometimes you are trimming in a tent so it's really cold... We got sick and to stay warm, we slept next to a propane gas stove which is really bad. They give the trimmers one thing for getting warm, so you are sleeping close to the stove. Breathing close to it is awful, but it's the only thing you have to be warm.”

The substandard living conditions include kitchens or outdoor cooking areas and bathrooms that are often unsanitary or even absent. One FGD participant said that she had never worked at a farm that had a clean bathroom, and that her coworkers experienced skin rashes and vaginal infections from the lack of hygiene. The poor living conditions combined with on-the-job exposures result in workers who are in a constant state of discomfort:

“You don't have a bathroom so you have to poop or pee in a ditch. They don't have a place to shower so you shower with a hose.”

“You are always on a farm and you aren't comfortable in your sleeping space. There's not a proper kitchen, you're just camping.”

Exposure to faulty electrical systems, machinery, and unsafe vehicle use were reported as hazards by many participants. In some cases, these were described as the types of hazards common to all agricultural workplaces (e.g., heavy machinery, electrical generators) but workers described situations unique to the cannabis industry such as intense indoor grow lighting. Electrical hazards created by improperly installed wiring or long-term use of extension cords were commonly reported by FGD participants as well as industry expert key informants, with one worker describing electrocution as their worst fear on the job due to the amount of electrical equipment present and the improper use and installation.

Many farms are in extremely isolated rural areas and require hours of travel on remote roads and unpaved access roads, resulting in car and other vehicle crashes. Another effect of the isolated nature of the farms is that emergency services may be several hours away, and participants described concerns about

being unable to receive timely health care in an emergency. The remote, mountainous areas of the Emerald Triangle region are largely uncovered by cellular voice or data, preventing workers from contacting emergency services directly. Several had experienced an occupational injury and not received professional medical treatment due to the distance:

“Three years ago I was using a fan [trimming machine that uses a spinning blade] and one day the fan did hit my finger. There was blood and I was scared but I was far from the city, so I just tried to take care of it myself.”

The planning and execution of this study were done during the COVID-19 pandemic, and participants were asked about the availability of PPE and precautions during the pandemic. Some trimmers were able to space their work areas at least 6 ft apart but reported inconsistent use of masks (which workers had to provide) and low uptake of vaccination when it became available.

3.5 | Training

None of the FGD participants or cannabis worker key informants received safety training, regardless of the legal status of their employer. Training on how to perform job tasks was also largely absent; trimmers occasionally reported employers showing an example of the type of work they wanted, but no other training, and described depending on coworkers taking time away from their own production to teach how to trim properly or avoid repetitive strain injuries.

“You don't really receive training; you have to figure it out. There are so many tools and stuff like that that you can be injured for sure. They never talked about emergency plans. Here there's no rights like that. Sometimes you don't even get paid so there's no type of compensation [for injury].”

Extraction workers reported brief, one-time training on how to use solvent extraction systems or just being instructed to “figure it out.”

“There is no certification for a lot of things... that guy [the business owner] didn't tell anyone he didn't know how to run the machine. They all learn on the job with \$100,000 equipment risking people's lives. A lot of people were in danger, it was a building that could have exploded.”

None of the workers were aware of employers having emergency plans or injury and illness prevention programs, and a key informant who is an expert in cannabis industry health and safety reported that lack of emergency planning is one of the most common problems in the legal industry:

"The biggest nightmare on a farm... is that they have chainsaws and no plan for major injury. What if someone severs a femoral artery and they are 8 miles from a road? Another big thing is there are no emergency action plans. Farmers do not recognize that their temp agency employees are their employees. Temporary employees are treated like second class citizens, they don't know first aid procedures, don't know emergency plans."

3.6 | Job satisfaction

While hazardous exposures and health outcomes were common, seasonal workers also reported satisfaction with their job's earnings, and some even mentioned positive aspects of the work environment. Some trimmers enjoyed living seasonally in isolated areas with clean air and pleasant scenery and felt a sense of camaraderie with coworkers. When asked why they would continue cannabis work, all FGD participants responded that they would return for the money—seasonal migrant trimmers can earn enough money in USD in one harvest season to support themselves financially for the rest of the year in their home country, where the dollar exchange rate is high. However, many also said that they enjoyed the locations, sense of adventure, free cannabis, and meeting new people.

"Hanging out with bears [laughs] - you're out in the mountains, it's nice, there's a lot of views. You don't have strict schedules at my farm. When there aren't fires the air is good. It's the mountains, you wake up and have time of breakfast, you have time for their own break times. This and the money."

"Because with one month and a half of working, I can live the rest of the year without work."

4 | DISCUSSION

4.1 | Contextualization of findings

Many of these findings are consistent with other research on physiological factors contributing to cannabis worker health and safety—workers are exposed to the cannabis plant, microbes, chemicals, musculoskeletal stressors, and machinery and experience outcomes such as respiratory and dermal symptoms as well as acute and chronic injuries. Workers reported respiratory and dermal symptoms attributed to exposure to cannabis plant materials and mold that are consistent with existing research.⁸ A variety of

microbial contaminants have been noted in workplace investigations⁶ and Otañez and Grewal report on a cannabis worker who workers developed a medically documented severe fungus allergy after repeated exposure to moldy cannabis.¹⁵ Allergic sensitization to *C. sativa* has been documented in cannabis users and workers with reactions ranging from minor skin irritation to anaphylaxis.¹⁸

Workers with experience as field laborers were exposed to pesticides during application. No pesticides are approved for use in cannabis, and California growers are limited to a small number of ingredients that are exempt from federal residue tolerance requirements such as neem oil and *Bacillus thuringiensis* products; despite this, detection of pesticide residues exceeding tolerance is the most common reason for failure of legally grown cannabis during lab inspection in California.¹⁹ All FGD participants who were exposed to pesticides were told that the product was organic and safe but given no other information or training. In a survey of Colorado cannabis workers, 34% of respondents had experienced symptoms such as skin irritation or headaches after handling pesticides,²⁰ and in a study assessing training needs in the cannabis industry the majority of participants listed pesticide or chemical exposure as the main concern.¹³

Previous research addressing MSDs or repetitive stress in cannabis workers has consistently found potential hazards or elevated rates of MSDs. In an online survey of cannabis workers, back pain was reported by nearly half of respondents in addition to hand/wrist/finger and knee pain,²⁰ and repetitive motions were identified in workplace observations and investigations.^{6,16} No previous investigations have explored workers' perceptions of MSDs, which participants in this study found to be a major source of pain and psychological stress present on a daily basis during work and persisting past the work day or harvest season. Increased stress has been found subsequent to development of musculoskeletal pain in workers²¹ and upper extremity and back pain is commonly associated with personal and work-related psychosocial stress and repetitive motions such as those required for trimming cannabis.²² Trimmers report working up to 13-h shifts with few breaks in substandard seating, and prolonged sitting and poor lumbar support are also associated with occupational back pain.²³

Training has been identified as the chief need for protecting cannabis worker health, with a particular need for cannabis-specific training materials that are appropriate to the unique characteristics and culture of the cannabis workplace, in addition to specialized equipment and machinery used in the industry.^{13,15,16} A small farm owner interviewee had voluntarily attended health and safety trainings and described them as helpful, but also expressed resentment that regulations around training for the cannabis industry are more burdensome than for other crops. California cannabis businesses are required to provide 30-h health and safety training to one manager and one employee,²⁴ however, this regulation is largely unenforced and none of the worker participants were aware of the requirement.

We identified differences between the experiences of seasonal trimmers, year-round workers, and management/

owner-level individuals. A recurring theme among management and owners of licensed businesses and stakeholders who are invested in the legitimacy of cannabis as an agricultural product is that cannabis growing has similar hazards to any other farming workplace, and it is only perceived as less safe due to stigmatization of the industry. Indeed, many hazards reported by worker participants are present in other farm workplaces: exposure to dust and wildfire smoke, hazardous machinery, heavy lifting, and repetitive motions. However, worker participants described a side of the industry where workers are paid in cash, required to live in unsafe and unsanitary housing, and chronically exposed to mold and potentially illegal pesticides. We propose that the reason for this is that the experiences of management and owner interviewees are vastly different from those of seasonal trimmers, and there is little crossover or communication between the two groups. An aspect of cannabis being an agricultural product like any other that was not addressed by interviewees is that the issues affecting migrant labor in the rest of California including substandard housing, lack of access to healthcare and safety resources, and workplace abuse²⁵ also affect seasonal trimmers.

Workers frequently reported that the quality of the cannabis was important to the growers and business owners, but the health and safety of the workers were not. When PPE was provided in the form of gloves, it was to keep the trimmers' hands from contacting the valuable cannabis flowers. When indoor spaces were well-ventilated or climate controlled, it was to ensure the quality of the cannabis. Some participants were required to work in a darkened room with a headlamp when indoor grow lighting was turned off to maintain the plants' photoperiod during working hours, resulting in eye pain. In general, workers expressed feeling as though they were not valued as individuals and that their health was secondary to the product quality and profits:

"I worked in late-bloom season [October/November] so it was getting cold in the nighttime, and they are more likely to work in the cold because they don't want the weed to absorb humidity."

"Dealing with employers is very informal. Nothing ensures payments – it makes you feel disposable."

There are no occupational health and safety regulations specific to the cannabis industry; many hazards fall within existing standards (e.g., hazard communication, prevention of repetitive motion injuries) and exposures unique to cannabis workplaces are covered by the General Duty Clause as enforced in California by Cal/OSHA. However, remote and isolated grows are difficult to access for inspectors and the majority of farms are unlicensed and therefore inaccessible to inspection or enforcement. Several workers had experienced law enforcement actions while working at illicit grows; workers reported great fear of these actions and no benefits for

worker safety. Due to this lack of relevance, we chose not to address regulatory structures in the context of this analysis.

4.2 | Study strengths and limitations

A unique strength of this study was the ability to gain a deep understanding of the experiences of seasonal migrant cannabis workers, who have not been included in previous research. The peer recruiter model was significantly more successful than recruiting by an advertisement through existing contacts involved with licensed businesses, resulting in a cluster of participants who are demographically similar in terms of race/ethnicity, age, and educational attainment. Previous health studies of cannabis workers have been performed among year-round employees of licensed businesses and have reported very different demographics—typically more male than female workers with a high proportion of non-Hispanic white respondents.^{8,20} The demographic differences in our participants compared to other studies are consistent with observations that seasonal trimmers are more likely to be migrant workers who in post-2018 years are typically Latino.^{14,26} Another benefit of recruiting by peers is that we were able to include workers who may drop out of the cannabis workforce due to ill health caused by the job—in a more traditional cross-sectional sample of a workplace, workers who left the industry due to health effects would not be included, resulting in a bias towards representing workers who did not experience health effects.

Despite the benefits of the focus on seasonal trimmers, the participant sampling results are the chief limitation of this analysis, preventing robust extrapolation of the results of this study to cannabis cultivation and processing as a whole. Participants reported increasing numbers of Hmong cannabis growers and seasonal trimmers, and we were unable to make contact with this geographically and linguistically isolated population.²⁷ Participants also reported having worked with decreasing numbers of US American seasonal trimmers and those coming from European countries, who were not included in our sample. Some of the shortcomings of recruitment were due to the COVID-19 pandemic, as it was not possible to attend meetings or industry gatherings to advertise the study and recruit in person. In addition, work on outdoor cannabis farms is highly seasonal and due to the project timeline, we began recruitment after most seasonal trimmers had returned to their country of residence.

Another limitation common to interview- and FGD-based research is that we must assume the participants understood the prompts of the facilitator and had the language to describe their experiences accurately. While most of the participants spoke Spanish at home, they all confirmed speaking English and, in several instances, clarified the prompts or responses in Spanish with the facilitator (XC), a native Spanish speaker. In addition, we were unable to describe every experience or concern raised by participants and instead focused on the dominant themes that encompassed the majority of the data.

5 | CONCLUSION

We were able to use the qualitative study design to develop rapport with focus groups and interview participants, resulting in a wealth of nuanced and valuable data on workers' first-hand experiences and perceptions of their occupational health and safety. Participants described feeling heard and understood, and in some cases offered appreciation for being asked to talk about experiences they had not previously shared. The present and forthcoming analyses of these data present a picture of cannabis worker occupational risks that are under- or unexplored and must be further elucidated to protect the health and safety of this vulnerable worker population.

At present, improving the occupational health of workers in the cannabis industry is hampered by two major factors: the illegal or mixed-legality (e.g., a licensed grower producing more plants than allowed by the license) production at a majority of farms, and the prevalence of farms with a small number of workers located in remote rural locations. These factors compound the workplace exposures, substandard living conditions, and lack of training because there is a reluctance for growers to engage with regulatory or other agencies for assistance or to report injuries or hazards, and the sites are not easily accessible for outreach or Cal/OSHA inspections. Several FGD participants noted that living and working conditions were better at licensed businesses, even though they were undocumented workers. While participants in the study described many negative experiences, it is important to note that many cannabis growers are concerned about worker health and safety and conform to relevant regulations or even seek out voluntary training. The transition to legal cannabis production, including de-scheduling cannabis at a federal level, will be a major factor in improving worker health and safety by permitting increased regulatory and research access to cannabis workers and allowing business owners access to existing health and safety resources.²⁶

The findings of this analysis should be used to guide future research in cannabis worker health and safety. The rate of occupational injury and illness among cannabis workers is unknown, and while risks and health effects have been identified, there is a significant need for research that includes a representative sample of workers from across the industry. The experiences and concerns of cannabis cultivation workers, especially seasonal trimmers, differ greatly from those reported by business owners and industry stakeholders. Existing research on cannabis worker health is largely based on workers who researchers were able to access via their workplace, which often results in recruitment limited to licensed businesses that feel relatively confident in their health and safety programs and the satisfaction of their workers. Marginalized workers such as migrants and those at illegal operations are not typically accessible to these recruitment schemes; these populations are difficult to reach, and great care will be needed to design research that captures a representative sample of the cannabis workforce while being sensitive to the sociopolitical realities that affect workers like criminalization and discrimination.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision for this article.

AUTHOR CONTRIBUTIONS

Marc B. Schenker, Xóchitl Castañeda, and Stella Beckman participated in the conception and design of the work. Marc B. Schenker, Xóchitl Castañeda, Stella Beckman, and Likhi Rivas participated in acquisition, analysis, and interpretation of data and drafting and critical review and revision of the work. All authors have given final approval of the version to be published and agree to be accountable for all aspects of the work.

ETHICS APPROVAL AND INFORMED CONSENT

The work was performed at the University of California, Davis and the University of California, Berkeley. Both institutional IRBs reviewed the protocol and determined it to be exempt from review. Participants provided verbal informed consent. The exemption for both IRBs was determined by 45 CFR 46 Subpart A §46.104 Exempt research, Category 2 based on meeting criteria (i) "The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects." The only identifiable information we collected was an email address to send the study incentive, which was unlinked to any focus group/interview or demographic study data.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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