

Understanding Occupational Injury and Substance Use Issues among Workers in Maine's Shellfish and Lobster Industries

by Tora Johnson, Katherine Darling, Debra Kantor, Joseph Spiller, O. Gracious Jones, Lois-Ann Kuntz, Tara Casimir, Amy Dowley, Greyson Kurtz, Lauren Sachs, Linda Silka, Bridie McGreavy

Abstract

In 2022, American lobster and softshell clam harvests contributed \$283 million to Downeast Maine's economy, employing thousands of harvesters. Harvesting is grueling work. Pain from work-related injuries precedes many opioid deaths, and workers in fisheries are disproportionately at risk. Harvesters are typically self-employed and often uninsured or underinsured, complicating access to health care. Prior studies have focused on injury risk or drug use among harvesters without revealing how injury, pain and substance use intertwine with cultural, social and regulatory factors. This study examined the socio-ecologically embedded injury–pain–substance-use process with surveys of harvesters and healthcare providers and advocates followed by interviews of harvesters and providers.

2009), and back, hand and wrist pain are common among lobster harvesters (Fulmer et al. 2019). Harvesting clams involves slogging through mud, bending, digging, and carrying heavy weights. Many shellfish harvesters report chronic pain that grows more persistent as they age (McGreavy et al. 2018). Chronic pain is a known driver of opioid addiction, and work-related injuries are known to precede many opioid deaths (Cheng et al. 2013). Unemployment and disability that may result from injury are also significant risk factors for opioid deaths (Aram et al. 2020).

MAINE'S FISHERIES DEPEND ON THE HEALTH OF FISHERIES WORKERS

In 2022, American lobster (*Homarus americanus*) and softshell clam (*Mya arenaria*) harvests contributed \$283 million to Downeast Maine's economy, employing thousands of harvesters. These culturally iconic and economically important fisheries are particularly crucial to the remote Maine communities of the Downeast and Acadia region. Clam harvests provided more than \$10 million for the local economy, an average of \$6,811 in income for 1,483 harvesters,¹ and clams serve as a main ingredient for local dishes in restaurants and tourist markets. Commercial fishing and aquaculture have been identified as priorities for economic development and investment statewide. Yet, despite the high priority placed on these industries, the health and well-being of fisheries workers has only recently come to the attention of policymakers and regulators.

Fisheries harvesters are disproportionately at risk for chronic pain (Berg-Beckhoff et al. 2016) and opioid death (Hawkins 2020). Trap fisheries like Maine's lobster industry pose risks of low back injury for harvesters (Kucera et al.

Most of the Downeast and Acadia Region of Maine is designated as a medically underserved area and health professional shortage area by the Health Resources and Services Administration.² The region faces significant economic challenges, including some of the highest rates of childhood poverty, the lowest educational attainment, and highest levels of disability in the state (Maine CDC 2022). The region also faces coastal vulnerabilities, including storm flooding, sea level rise, and damage to wastewater infrastructure, that affect fisheries and community resilience (Johnson and East 2014; Johnson, Stancioff et al. 2019).

The health of fisheries workers is intertwined with public health and environmental well-being: social and structural factors interfere with harvesters' ability to learn about and follow pollution closures, engage in fisheries management practices, and participate in efforts to address threats like pollution, invasive species, and overfishing. For example, shellfish harvesters must comply with pollution closures and engage in conservation and pollution-prevention activities to ensure a safe and sustainable food supply. Lobster harvesters must actively collaborate in efforts related

to stock management and preventing whale entanglements. When health issues prevent harvesters from engaging, food supplies and public health are put at risk.

Clamming and some lobstering jobs require minimal investment in equipment and licensing, so they are accessible to people facing barriers to other forms of employment. Harvesting is often one of several seasonal occupations used to make ends meet. Harvesting clams, in particular, provides income for vulnerable coastal populations; previous research showed challenges like housing insecurity and limited access to internet, phone and US mail among shellfish harvesters (Johnson, Morgan et al. 2019). Workers in these industries are self-employed, so they do not have access to employer health insurance or many legal protections like unemployment benefits or workers' compensation. Together, these social conditions make harvesters' structurally vulnerable (Bourgois et al. 2017), facing unique barriers and risks.

In 2019, our interdisciplinary research team joined with key community partners to better understand the fundamental connections between the health of fisheries workers and the sustainability of Maine's fisheries. We used a mixed-methods approach to generate pilot data on injury risk, healthcare access, and provider interactions, substance use patterns, and social support networks of workers in Downeast shellfish and lobster industries. This study involved coproduction of research protocols and analysis with fisheries, social service, and healthcare partners.

SPANNING BOUNDARIES TO BUILD A HEALTHY FISHERIES WORKFORCE

Harvesters in Downeast Maine's shellfish and lobster fisheries face interlocking challenges that affect workplace injury, chronic pain, substance use, and healthcare access. However, prior research and policy approaches have treated occupational health, substance use, and fisheries management as separate concerns. Comprehensive approaches must consider the role of factors like fisheries policy, changing environmental conditions, and coastal access alongside the cultural and socioeconomic realities of harvesters, their families, and communities.

Challenges in communicating fisheries regulations illustrate the fundamental links between harvesters' lived realities and fisheries management. For example, public health depends on harvesters knowing where and when it is safe and legal to harvest, but structural barriers can complicate communication. Our previous research revealed widespread

problems with the state's system for informing harvesters about shellfish closures due to pollution and biotoxins. In a 2018 survey, over half of commercial harvesters and almost two-thirds of recreational harvesters reported difficulty determining where it was safe and legal to harvest shellfish. Based on these findings, the Maine Department of Marine Resources (DMR) is revising their methods for communicating closures, but issues still remain. Nearly half of harvesters said they rely on word-of-mouth to learn of closures. Survey (Johnson, Morgan et al. 2019) and interview (McGreavy et al. 2018) research suggests that many harvesters have minimal access to technology and literacy challenges that affect their ability to read and understand closure notices and other communications from state agencies, including the Maine Department of Health and Human Services and DMR. Such challenges may also impact harvesters' ability to access health care, recovery services, and insurance.

In this paper, we analyze data from surveys and semi-structured interviews with harvesters, healthcare providers, and fisheries stakeholders to describe the social, environmental, and workplace conditions that put harvesters at risk for a cascade of problems including injury, substance use disorder, and overdose. We outline possible interventions to interrupt these dangerous cycles related to workplace injuries among harvesters with the interwoven goals of supporting sustainable fisheries, healthy workers, and resilient coastal communities.

METHODS

This project was an initiative of the Downeast Health Research Collaborative, a transdisciplinary and community-engaged collective of scholars from a wide array of disciplines that conducts boundary-spanning research to help solve wicked, health-related problems among rural communities. The research team included people with significant experience studying and working in fisheries in Maine and elsewhere, as well as experts in community nursing, medical sociology, community resilience, and occupational health. The research team also included graduate and undergraduate students, most of whom had lived experience in coastal Maine communities and fisheries. A team of community partners focusing on fisheries, healthcare, substance use recovery, and community development participated in all phases of the research, including developing survey and interview protocols, analyzing data, and developing recommendations.

Data Collection

The study began with two surveys. A survey of lobster and shellfish harvesters inquired about experience with occupational injury, self-medication, and the healthcare system, as well as a series of mental health screening questions (those that scored high on mental health risk received a list of services in their county). We also surveyed people who provide healthcare and recovery services, fisheries advocates, wardens, and others with interest in the industry. The survey of providers and advocates inquired about their experiences serving harvesters and the health-related challenges they observed. A decision tree was developed to aid interviewers in managing any mental health crises that might arise during our interviews (available in the online appendix³). The process of developing the decision tree involved close consultation with community advisors, and the research team participated in mental health first aid training to prepare for any crisis situations that might arise during interviews.

Mailing lists for harvesters were compiled using commercial license lists provided by DMR, and provider mailing lists were compiled from public medical license listings. Additional addresses were gleaned through public websites and snowball sampling (where research participants are asked to identify other potential subjects). Physical surveys were mailed to those with no email address in their license record; all others were emailed a link inviting them to participate online. Additionally, throughout the summer of 2021, research teams conducted outreach efforts across the region, visiting lobster and shellfish buyers, harvesters on mudflats and docks, harbor masters, municipal shellfish committee meetings, and lobster zone council meetings. Posters and waterproof cards advertising the survey were posted in areas harvesters frequent. Links to the survey were posted on local social media sites and in local newspaper stories. Harvester respondents who provided a mailing address received a \$10 Visa gift card. Providers and advocates were not offered compensation. Survey data was collected from July 2021 to November 2021.

Upon completion of the survey phase and preliminary analysis of data, we compiled a list of respondents who had indicated that they were willing to participate in an interview. Interviews were conducted between December 2021 and April 2022. Interview audio was recorded using a HIPAA-compliant Zoom service, transcribed using Otter.ai machine transcription service, then reviewed and corrected

by student research fellows. Harvesters who participated in interviews were provided with \$50 Visa gift cards.

Community Feedback

We conducted a variety of activities to confirm and extend the insights from surveys and interviews. This included presentations followed by discussion to collect feedback from the project advisory committee and a variety of stakeholder groups, including two sessions at the Maine Fishermen’s Forum, the Maine Shellfish Advisory Council, and several public and occupational health audiences.

RESULTS

We received 106 valid responses to the harvester survey, with roughly 60 percent of respondents working in each fishery. Many reported working in both the lobster and shellfish industries, as well as others (Table 1). Thirty-one percent of respondents reported total annual incomes of \$20,000 per year or less, while about 28 percent reported incomes of \$50,000 or greater. Fifty-nine percent of respondents had been working in fisheries for more than 10 years, so the majority of respondents had long experience in the field. On the provider and advocate survey, we received 31 responses. Sixteen respondents were medical or behavioral healthcare providers, and others included seafood dealers (7), fisheries advocates (4), and enforcement officials (4).

We conducted interviews with 13 harvesters in the lobster and clam fisheries, several of whom were also engaged in advocacy and substance use recovery work as either professionals or volunteers. Ten of the 13 harvester interviewees reported working in multiple fisheries. We interviewed six healthcare providers, one shellfish warden, and a fisheries advocate. Among the healthcare providers interviewed, one also owned a lobster boat, which they operate

TABLE 1: Occupations of Survey Respondents

I am a (Check all that apply)	Count	% of total
Professional shellfish harvester	51	61
Crew/sternman in a lobster fishing operation	26	31
Owner of a lobster fishing operation	22	27
Professional harvester of worms or periwinkles	13	16
Professional harvester in other fisheries	9	11

with their spouse. Data from surveys and interviews with healthcare providers and other stakeholders were used to triangulate and expand insights gleaned from harvesters.

The analysis revealed five key themes:(1) factors that increase risks for injury; (2) how harvesters respond to injury; (3) conditions that influence interactions with the healthcare system; (4) barriers to health insurance; and (5) the prevalence of an injury, self-mediation, and addiction trap.

Injury Risk

Shoulder, arm, elbow, and hand injuries were the most commonly reported types of injuries with 60 percent of lobster harvesters and 77 percent of shellfish harvesters reporting injuries in the past year. Also, a majority of both groups reported back or neck injuries (54 percent of lobster harvesters and 69 percent of shellfish harvesters). A majority of shellfish harvesters also reported leg injuries. Overall, shellfish harvesters reported significantly higher incidence of injuries than lobster harvesters (Table 2). These findings are generally consistent with prior studies in other regions (Berg-Beckhoff et al. 2016; Kucera et al. 2009; Fulmer et al. 2017, 2019).

Interviews with harvesters provided further insights into how injuries happen in each fishery. Harvesters in both fisheries discussed repetitive-motion injuries and those incurred when lifting or carrying. The gear configuration and ergonomics of lobster boats were discussed at length as factors in injuries. One lobster boat captain said, “Always, always to my right side. I almost feel my right side of my hip is not as good. I twist to the right. Where my ankles stay put and I twist to the right. It’s hard to do it [haul traps] any other way.” A shellfish harvester explained, “One of the common problems is called ‘hog hands,’ where their hands

get locked into this position,” demonstrating a claw shape with his fingers.

Shellfish harvesters reported carrying their gear and catch across long distances, slogging over mudflats or rough terrain because of limited shore access. The heavy weight, uneven ground, and sucking mud caused back and knee problems.

“I lug anywhere from a half a mile to up to a mile, both ways, digging and then lugging back,” explained one clammer. “Most of us, we usually use a drag, which slides across the mud. You’re still pulling it, and you still got to lug it up across land because you can’t drag it. It’s too hard.... You’re digging anywhere between 100 and 150, 200 pounds every day.”

Harvesters in both fisheries discussed hand and arm injuries caused by cuts, abrasions, and cold temperatures. They commonly described working through such injuries and resulting infections while continuing harvest activities, sometimes resulting in long-term physical limitations and chronic pain. “I have had frostbite... severe enough that now it is self-induced neuropathy,” said a harvester who works in both industries. “My feet are numb now. I get a burning sensation, shoots up into my legs.”

Clam harvesters reported using bare hands or very thin gloves to pull clams from the mud under certain conditions where using a rake would damage the catch. This process involves scooping clams out and subjects the harvester to scrapes and cuts from broken shells and sharp rocks. Lobster harvesters and study advisory committee members talked about severe infections occurring on harvesters’ hands, especially when bait comes into contact with existing cuts. Anecdotes indicate that some healthcare providers may not be aware of this risk to harvesters, delaying appropriate treatment of wounds and infections.

Response to Injury

Across fisheries we found a shared belief that injury was inevitable. “Working through it,” often using self-medication with both licit and illicit drugs, is exceedingly common. This tendency to work through injuries in spite of pain and risk of long-term complications appears to be exacerbated by a combination of long-held cultural practices and practical considerations related to access to care and the need to maintain income under self-employment. These trends are clearly exacerbated by cultures of independence in remote communities, as well as structural barriers like limited access to affordable housing, health insurance, education, and technology. Here we discuss the conditions that contribute to

TABLE 2: **Types of Injuries Experienced by Lobster and Shellfish Harvesters**

Injuries	Lobster harvesters		Shellfish harvesters	
	Count	%	Count	%
Shoulder, arm, elbow, hand	30	60	40	77
Back or neck	27	54	36	69
Leg	21	42	28	54
Head or face	8	16	7	13
Other injury	1	2	5	10

TABLE 3: **Harvesters' Responses to Injury**

Response to injury	Count	% of total
Rested/didn't work	36	43
Over-the-counter medication (Tylenol, Aleve, Advil, etc.)	35	42
Visited a doctor, physician's assistant or nurse practitioner	26	31
Exercise or stretching	24	29
Visited a chiropractor	11	13
Medical or recreational marijuana, CBD, or THC	10	12
Other	10	12
Prescription medication	7	8
Visited a massage therapist/got massage from friend/family	6	7

these responses, including social and cultural norms, and systematic barriers to healthcare access.

Harvesters reported an array of adaptations and responses to injury, but in the survey, just 31 percent of harvesters reported visiting a doctor after being injured (Table 3). Most commonly, their response was to rest (43 percent) or take over-the-counter medication (42 percent). In comments, four reported “working through it,” though this was not an option in the survey selection.

In interviews, every harvester related narratives about taking extreme measures to work through injuries without seeking medical care, describing either themselves or their colleagues. According to a shellfish and lobster harvester, “Unless... it’s sticking out or very, very bloody, we work through it... Not never, ever, ever seen an ambulance show up.”

This quote from a shellfish harvester noted a common practice that we heard about repeatedly from harvesters: “I’ve actually stitched myself up before, believe it or not.”

A shellfish harvester explained one way they managed to keep harvesting in bitter cold conditions: “We heat up buckets of salt water, like we bring out a propane burner, and then when we lose feeling we just dip our hands in the boiling water. Do we have gloves on? Yeah.”

To manage pain, survey respondents most commonly reported using Tylenol (acetaminophen) and other over-the-counter pain medications every day, most days, or occasionally (77 percent). Marijuana, THC, or cannabinoids were used by 29 percent. Twenty percent reported using prescription pain medication with a prescription, and 12 percent

reported using prescription pain medication without a prescription.

Seventy percent of harvester respondents indicated that they had avoided going to the doctor or getting other kinds of medical care. According to a lobster boat captain, “If you’re asking if I’d seek medical advice, that’s kind of almost the last alternative.” The most common reasons cited for avoiding medical treatment were cost (39 percent) and lack of time (30 percent). We will address the issue of financial and insurance barriers in the next section.

A small but significant number of harvester respondents (11 percent) said they avoided medical treatment because they were worried about how they would be treated by clinicians. This response was more common among older harvesters, while both harvester and healthcare interviewees said they believed both injuries and problems related to self-medication for pain were more common among older harvesters.

Interactions with Healthcare Providers

Interviews with healthcare providers corroborated the disconnect between harvesters and clinicians. Some clinicians struggled to understand or connect and solve problems with their harvester patients and often expressed frustration with patients not following advice. They were seemingly unaware that their advice was often impractical and required an alternative approach. For instance, recommending weeks or months of rest or unworkable changes to harvest practices, in a harvester’s eyes, amounts to suggesting that they stop eating, feeding their families, and paying bills. In short, it would appear rational to ignore such advice and continue working.

Some healthcare providers read such resistance to clinical recommendations as stubbornness or as an insult. “There’s no value given to education and to somebody who is an expert, they think their opinion is just as good,” said one physician. “I don’t need anyone to kiss my feet, but you came into my door. If you don’t respect my opinion, then why did you come here?” Some healthcare providers saw all or most such resistance as drug-seeking, rather than an opportunity to take a new approach. “The ones who are still trying to get either opioids or other controlled substances for pain, don’t want to recognize that there might be a problem here,”

observed one physician. “That’s a big barrier when we try to even address it, [they say], ‘well, I need it to work.’”

However, other healthcare providers showed more cultural sensitivity in working with harvester patients. These providers informed themselves about the realities of patients’ lives, developing cultural competency and adapting their treatment approach accordingly. A physician explained that getting to know the patient is crucial. “The more you know about them, what they do, what they work, everything, the better you’ll be able to help them. It’s one of my key questions: what do you do for a living?”

A family nurse practitioner and a relative of a lobster harvester said, “Trust building doesn’t happen overnight. It takes time to build trust. But when you do build trust, something that I admire most is their straight talking. They’re authentic in a way that is still respectful and honest.” Similarly, a mental health provider described adapting schedules to harvesters’ time challenges: “I’m very flexible...I go above and beyond to schedule with tides, and sometimes my coworkers and the receptionist get a little put out because it isn’t easy. But to me, it’s important.”

Health Insurance

A story from a shellfish harvester was typical of narratives we heard in which the lack of insurance compounded problems related to injuries. He had used heroin to numb pain from a back injury, he told us, because it was easier to get and less expensive than insurance or prescription pills. He overdosed three times and kept getting sicker. “I didn’t go to the hospital when I should have. When my organs shut down, I almost died because I kept putting it off. I put it off and put it off because I didn’t have health insurance.” At the time of the interview, he was in recovery and had MaineCare, but expected to lose that coverage when he began harvesting again the following spring.

More than one-quarter of harvester survey respondents in our study said they lacked health insurance entirely. Half were on Medicaid or Medicare (Table 4). Interviews provided important insights into the insurance landscape for harvesters. They reported hurdles related to housing insecurity, boom-and-bust income cycles, access to technology that made acquiring and keeping health insurance difficult or impossible, and a wide array of other structural barriers.

A shellfish harvester told us the story of a colleague:

I don’t even think he has MaineCare because I don’t know if he knows how to go about navigating that. I mean, it could

TABLE 4: Health Insurance Status

Do you have health insurance?	Count	% of total
I do not have health insurance	22	27
MaineCare (Medicaid)	21	25
Medicare	19	23
Insurance through a family member's employer	11	13
Private insurance I pay for myself	10	12
Insurance through an employer	10	12
Other	2	2

be pretty confusing trying to navigate the forms and the paperwork. I know he doesn’t have a computer, he doesn’t have WiFi. I don’t think he has a smartphone. I think he gets mail. You know, so that’s the kind of person that really could use some assistance on navigating the myriad channels of bureaucracy.

Others spoke about the lack of affordability of insurance. “I think a lot of fishermen would actually [get insurance],” said a harvester in multiple fisheries, “if it was something affordable for them.”

Yeah, and healthcare... is expensive. It is [expletive] expensive,” observed a shellfish harvester. “Most fishermen, they got families, they got mortgages, truck payments, kids to take care of. They can’t afford the premium on healthcare.

In some cases, harvesters said they were not able or willing to get insurance until they aged into the Medicare system or were well along in their struggles with pain and addiction and had been out of work long enough to qualify for the state’s Medicaid program. “I got lucky,” said one harvester who got insurance after a long struggle with injuries and addiction. “I got MaineCare, which helped me because of me getting into counseling and everything else.”

Some lose insurance when they make too much to qualify for MaineCare and not enough to pay private premiums, which was a common problem for lobster boat owners/captains. Harvesters who are enrolled in MaineCare or housing-assistance programs are unable to save funds to help them weather times when they can’t work because having funds in savings can cause them to lose their benefits. According to a psychiatric nurse practitioner, “There are slack times and good, high earning times. And they have to be able to put money away. But you can’t put too much

money in the bank if you have MaineCare or live in a subsidized apartment.”

Most of the interviewees described age-related differences in willingness and ability to pay for health insurance and healthcare. Younger harvesters often did not see value in health insurance plans, while older harvesters expressed regret for not interacting with health systems to mitigate injuries sooner. Some older harvesters said that when they were younger, they didn’t save any money. Then when injuries and health problems began to crop up, they lacked funds to allow them to take time off from work. Healthcare providers told us that most harvesters in their practice who were struggling with addiction linked to previously untreated pain were in their late 30s through 50s.

Some older harvesters had tried to teach younger harvesters about injury risk and the importance of financial preparation with little success. “They don’t want to listen,” one experienced lobster harvester said. “You try to tell them things that you’ve learned the hard way, and they don’t like it. They just do things their own way. They are definitely knuckleheads.... I’ve given up on talking to the knuckleheads. They’ll learn the hard way, just like the rest of us have.”

Analysis of the Injury–Self-Medication–Addiction Trap

Our analysis revealed a dangerous cycle linking injury, self-medication, and opioid addiction exacerbated by structural and cultural factors affecting health. Every person interviewed discussed the prevalence of chronic pain from work-related injuries leading to self-medication and associated problems. Substance use disorder was commonly reported, along with related illnesses such as hepatitis-C, HIV, and organ failure due to long-term substance use. Many people interviewed described personal disruptions such as divorce, homelessness, involvement in the criminal justice system, and mental health issues stemming from injury and related substance use.

We heard a wide array of stories about struggles with pain, addiction, and overdose across both fisheries. In a typical narrative, one shellfish and lobster harvester related, “A lot of it was due to the injuries... and the doctors prescribing the pain medications, and I got addicted to it. And it took off from there. It’s just stupid... It started with my back and just escalated.” One shellfish harvester told us he counted four overdose deaths among fellow harvesters in his town of 1,200 people in one year.

While opioids like Oxycontin and heroin were reported as persistent problems for harvesters grappling with chronic

pain, our data show that self-medication with other substances is even more common. This includes substances such as over-the-counter medications (ibuprofen and acetaminophen), but also more dangerous substances like alcohol, methamphetamine, and the herbal supplement kratom. A nurse serving coastal communities said, “Chronic pain, they tend to live with, but that also leads into the whole addiction issue.... That’s how a lot of lobstermen get into the whole addiction issue, you know, treating the chronic pain and drinking.”

While this study was not designed to quantify prevalence, it was clear from both survey and interview results that opioid addiction and overdose are tips of a self-medication iceberg stemming from untreated and undertreated pain from work injuries. Harvesters and providers identified common conditions of the injury–self-medication–addiction trap, including the risk of injury and chronic pain, structural barriers to healthcare, and psycho-social factors described earlier. The outcome for most who fall into the trap is ongoing pain and deteriorating health. For some, the trap leads to substance use disorder, overdose, and too often, death.

DISCUSSION AND RECOMMENDATIONS

The study revealed widespread and intersecting concerns among harvesters related to injury and chronic pain, healthcare access, deferral of care, substance use, and addiction. In the course of this research, we observed that harvesters’ families and especially spouses can be an important resource in addressing these issues. Narratives about struggles with addiction commonly included accounts of family intervening and providing support. Female partners of male harvesters were often most engaged and vocal in our follow-up discussions about the study’s findings. Even when they themselves were not harvesters, they exhibited deep understanding of the issues, commonly speaking for their more reticent partners.

In summary, it is clear from this and other research that injuries are exceedingly common and viewed as expected among fisheries workers. The number of narratives we heard about back injuries leading to chronic pain and a deadly slide into addiction and overdose suggests that this particular type of injury is a crucial risk factor. Our interviews allowed us to gain a much more nuanced understanding of the interrelated conditions that lead to injury, pain, self-medication, and addiction. While only a small percentage of injured harvesters may develop substance use disorders,

self-medication is practiced in some form by the majority of harvesters in both fisheries. Lack of access to trusted, culturally competent medical providers fuels the injury-self-medication-addiction trap. Given these insights, it is clear that solutions that only target prevention and treatment of opioid addiction would address only a tiny fraction of the injury-related problems facing harvesters.

Interviews and subsequent discussions with project partners and industry advisors provided several insights into where, when, and how interventions might be most effective in addressing the intertwined issues of injury, pain, substance use, and health among workers in the shellfish and lobster industries.

Embed Occupational Health and Safety Programs

It is crucial for those involved in fisheries management to understand that the health of fisheries workers is inextricably linked to management practices and that the future sustainability of the fisheries sector hinges on a healthy workforce. Health considerations should be embedded in fisheries management decisions. For instance, many injuries can be prevented by securing coastal access to mudflats and ensuring that working waterfront infrastructure is safe. Occupational health and safety efforts embedded in harvester education and incentive programs should be expanded to provide training and supplies for ergonomics, first aid, health insurance access, and substance use response. Such programs should also engage and leverage families and communities. Not only will these interventions directly address issues, they will help to normalize engagement with healthcare and support systems.

Lower Structural Barriers in Healthcare Systems

Maine's healthcare system needs to adapt to the realities of rural communities with resource-dependent industries prone to injuries, chronic pain, and substance use issues. Such adaptation not only includes structural changes that lower barriers to care such as adjusting schedules to work with harvester schedules. It also requires increasing cultural awareness and working with patients to solve problems in ways that are workable given the constraints and particular health challenges they face. Health navigators with experience in fisheries and fishing communities can serve as liaisons to improve communication and problem-solving. Engaging spouses in problem-solving with taciturn or mistrustful harvesters should be explored as a strategy to improve outcomes in clinical settings.

At the behavioral-health- and health-system level, funding is needed for training healthcare providers, as well as for low-barrier and peer-led healthcare delivery and intervention models, including culturally informed health navigator and peer-support programs. Providers in emergency departments and clinical practices should be trained to look for opportunities to intervene earlier in the injury–pain–substance-use process. If someone presents at the emergency room with a back injury, questions about their occupation and insurance status could help identify people who are at higher risk for later substance use disorder. Early identification of such people could trigger informed, fisheries-oriented interventions aimed at helping harvesters access needed care and support to address their injury and maintain their financial security. For instance, a health navigator with fisheries knowledge could assist harvesters to access insurance and serve as a liaison to help them continue harvesting. When continued harvesting is not advisable, the healthcare worker could coordinate access to financial and other services to assist them in weathering a period without income.

One idea that emerged from discussions is a mobile van to provide basic medical and mental health care and help navigating the healthcare system in locations harvesters frequent, such as docks, seafood dealerships, or lobster zone council meetings. Also, increased access to urgent care services would expand the hours in which harvesters can access care.

Revelations about age-related changes in both risk of injury and substance use have crucial implications for policy interventions. Among younger harvesters, it's important to prioritize injury-prevention programs and financial literacy and money management training. Such programs can help reduce injuries, lower economic barriers to health, and promote financial stability as the harvesters age and face injury-related crises. Additionally, intervention should help dispel older harvesters' mistrust of the healthcare system and reduce their reluctance to properly treat injuries in a timely manner.

Build Financial Safety Nets for Fisheries Workers

Interventions that increase access to health insurance and financial backup for self-employed harvesters will be vital to improving health and preventing substance-use-related issues. This issue is especially important for shellfish harvesters. Some of the lobster associations in Maine have group health insurance options, but no such programs exist

for the shellfish industry. Also, rules should be changed to allow harvesters to retain health, housing, and food benefits when they save money to prepare for an increasingly uncertain future. Changes could include expanding eligibility requirements under Maine's ABLE ME program for individuals who become disabled and creating new programs or exemptions allowing self-employed individuals who lack a safety net to save funds without losing benefits.

Prioritize the Most Vulnerable Workers

Finally, harvesters in the shellfish industry are at far greater risk for injury and are, on average, more socially vulnerable than those in the lobster industry. Furthermore, because the lobster industry is much larger and more lucrative, the shellfish industry receives far less attention and fewer resources. The shellfish industry, however, is critical to rural coastal communities in the Downeast region. Because of the shellfish industry's low barriers to entry, it employs many of the most socially vulnerable members of the community and infuses the local economy with financial resources. Investing in injury-prevention and health-related programs, as well as insurance programs will be crucial to supporting this industry into the future.

CONCLUSION

Our study makes clear that health-related challenges are widespread and, too often, overwhelming for shellfish and lobster harvesters in the Downeast region. Injury, chronic pain, and substance use issues affected every harvester in our study in one way or another and affected their families and communities. This reality compounds other challenges from environmental, regulatory, and financial issues that affect remote coastal fisheries-dependent communities in Washington and Hancock Counties. Based on prior research and related evidence, we have reason to believe these problems permeate fisheries and seafood industries statewide, as well. Moreover, they may constitute a significant element of the state's opioid crisis overall.

The safety and sustainability seafood harvests in Maine depend on a healthy workforce ready to tackle complex challenges. If we do not address health issues among fisheries workers, not only will harvesters continue to suffer from pain, poor health, and substance use disorder, but also their struggles will affect Maine's economy, especially in the Downeast region. The future of these iconic Maine industries depends

on timely action undertaken in partnership with harvesters, fisheries advocates, and healthcare system leaders.

ACKNOWLEDGMENTS

Support for the study was provided by the University of Maine System Rural Health and Wellbeing Grand Challenge Injury Prevention Seed Grant Program, the Maine Shellfish Restoration and Resilience Fund, and the Elmina B. Sewall Foundation. We also wish to acknowledge the invaluable contributions of our advisors from lobster and shellfish harvesters and buyers, Community Caring Collaborative, Sunrise County Economic Council, Maine Center for Coastal Fisheries, Maine Coast Fishermen's Association, Maine Mobile Health Program, the Maine Shellfish Learning Network, and the Maine Department of Marine Resources. The study protocol was overseen by the University of Maine Institutional Review Board to ensure best practices were followed for human subjects research. (IRB Protocol 2021-05-04).

NOTES

- 1 https://mainedmr.shinyapps.io/Landings_Portal/
- 2 <https://data.hrsa.gov/tools/shortage-area>
- 3 <https://doi.org/10.53558/HMLG6818>

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Tora Johnson is a social scientist and geographer. She codirects the Sustainable Prosperity Initiative at the Sunrise County Economic Council and is an external faculty associate with the University of Maine's George J. Mitchell Center for Sustainability Solutions. Johnson's research centers on best practices for supporting coastal community resilience.

Katherine Weatherford Darling is a health equity researcher and assistant professor of health science at University of Maine School of Nursing. Her research uses community-engaged sociological methods to uncover the root causes of health inequities to support the design of effective policy solutions.

Debra Kantor is currently an instructor for the graduate faculty at the University of Maine. Before moving to Maine, Kantor worked as a medical anthropologist with extensive international experience in the development and assessment of HIV/AIDS and tuberculosis programs.

Joseph Spiller has supported research projects focused around community engagement and health equity in underserved communities. He was a DEI fellow with the University of Maine and a 2020 Maine Policy Scholar.

O. Gracious Jones is a graduate student at the University of Maine, working toward an interdisciplinary PhD focusing on rural healthcare economics.

Lois-Ann Kuntz is an applied psychologist interested in improving human relationships within our physical, biological, social, occupational and technological environments. Since 2003 she has incorporated community engaged learning and research in both campus and online courses.

Tara Casimir serves as an assistant professor at the University of Southern Maine. Her research focus encompasses global and community health, particularly in capacity building within low resource areas.

Amy Dowley is a GIS Specialist at the Maine Department of Inland Fisheries and Wildlife. She served in the United State Peace Corps and as a community health worker for the Maine Mobile Health Program.

Greyson Kurtz is an interdisciplinary PhD student at the University of Maine who studies Passamaquoddy language, culture, and history. Their research focus is language reclamation/revitalization methods in Passamaquoddy.

Lauren Sachs works with Healthy Acadia, where she serves in a dual role as Washington County's Recovery Response Coordinator and PROSPER Health Navigator.

Linda Silka is professor emerita at the University of Maine. A community social psychologist, she directed the Margaret Chase Smith Center at the University of Maine and now serves as senior fellow at the George Mitchell Center for Sustainability Solutions.

Bridie McGreavy is an associate professor of environmental communication in the Department of Communication and Journalism at the University of Maine. Her work uses engaged and decolonial methods to cocreate knowledge focused on water and environmental justice. She is a faculty fellow with the Mitchell Center for Sustainability Solutions.