2020

Characterizing occupational health exposures and health outcomes among immigrant dairy farmworkers in Vermont

Mary-Kate Barrett
University of Vermont

Characterizing occupational health exposures and health outcomes among immigrant dairy farmworkers in Vermont

By Mary-Kate Barrett

A senior thesis

submitted in partial fulfillment of the

requirements for the degree of

Bachelor of Science

Environmental Program

College of Agriculture and Life Sciences

University of Vermont

2020

Advisors: Bindu Panikkar (ENVS/RSENR), Ingrid Nelson (GEOG/ENVS), and Abel Luna (Migrant Justice)

ABSTRACT

Migrant dairy workers face a wide range of occupational and health hazards at work. Based on in-depth interviews (n=10) with relevant community, academic, and legal experts, and surveys conducted by the Vermont non-profit Migrant Justice of 100 migrant dairy workers, this research examines the environmental risks, occupational health hazards, and health outcomes experienced by migrant dairy farm workers in Vermont. Our results show that Vermont migrant dairy farmworkers who work in medium to small farms experience similar health risks as in other states with bigger dairy infrastructure. The health risks reported by migrant dairy workers include long work hours, exposure to harmful chemicals, accidents from powerful animals and heavy machinery, and poor access to health care, information, and transportation. Health outcomes reported include respiratory issues, headaches, vision problems, injuries, musculoskeletal pain, depression and stress.

ACKNOWLEDGMENTS

This project would not have been possible without the help of my advisor, Bindu Panikkar. I have so much gratitude for your guidance, feedback, and thoughtfulness throughout this entire project. Thank you for giving me your time.

Thank you to my secondary advisor, Ingrid Nelson, for joining this team and similarly taking the time to read through my draft and provide me with guidance. Thanks also to Abel Luna and Madeline Sharrow of Migrant Justice for their valuable contributions, and to all the farm workers that were surveyed through Migrant Justice, whose survey answers are used in this project. Thank you additionally to all farm workers everywhere, who continue to do the essential work of keeping the food system intact as the world faces a global pandemic.

Special thanks to Walter Keady, Qing Ren, Kelly Hamshaw, and Julia Selle for all their hard work, collaboration, and encouragement on this Environmental Justice project. Thank you for letting me be a part of the team.

TABLE OF CONTENTS

INTRODUCTION

Immigrant farm workers play an important role in the United States' dairy industry, an estimated 51% of all dairy labor in the United States are carried out by immigrant labor (Adcock et al., 2015). Since at least the 1990s, there has been an increase in Latino migrant workers on dairy farms. A labor shortage in the farming sector coincided with increased migration patterns from the Global South to the United States, as a result of the neoliberal trade policies such as the North American Free Trade Agreement (NAFTA), that transformed agriculture and land access in Mexico (Baker & Chappelle, 2012; Radel et al., 2010; Jenkins et al., 2009; Mares, 2019). After the passage of NAFTA, an estimated 2 million Mexican farm workers lost their livelihoods and were forced into cities and across the border to find work (Mares, 2019). Historically, starting in the 1930s, farm workers have been excluded from most labor regulations, due to a history of agricultural exceptionalism. Farm workers are not included in regulatory laws such as the National Labor Relations Act and the Fair Labor Standards Act, making it possible for farmers to violate labor standards for training and compensation (U.S. Congress, 1934; U.S. Congress, 2011; Liebman et al., 2018).

Most of the literature on dairy farm workers in the United States concerns top dairy producing states, which include California, Idaho, New York, Michigan, and Wisconsin in particular, where immigrants make up 40% of the dairy producing workforce (Harrison & Getz, 2018; Shahbandeh, 2020). Many studies have documented dairy farm work as one of the most hazardous sectors of the United States' economy (Arcury & Quandt, 2007; Bauer & Kantayya, 2010; Buckheit et al., 2017; Chapman et al., 2011; Douphrate et al., 2013). Harrison and Lloyd (2013) found that on Wisconsin dairy farms, occupational segregation exists and employers organize work and workers in unequal ways. Several studies focused on worker safety on

Wisconsin dairy farms, found that few farms have safety expertise, worker safety training, and dairy injuries remain common (Keifer et al., 2012; Juarez-Carrillo et al., 2017). Chapman and colleagues (2011) found that safety interventions to farmers were successful in minimizing risk on Wisconsin dairies, but Liebman and colleagues (2018) finds a large presence of hazards to workers on dairy farms in both Wisconsin and New York, based on an impact assessment of OSHA large dairy local emphasis programs. Farm fatalities and injuries from accidents and exposure remain high (Colt et al., 2001; Buckheit et al., 2017; Hansen & Donohoe, 2003). Douphrate and colleagues (2013), in their global study of the dairy industry, contend that underreporting of injury and illness is extremely common across the sector as a whole.

Research about chemicals used on dairy farms and their health outcomes exist to some extent, but lacks in part because cancer and other chronic illnesses take a long time to develop and diagnose, and following migrant farm workers for such longitudinal health analysis is difficult because of the transitory nature of the work (Arcury & Quandt, 1998; Lantz et al., 1994). Despite this, many studies have reported exposures to chemicals such as volatile organic compounds (VOCs), formaldehyde, and cleaning products and their associated health risks among dairy farmworkers. Formaldehyde is another key chemical of concern used on dairy farms in footbaths, generally to clean hooves to prevent disease (Doane & Sarenbo, 2014).

Chemicals on dairy farms enter the body by making contact with the skin, respiratory tract, eyes, or the gastrointestinal system. Acute effects include skin rashes and eye/respiratory irritation, while chronic outcomes can be cancer or cognitive deficits and may lead to death (Quandt & Arcury, 1998). Beck and colleagues (2007) found that volatile organic compounds found in the air in dairy farms can make respiratory illnesses worse. The presence of VOCs in the air was measured in the stables and the keeping area of cattle in Northern Germany. Farmers

working with the cattle also reported asthma, rhinitis and conjunctivitis. Similarly, Dalphin and colleagues (1998) found that dairy farming was significantly and highly associated with respiratory illness and increased the odds of chronic bronchitis in their study of dairy farmers in the French province of the Doubs. Formalin in formaldehyde is a known carcinogen and irritant at certain levels of exposure (Doane & Sarenbo, 2014). A study of formaldehyde exposure on dairy farms in New York state found that concentrations of the chemical were within the safety guidelines created by the Occupational Safety and Health Administration, and that ventilation was important in maintaining safe exposure (Doane & Sarenbo, 2014).

The existing literature shows that the health and safety risks that migrant workers face are high. Most of this scholarship in the dairy farm industry has been done in top dairy producing states, in bigger dairy industries. Still these studies have not adequately characterized the risks at work, hazardous exposures, and health outcomes especially among the migrant dairy farmworker especially in secondary tier dairy producing regions with medium to small dairy farms. This research focuses on the dairy farms in Vermont, which hosts mostly medium to small farms, is known for its renewable and green energy infrastructure, its higher number of organic farms than in other states producing a large percentage of the milk for the entire region of New England, and known for its widely selling market goods such as Cabot cheese and Ben and Jerry's ice cream (Parsons, 2011). In particular, this research examines if migrant dairy farm workers in Vermont face similar risks and health outcomes.

The Vermont Dairy Industry

Agriculture, dairy farming and its associated idyllic landscape has long played a central role in the social imaginary and identity of Vermont. While its role in the state's local economy

is marginal at 1%, agriculture retains a strong footprint in the state's land use with close to 20% of the state's land invested in Agriculture (Thompson et al., 2017). Dairy farms in Vermont contribute to 70% of agricultural sales and manage 80% of Vermont's open lands. Agricultural crops, in comparison, do not contribute much to the local economy. In 2015, the most commonly produced crops were hay and corn for livestock, outside of maple and apples. Dairy farming, production of hay, and corn dominate this industry (Vermont Agency of Agriculture, 2015). Vermont has 185 Animal Feeding Operations with 200-699 cows and 25 Concentrated Animal Feeding Operations with over 700 cows (Colby, 2018).

Nationally, Vermont is not a top dairy producer. The state produces less than 2% of all milk in the country, which ranks it as the 18th largest producer of all 50 states (USDA, 2020). Vermont has the highest dependence upon a single commodity, milk, for agricultural revenue in the country and the dairy industry brings in about $2.2 billion a year (Mares, 2019; Kades, 2019). In Vermont, dairy products make up 71.1 million dollars' worth of exports and 63% of all milk produced in New England comes from Vermont (Vermont Agency of Agriculture, 2015). The state has lost more than 90% of its dairy farms due to the continuous downturn in milk prices over the past 75 years, leading small farms to consolidate (USDA, 2020; Mares, 2017; Kades, 2019). There was a 7.2% decrease in the number of dairy farms from 2012 to 2017, and a 4.7% decrease in farm acreage during the same period (Thompson et al., 2017). As of 2015, there were fewer than 900 dairy farms left (Vermont Dairy Promotion Council, 2015). Still, the dairy industry plays a sizable role in the state's economy and identity, and yet the health and safety of the workers that sustain these farms and this shrinking industry has largely been overlooked. For this reason, this research provides a unique insight into this underexplored Vermont context.

Dairy Farm Workers in Vermont:

Immigrant labor is an integral component of the Vermont dairy industry, especially as it expands and modernizes (Baker & Chappelle, 2012; Liebman et al., 2018). A 2010 survey reported that 75% of farmers believed there was a labor shortage and 37% thought that Latino migrants could sufficiently fill that hole (Baker, 2013). As of 2016, there are approximately 1000-1500 Latinx migrant dairy workers in the state, 90% of which are thought to be undocumented, though it is difficult to find an accurate report of this number due to legal risks for both employers and employees (Mares, 2019; Kades, 2019; Baker, 2013).

Baker and Chappelle's (2012) surveys between 2009 and 2011 on dairy farms in Vermont showed that Latinx workers are young and predominantly male; 93% were Mexican and 7% from Guatemala. Of those surveyed, 89% only spoke Spanish and 4% reported being able to speak English well. Many of the workers were found to have little to no experience with the United States' agriculture sector, and the laborers were highly transient, with 50.8% having been on their current farm for no more than 1 year and 8.3% for more than 3 years. 91.6% of these migrant dairy workers in Vermont were milkers and worked a mean 64.5 hours a week with a median hourly wage of $7.75 an hour. All of the workers surveyed lived on the farm (Baker & Chappelle, 2012). Undocumented migrants have become integral to keeping smaller farms open as farmers get away with low wages and, at times, poor working conditions due to intensive milking technologies and schedules that have allowed the state to produce milk at record levels (Radel et al, 2010; Jenkins et al, 2009; Mares, 2019).

There is a small but growing literature on the health and safety of Vermont dairy farm workers. Baker & Chappelle (2012) surveyed 120 Latino workers on 59 Vermont dairy farms and found the most common health issues to be back/neck pain and mental health issues.

Isolation and fear of Immigration and Customs Enforcement (ICE) were also found to be primary barriers to health. Buckheit and colleagues (2017) also examined barriers to health care access and found that language and lack of insurance were the main issues. In a study of 34 interviews with Vermont farmworkers, Walcott-MacCausland (2014) found that barriers to healthcare access for workers in border counties led to self-medication and a dependency upon employers for care. More information on the unique occupational and environmental risks to migrant farmworkers in Vermont is needed.

Dairy farm workers are exposed to wide ranging chemicals used by the farming industry in Vermont; Close to 92,000 acres or 96% of corn grown are GMOs in Vermont to feed the dairy industry. Atrazine, metolachlor, and glyphosate are the top three herbicides used in Vermont (Regeneration Vermont, 2016). Confined, non-grazing dairy production are also treated with a wide variety of fertilizers, pesticides, and antibiotics (Regeneration Vermont, 2016). The annual pesticide use documented by the Department of Agriculture notes that the pesticide use is up 39% from 2008 through 2012. The data on annual pesticide use has not been updated by the state since then. Similarly, herbicides, especially glyphosate use, has doubled since 2002 while the number of farms in operation in Vermont has declined (Regeneration Vermont, 2016). Vermont has the highest rate of glyphosate use in the New England region with over 36,000 tons of glyphosate used in 2016 (Regeneration Vermont, 2016). Despite the wide usage on farms, no studies have been conducted in Vermont on how chemical exposures impact the health of migrant dairy farm workers in Vermont. The research explores the relationships between health and safety risks, health barriers, and health outcomes among migrant dairy farm workers in Vermont.

Vermont is unique place to conduct such a research because of the role dairy plays in its economy and self-image, as well as its proximity to the northern border, which might pose its own unique risks and tensions. Immigrant farmworkers are essential workers. The "essential" role that immigrant laborers play on farms was made especially apparent with the onset of COVID-19. Their continued work is sustaining the food system, and many undocumented workers have been given letters that give them permission to keep working, despite national stay-at-home orders (Jordan, 2020). However, the spread of COVID-19 has also produced more injustices. Undocumented workers are excluded from obtaining federal stimulus packages. And as the consumption of milk continues to fall, so too will compensation for dairy farmers and thus compensation for laborers (Trombly, 2020; Norton, 2020). Additionally, workers are often in close contact with other workers on farms and in housing, and so the possibility of infection is greater (Trombly, 2020). Overall, the pandemic has made clear the critical work that immigrant workers provide, which makes sharing this research on migrant health and safety with the public more relevant. Below we highlight the detailed methods used to collect data on migrant dairy worker and findings on their work experiences, the hazards they face and health outcomes they face on dairy farms in Vermont.

METHODS

This research is part of a community-based research project investigating environmental injustices and inequitable distribution of environmental and health services across the State of Vermont. This research was done in partnership with Rural Environmental Justice Opportunities Informed by Community Expertise (REJOICE), a coalition of community, academic, and legal experts. REJOICE was started to understand environmental justice issues in Vermont and to ensure that a community-based approach would inform environmental justice policymaking in the state. Vermont is one of eight states not to have an environmental justice policy. REJOICE has been working with partners such as Vermont Department of Environmental Conservation and Vermont Department of Health to ensure that the voice and the key health and environmental concerns of the poor and communities of color are taken into consideration within environmental and health decision-making in the state.

As part of this initiative, the Research Core of the REJOICE team conducted a hot spot spatial analysis to identify ten priority communities of concern. Based on this data, more in-depth quantitative and qualitative research was conducted in the hotspot communities or highly marginalized communities that tend to suffer the greatest environmental and health burdens. Research assistants consisting of undergraduate and graduate students obtained specific training from the community members to do door-to-door surveys (n=571) and interviews (n=50) in the ten priority sites. I was not involved in the initial data collection. The rest of this section is focused on the specific methods and associations that have built this scholarship on occupational and environmental risks among migrant dairy workers.

This thesis paper draws from a subset of the interview data that the REJOICE group collected, and is focused on migrant farmworkers, one of the groups in Vermont that faces high

environmental and health risks. The interviews were conducted with key informants who are either community experts, environmental organizations, or the state who work with or represent the needs of either communities of color, low-income, and the most marginalized population in the state. The research assistants involved in the REJOICE project conducted the interviews in person at a location of the interviewees choice and convenience. One interview was conducted by the author on Zoom, a video conferencing software, due to the outbreak of the COVID-19 global pandemic. The key informant interviews were semi-structured and were an hour to an hour and a half long. The interviews explored the key environmental, social, and health problems migrant farmworkers face in Vermont, and how these injustices impact their lives and communities. All of the participants interviewed in this study were over 18 years of age and all study protocols were approved by the University of Vermont Institutional Review Board (Appendix B).

In addition to the in-depth interviews, this research is built upon the surveys (n = 100) that were conducted by Migrant justice (2020) between 2018 and 2019 and the document they released explain their results (Appendix A). I did not play a role in the data collection for the Migrant Justice surveys. Migrant Justice is a non-profit organization working to "build the voice, capacity, and power of the farmworker community and engage community partners to organize for economic justice and human rights" (Migrant Justice, 2019).

The health and safety surveys were conducted with migrant farm workers by Migrant Justice in order to better understand the safety needs and concern of the farmworkers and to better represent and advocate for their needs and farmworker dignity in their campaigns. The surveys solicited information about living conditions, access to safety equipment/healthcare, chemical/animal/machinery risks, and mental health issues was collected. The farmworkers

included came from dairy farms all across the state. Farms that participate in Migrant Justice's Milk with Dignity Campaign were not included because participating farmers in this program have already agreed to comply with the requirements of the human rights-based Code of Conduct (Migrant Justice, 2020; Migrant Justice, 2016). Information on the health and safety of migrant workers is highly sensitive and access to contacts in this vulnerable community are difficult to obtain[1]. For this reason, I did not have access to the full data set that Migrant Justice collected and instead rely on the surveys as secondary data. This data represents information from a one of the most vulnerable groups, that is difficult to access. Migrant farmworkers are likely to not engage in online surveys and to take surveys given by researcher's unknown to them.
The data from the Migrant Justice health and safety surveys will be compared with the information from the interviews to allow for a more complete understanding of the themes and be placed within an accurate context (Teddlie, 2009).

I coded the interview data using NVivo 12, a qualitative analysis software, to identify common themes, deviating perspectives, and assess the credibility of the findings. I then conducted a systematic hierarchical thematic analysis to label and categorize the data. Themes identified for the study influenced by the theoretical framework of the Vulnerable Population Conceptual Model formulated by Flaskerud & Winslow (1998). I also utilize the environmental health disparities and the vulnerable populations conceptual model to explore the environmental health disparities that migrant farmworkers face within Vermont (Gee & Payne-Sturges, 2004). The vulnerable populations conceptual model theorizes that "there are interrelationships among

[1] To design the surveys, Migrant Justice met with workers over the course of three months to look at the potential questions and tweak them until they presented something that would be understandable for the community. After the questions were designed, a group of 8-12 farmworkers coordinated the research by meeting with workers on farms, at churches, and at the University of Vermont. Since the coordinating committee were made up of farmworkers, they knew a lot of farmworkers and were trusted in the community.

resource availability, relative risk, and health status" (Bragg-Leight, 2003, p. 441). Vulnerable populations are "social groups who experience limited resources and consequent high relative risk for morbidity and premature mortality" (Flaskerud & Winslow, 1998, p. 1). The VPCM is a useful tool in analyzing immigrant farm workers because immigrant farm workers face multiple challenges at work which they may not feel comfortable raising with their employers due to fears of losing their employment, and their right and means to be in the U.S, hence are a disenfranchised and political marginalized population, which further increases the risks that they face in their workspace. In addition, the jobs performed by migrant farm workers tend to be low-income, are subject to discrimination and are therefore a very vulnerable population. The environmental health disparity framework posits that psychosocial stressors may be the vulnerability factor that links social conditions with environmental hazards (Gee & Payne-Sturges, 2004). Psychosocial stressors in this research include occupational and social hazards.

Table 1. Framework of coding structures

Constructs	Concepts	Narratives
Occupational Attributes	Work Organization	Cleaning activities
		Routine
	Occupational Health Hazards	Chemical exposures
		Musculoskeletal risks
		Animal hazards
	Social Hazards	Language issues
		Immigration threats
		Wage inequality
		Lack of breaks/long hours
		Access to adequate housing
		Other social hazards

	Occupational Health Services	Access to safety equipment
		Inadequate training
		Access to health care
		Access to transportation
	Health Outcomes	Problems due to chemical exposures
		Musculoskeletal problems
		Psychological health
		Accidents and injuries
		Other health problems

RESULTS

Migrant dairy farm workers face a variety of health risks and barriers to health. In this section this research presents the results from the study which characterizes the experiences of migrant farm workers in three key sections—1) working conditions on dairy farms, 2) social barriers to health, and 3) health outcomes self-reported by the migrant farmworkers. The working conditions on dairy farms explores issues related to chemical exposures, lack of breaks/long hours, inadequate work and safety training, and inadequate access to safety equipment. The social barriers to health characterizes issues related to wage inequality, immigration pressure, language, housing, health care, and transportation. The self-reported health outcomes details reports of accidents and injuries, musculoskeletal risks, health risks from chemical exposures, and other chronic conditions experienced by the migrant dairy workers.

Working Conditions on Dairy Farms

Our key informant interviews largely identified that the work routine of migrant dairy workers varies from farm to farm, and depends on factors like the size of the farm, how many workers there are on a farm, and how many cows there are. Most workers are hired to work directly with the cows, which means rising as early as four in the morning to milk them. Depending on the schedule, cows might have to be milked a couple of times a day. When discussing the tasks of farm workers, one community member said, “Milking every day, three times a day, always means you’re doing the same motion for years. Repeated movements that you’re basically doing for years, every single day.” Key informants also reported that migrant farm workers also face long hours and a lack of breaks during the work day.

The survey results confirmed the key informant reports and identified that 94% of workers reported working at least 8 hours, while 38% reported working 12 or more. Additionally, 24% reported that they did not have a break during their shift, and 30% reported that they work all seven days a week (Migrant Justice 2020). This strenuous work schedule impedes the sleep schedule of about a quarter of the migrant dairy workers as well, with 23% reporting that they do not have time to sleep eight hours a night (Migrant Justice, 2020). When speaking to the long hours that workers face, one community member said: "I mean it's all over the place… there are guys who work 11:30 p.m. to 11:30 a.m., people who work 1 a.m. until 1 p.m., and some who work 7 a.m. to 7 p.m., and a lot of times they're in situations where they can't get a good night's sleep. You put that together and that just seems like it ups the ante for danger."

The length of the work day varies by the specific needs of the farm. One community member reported that: "I was talking to one guy who told me he's supposed to work a 12-hour day, but he helps out when the cows are giving birth, and so he was working 19 and 20 hour days when a lot of them were having babies… he learned English so he could say to the boss 'you hired me for this many hours, but I'm working this many hours and not getting paid.' They basically said well go somewhere else, and he did." While this worker was able to find another job, not everyone is equally lucky, many also face termination if the workers fail to comply, or demand to be paid appropriately for their performed labor. Additionally, some farms are so small that there are only one or two workers, which increases the amount of work that they need to perform since there are no options for others covering their shift. One community member gave a particularly harrowing anecdote: "There are workers who work eight hours, sleep for three, and then come work another shift. They never actually get to sleep for eight consecutive hours, for

years." This anecdote speaks to either the shortage of workers in the dairy industry or the inability of their employers to afford more field hands where the farmers themselves are struggling to making their ends meet in a market that continues to subsidize mild prices.

These poor schedules also have other trickle down effects. Pressed for time, ironically it is not unusual for dairy farm workers to miss meals, eat properly, to eat on time, and often do not have access to healthy food, since it takes time to buy and prepare healthy food. Some people only have 10-20 minutes to eat, and so convenience is of utmost importance. In the Migrant Justice Health and Safety Survey, 23% reported running out of food at some time (Migrant Justice, 2020). Community members also spoke about worker exhaustion after long days, which similarly leads to a desire for convenience without necessarily thinking about the health benefits of the food.

Chemical Exposures: Both our survey and interview results show that the migrant dairy workers in the study are exposed to a wide range of chemicals. In the Migrant Justice Health and Safety survey, 83% reported experiencing harm from a chemical or biological risk while working on the farm. The top exposures were from acid (43%), manure (44%), iodine (51%), chlorine (70%), and footbaths (55%) (Migrant Justice, 2020). Exposure resulted from conducting day to day tasks such as milking, cleaning/disinfecting, from pesticides applied to corn that is grown on the dairy farms, and indoor air pollution. Specific pesticides of concern in the state included glyphosate, atrazine, and neonicotinoids. Community members that were interviewed made it clear that working on a farm meant being in constant contact with chemicals, regardless of the task. The activities that exposed dairy workers the most to chemicals were cleaning and maintenance of the barn. Iodine is used for both washing and cleaning, but its main usage is for cleaning the teat of the cow. Community members reported that when using it in this context, it

often splashes into worker's eyes. Chlorine is used mainly for washing/disinfecting the machines, and that will also often splash onto workers faces and burn them. It was noted that chlorine is particularly dangerous if it gets mixed with other chemicals, such as ammonia. Similar to chlorine, acid is used for cleaning and is extremely dangerous, especially when mixed with other chemicals. One community member spoke about this and said: "With chlorine and acid, a lot of people don't know how to use it or know the effects associated with it so they don't wear protective gear such as a mask or gloves. People just don't know the associated risks. You learn by something happening to you."

Antibiotic use was another chemical use of concern to dairy workers. One key informant that works closely with migrant workers reported that, on dairy farms, there is: "Routine antibiotic use. The second a cow goes dry, they go back to freshen up, routinely after lactation period. Almost all the big CAFO farms, the second lactations over, they give an antibiotic dose. Just for prophylactic purposes because these cows are in filth and standing in shit and urine water. So it's routinely used." This community member also reported that although tolerances for antibiotic uses are set by the state, farmers can manipulate the tests to make sure that they do not go over the mandated tolerance.

Footbaths for cow hooves are also another major source of chemical exposure for workers. In this case, the danger comes from the formaldehyde in the footbath, either in liquid or powder form. Problems with hooves occur frequently, especially in big milking parlors. According to one community member, cows will walk through the footbaths in their loping shed and go immediately to the milking parlor, which spreads the formaldehyde around and gets into the manure pit which is then spread on the land, untreated. There is no filtering of hazardous waste.

The poor living conditions under which migrant dairy workers live could also be the cause of exposures to these chemicals, especially since some workers live in the barn. Several community members identified that the water at the farms might also be contaminated due to the "heavy-duty fertilizers" and range of other chemicals that seep into the water system and said that many of the workers do not drink the tap water on the farms, and instead drink bottled water to avoid being contaminated. Some community members expressed frustration with how the state responds to the excessive/dangerous use of chemicals on farms, especially when farms are found to be in violation of a law regarding chemical usage. One community member mentioned that he filed a complaint with the agricultural agency because he a saw a farmer: "Set up a make-shift place where he was mixing all his pesticides. And he had all these containers, it was out-- it was that rainy period in June. It was all just soaked wet on these cardboard boxes of atrazine! And glyphosate! And metolachlor! All the containers just thrown, getting rained on." He continued, that the agricultural agency took a month to respond to the claim, and by the time someone came out to look into it, it was gone. The lack of response from the agency is concerning, given that cavalier practices increase exposure for farm workers, putting their health and lives in danger. Farm workers, the most vulnerable people on the farm, and several community members expressed frustration that these workers are largely ignored when the public thinks about agriculture in Vermont because Vermont is perceived as a "pure place," versus the reality of hazardous chemicals that are in use in agriculture in Vermont that workers on the farms deal with every day.

Work Safety and Health Training: Training on farms has the potential to curb the hazards of the environment, but access to adequate training is lacking. In the Migrant Justice Health and Safety survey, only a quarter of workers reported having received training on safely handling

chemicals on the farm and a training on the risks associated with the chemicals used in the farm, and only 8% were given training or had training on the biological risks that workers face on the farm. There was also a general lack of training in animal risks and working with animals safely on the farm, half the workers reported not to have received such a training. Additionally, only 45% of workers reported training to safely operate the machinery and other equipment on the farm. However, of all the workers that reported training, a majority 58% reported that their training was sufficient (Migrant Justice, 2020). Additionally, it is important to consider that much of the training received was in English, unless another worker who had been there longer was on the farm to teach them.

While one can learn to conduct work through practice, lack of adequate training may increase the chance of exposure to hazards and risks at work. Community members expressed a lot of concern for this, especially in relation to working with chemicals. One community member said, "You learn by doing and then having something happen to you. There's pretty much no real training." Another issue is that when workers train other workers, they are not being compensated for their time and expertise. Workers have suggested that videos are helpful in training, but there are not many available. Overall, a community member said that: "A lot of the time when the training is done by the boss, even if it's with the best intentions and hand signs, you don't really get to ask questions, and that is really important. Without questions, you can't ask about the risks that lead to a lot of accidents on the farm."

Access to Safety Equipment: Access to safety and protective equipment is lacking on my dairy farms. In the Migrant Justice Health and Safety survey, 44% reported having access to protective masks, and only 29% reported having access to safety glasses. Additionally, only about half of workers reported being able to talk to their boss about individual health and safety

concerns (Migrant Justice, 2020). One community member spoke about the dangers of being exposed to chemicals, even with protective equipment, making the lack thereof particularly concerning. He said, “They are so exposed to these things that we know are toxic, things that we know are designed to kill life.”

Another community member gave an example of a worker who would come in on his day off to clean the machinery in order to get a bonus. He would come in and use the heavy disinfectants without gloves or a mask, because nothing was provided for him. This type of behavior was encouraged, especially with the added benefit of a bonus, with no real regard for the health of the worker. Access to safety equipment has always been lacking for farm workers, but it is particularly salient during the COVID-19 pandemic. When asked about how work is being impacted by this global emergency, one community member said, “Farm workers have never had any benefit or access to health care since the 1930s when farm workers were excluded from labor laws. There’s always been a shortage of masks and gloves, we already don’t have that on the farm. There’s nothing being provided. We have been doing this a long time. With COVID-19, things are going to continue. We have to milk cows, our schedule will continue, there is no health care for us, we cannot take a day off.” The current global health emergency reveals both how lacking protections for farm workers are and how essential they are to keeping the food system running.

Social Barriers to Health

In addition to the physical, occupational hazards that workers face, they are also subjected to multiple social hazards. The key social issues of concern identified in the surveys and interviewers that may harm the health include wage inequality, immigration pressure,

language barriers, access to adequate housing, access to health care, and access to transportation which are detailed below.

Wage Inequality: Wage inequality and theft emerged as a top social hazard from speaking to different members of the community. One community member spoke about how fear of speaking up leads to a lot of wage theft-- fear of immigration or abuse from the farmer. He also mentioned that the problem is exacerbated along gendered lines: "That's how we experience discrimination in the workplace, low wages. Especially if you're a woman, you're going to get the lowest possible amount, even if you're doing the same or harder work than men, you're going to get a really low wage."

Immigration Pressure: The threat of ICE is a huge social hazard that migrant dairy workers face on farms. In the Migrant Justice Health and Safety survey, 37% of workers reported concerns that their boss will call immigration on them (Migrant Justice, 2020). Community members report that workers live in constant fear, especially because many of the farms are within 25 miles of the border in the Northeast Kingdom and Franklin County. This is particularly an added threat in Vermont due to the larger presence of border patrol in the state. The key informants noted that the workers are often afraid to leave the farms because of this threat, and view stepping off the farm as putting oneself in danger. This leads to extreme isolation, and also opens up a power dynamic between farmer and worker-- workers are afraid of speaking up against hours or wages because if they do, the farmer could easily call border patrol.

This is particularly dangerous in health emergencies. One community member spoke about how if there's an emergency, many workers will choose to stay home, rather than potentially endangering themselves by going to a hospital. The member spoke about cases where immigration was called at the hospital, because the workers could not speak English and so the

hospital workers called border patrol. He said: “People stay home and hope that they heal, you know because you’d rather stay home and support yourself than go and expose yourself and go to prison because no one’s going to take care of you in prison, and then your family is the one suffering.”

He also said that in order to avoid border patrol, some people will travel three or four hours just to access health services. He gave an example of when a pregnant woman had to take precaution: “Three workers were arrested at a Walmart and she lived near the Walmart and so she was going to the hospital for her checkups and she started noticing that the border patrol started showing up to her checkups, so she stopped going and had to arrange for someone to come to her house because of fear that she would be detained while pregnant and go to prison.

Fears of being detained are not unfounded, especially under the Trump administration. One community member said that as people were speaking up against the administration and farm worker conditions, leaders were being targeted, especially members of Migrant Justice. In one case, during their Milk with Dignity campaign in which they marched 13 miles to the Ben & Jerry’s headquarters, two people were arrested immediately after it, without getting any food.

Language barriers: Language is another issue that poses problems for migrant workers. One community member reported that some farmers will verbally harass workers if they do not speak English. One of the community members mentioned that she went to a forum for dairy farm workers, and as they were talking about their experience, someone in the audience asked, “what can we do to help?” and many spoke about the urgent need to learn English. She says when she started volunteering to teach English, on the first day, she started out with one student but ended up with six because there was such an interest in learning the language.

Understanding English also goes hand in hand with receiving adequate training on farms. As a result of not being able to speak English, many workers have to learn through hand signals, or sometimes not at all. Additionally, it can significantly impact access to transportation. One community member reports that the process of getting a driver's license in Vermont is extremely difficult "unless you have some degree of English." Language barriers also pose specific challenges to accessing relevant information and specific state based recommendations made on the pandemic as well.

Access to Adequate Housing: Poor housing is a significant issue for migrant dairy farm workers in Vermont. Community members identified that there is no real standard for farm worker housing, and so while some conditions are not bad, it varies wildly. In the Migrant Justice Health and Safety survey, 20% reported living in or near the barn and 7% reported lack of heating in their housing (Migrant Justice, 2020). One community member reported: "It goes from really, really bad like oh my God this is fucked up to oh this isn't too bad I could live here and it's really that. It ranges, but I'd say most of them fall in the lower end. There's a group of people I work with that live about the cows in the barn. One of the people has no windows… We cut a hole in the side of the barn and put the exhaust out, so at least he could sleep."

Sleeping in the barns is not an uncommon experience. For the workers who experience this, there is truly no separation of work and home. Additionally, the barns get extremely hot in the summer and cold in the extreme weather of the winter. Some housing is not insulated. In one case, a worker had to wrap their whole apartment in plastic because "the wind was just ripping through it." The barns tend to be dirty and infested with bugs and rodents, though even that is not specific to just the barns. One community member spoke about a roach infestation in the housing of one of the farms, saying that the problem had been there, unresolved, for years. Rodents are a

huge issue too: “I mean these guys live with mice and rats… there was one house that I went into, 19 mice in one day. The place is a shithole… the guy spends his whole day off cleaning the house and he can’t get it clean.” Another community member reported that, “Some housing you come and it’s a complete mess. There are bed bugs, rats, holes on the walls and floors, no heating… Each farm has their own little issue. One worker I know had to build his own bed out of wood pallets.”

In addition to poor housing conditions, some workers are faced with hidden housing costs that they did not know they would have to pay. One community member spoke about how since 95% of workers are undocumented, housing needs to be provided, which is what attracts a lot of people to work on farms in the first place. However, some workers have noticed that farmers take out reductions on pay stubs, and sometimes, “it adds up to even more than what you should be paying.” Workers are taken advantage of because of their documentation status, and the power dynamic between worker and farmer makes it difficult for the worker to do anything about that.

Access to Health Care: Access to adequate health care is another issue that migrant dairy farm workers face in Vermont. In the Migrant Justice Health and Safety survey, 63% reported having access to doctor/medical services, 34% reported having access to first aid, and only 16% reported being covered by insurance (Migrant Justice, 2020). Farm workers have been excluded from health services by law and do not qualify for free health care or Medicaid, despite the dangers of the job. Because of this, when workers get sick or injured, they do not seek help. Community members reported that the emergency room is extremely expensive for workers, and so when you are working to sustain your family, you are thinking of that rather than your own

health. Workers will stay home and hope that they heal on their own. Additionally, as previously mentioned, the threat of ICE detaining you if you go to the hospital looms large.

Despite these issues, community members have noted some improvements. One person spoke about open door clinics that are helpful because they have Spanish services and access to transportation. They also mentioned that at many hospitals it is now mandatory to have Spanish interpreters, which has been helpful.

Access to Transportation: Access to transportation emerged as another important service that is lacking for migrant farm workers. Community members spoke about how access to transportation leads to access to health services, the ability to go out in the community, and the ability to get a driver's license. In Vermont you can get your license if you are undocumented, but getting to the appointment is difficult for workers given their complex schedules and lack of rides. One community member spent time in a food pantry, asking migrant workers what their barriers to health were. All of them said transportation, not food, even though they were in a food pantry. Another community member mentioned a farm worker forum they went to, and besides teaching English, the biggest way workers said that people could help was to give them rides to the doctor's office and grocery stores. One of the community members is involved with an organization that arranges rides for workers, and said that, "I mainly have about a dozen drivers who I can count on for one ride a week. I have another group of six or seven who will give rides in emergencies, so a lot of times workers will get an appointment at the clinical club and say 'I have an appointment at six,' but it's already 2, and so it's hard to get regular drivers to do that."

This reflects how some services are available, but it is hard to get transportation during an emergency, when it is arguably the most important. Additionally, this organization is specific to one region of the state.

Health Outcomes

In this section, we report the accidents and injuries, musculoskeletal risks, health risks from chemical exposures, and other chronic conditions experienced by the migrant dairy workers.

Accident and Injuries: Accident and injury hazards are another large occupational hazard on Vermont dairy farms. Many of these injuries come from interacting with the large animals. In the Migrant Justice health and safety surveys, 78% of workers reported being hurt by an animals related risk, 44% reported unsafe animal gates, and 70% reported being hit or kicked by an animal (Migrant Justice, 2020). One community member brought up the common misconception that cows do not bite because some do not have teeth, making the point that even without teeth, they can still bite hard.

Accidents also occur when using machinery. In the surveys, 22% of workers had been harmed by milking machines, and 42% by connecting milkers (Migrant Justice, 2020). One community member said that accidents frequently occurred from slipping, because the floors of the parlor are always wet with milk. There are also a lot of trip hazards. The wet floors coupled with the trip hazards make carrying heavy machinery particularly dangerous.

Musculoskeletal Risks: Musculoskeletal risks are another occupational hazard that migrant farm workers face. These risks come from carrying heavy machinery and doing repeated motion for an extended period of time. In the Migrant Justice Health and Safety surveys, 77% of workers reported being harmed from a musculoskeletal or machinery risk. Of these workers, 82% also reported having pain in the back or neck. Additionally, 58% of workers reported being harmed by repetitive movement, and of those workers, 73% reported having pain in the back or

neck (Migrant Justice, 2020). One of the community members spoke to the kind of pain workers experience, saying that: “You’re in that [milking] position for years basically, every single day. So that was a big one. Lots of harm from musculoskeletal things” It is clear that the everyday tasks on dairy farms have the potential to cause a tremendous amount of pain for workers.

Health Problems Due to Chemical Exposures: Health issues due to chemical exposures was a main concern for community members. In the Migrant Justice Health and Safety survey, 83% reported experiencing harm from a chemical or biological risk while working. People experienced itchy eyes (49%), coughing (47%), headaches (50%), skin rashes (36%), difficulty breathing (27%), and vision problems (22%). People also complained about chronic health issues, like asthma and autoimmune disorders. Additionally, 50% had experienced being sick with the flu constantly because of a lack of sleep and inability to rest (Migrant Justice, 2020). Health outcomes from chemicals are intimately related to lack of training, lack of equipment, lack of adequate health services, and lack of sleep.

Psychological Health: Psychological health outcomes are another important facet of migrant health. In the Migrant Justice Health & Safety survey, 67% of workers reported one or more concerns related to mental health. The most prevalent were feeling stressed (64%) and feeling depressed (40%). Factors that contributed to poor mental health include concern about losing their job (29%) and mental issues as a result of musculoskeletal or machinery injuries (72%) (Migrant Justice, 2020). One community member mentioned that in speaking to workers, she learned that some workers desired to socialize with the broader community, and that to help, people could extend invites to them. Community members also mentioned efforts to decrease worker isolation, like social hikes with workers, English teachers, and friends. This helps to build trust in the community. One person said, “How far you get with people is going to be based on

how much you get to know the people… workers who we don't know very much, when we go in their house and offer to bring furniture they'll say no, but when somebody they know and have been working with for years comes in, they'll say yes."

Trust in the community contributes to migrant health, especially when trying to speak to workers about the issues they face. Sexual harassment is another issue on farms that leads to poor psychological health outcomes. One community member reported harassment occurring from farm management, impacting mainly women and the LGBTQ+ community.

DISCUSSION

The results of this study found that immigrant dairy farm workers face high occupational risks, have few socioeconomic and environmental resources, and face poor health outcomes as a result of these risks and limitations. These findings follow the Vulnerable Population Conceptual Model which hypothesizes that there are interrelationships among resource availability, relative risk, and health status in a vulnerable population (Flaskerud & Winslow, 1998). The results also follow the environmental health disparities framework, as health disparities in this community were thought to increase because of the combination of farm worker exposure to occupational/social hazards and a lack of resources.

The extent of occupational and environmental risks that farm workers are exposed to vary from farm to farm. The relationship between resource availability and relative risk emerged as an important link in this research. Farm workers face a lack of empirical resources such as fair wages, adequate housing, health care, job training, transportation, and social connectedness. Community members stressed the importance of each of these resources, which is consistent with the existing literature, which emphasizes training, fair wages, and health care access as an important resource in avoiding poor health outcomes (Juarez-Carillo et al., 2017; Arcury & Quandt, 2007; Keifer et al., 2012; Liebman et al., 2016; Conner et al., 2010). In the Vulnerable Population Conceptual Model, risk increases in inverse proportion to resource availability; in the case of migrant farm workers, risk manifests as exposure to chemicals, accidents/injuries, long hours, a lack of safety training and equipment, and musculoskeletal damage. The associated risks of these elements are thought to increase without adequate health resources.

Another important relationship in the VPCM is between relative risk and health status. Health status in the model is measured by mortality and morbidity (pathophysiological and

psychopathological changes), referred to as health outcomes in this study. There were no accounts of mortality from the farm workers or community members, but changes in pathophysiological and psychopathological states were reported in the Migrant Justice surveys as respiratory issues, headaches, vision problems musculoskeletal pain, depression and stress; and were thought to have resulted from exposure to chemicals, dangerous machinery, and animals, all of which are high risk occupational hazards. Risk can also be viewed as a stressor, which can exacerbate poor health by weakening the body's defense against these challenges (Gee & Payne-Sturges, 2004). These findings are somewhat consistent with other studies on the acute health outcomes of migrant workers, though information on chronic issues is lacking because of the transient nature of the occupation (Hansen & Donohoe, 2003; Baker & Chappelle, 2012; Colt et al., 2001). It differs slightly from Buckheit et al. (2017) who found diabetes, hypertension, and depression to be the most common health concerns in the past month in their study of 25 Spanish speaking dairy farm workers in the Northeast.

A third relationship that the VPCM underscores is between health status and resource availability. This study highlights severe lack of resources available for migrant workers and emphasizes their status as a vulnerable population. Barriers to health such as wage theft, language, poor housing, and the threat of immigration greatly impact socio-economic resource availability, which in turn worsens health outcomes. Many of these barriers were seen to impact the willingness of farm workers to seek health care. For example, low wages often mean choosing between getting health care for yourself or sending money home to feed your family. Low income in the United States continues to be the most significant predictor of poor health outcomes among vulnerable groups (Bragg-Leight, 2003). Additionally, Access to transportation is especially important in the fight against barriers to health care because of the isolation that

many migrant workers are subjected to. Workers who live on rural farms are geographically isolated from towns and often their families, giving way to negative psychological and spiritual impacts, as well as increasing the potential high-risk behavior like alcohol, drug abuse, and violence. The geographic isolation of Vermont immigrant farm workers was also confirmed in Baker & Chappelle (2012), and was found to contribute to poor mental health in particular. The threat of immigration for this particular group was found to be an extreme barrier to health, a finding that is also reflected in Baker & Chappelle (2012) and Bauer & Kantayya (2010). It is important to emphasize how big of a threat ICE is for these immigrant communities, and the role this fear plays in farm workers willingness to seek out health care. It is thought to be safer to remain invisible.

The relationships highlighted above were expected and are generally consistent with the body of literature on migrant farm worker health, but they are profound because they expose areas in which environmental justice for Vermont migrant farm workers needs to be addressed, particularly in the areas of health and safety. In order to improve health outcomes, it will be important to focus and intervene on these risks and barriers to health, many of which are directly related to each other. For example, the language barrier influences occupational risk because of it limits the level of training that can be received. Language also impacts health literacy, which is the degree to which a person can obtain and understand basic health information and services. The higher a population's health literacy is, the better their health outcomes are (Stimson, 2019). Language can also influence access to transportation, as community members revealed that the ability to speak English makes getting a driver's license much more attainable. Poor working conditions and long hours can influence the amount workers are exposed to chemicals, which is exacerbated by poor safety training and limited access to safety equipment. Language as a barrier

also comes into play here because it limits the ability of workers to express their needs. A lack of sleep from long hours could lead to more accidents and injuries, which is also driven by poor housing that prevents sleep and living well. Additionally, poor working conditions underscore the power dynamic between farm workers and farmers. Mares (2019) confirms that some farmers take advantage of undocumented workers through forced labor and verbal abuse while the threat of deportation hangs over them.

These findings are significant because they underscore the importance of the connectedness between access, occupational/environmental risks, and health outcomes for Vermont immigrant dairy farm workers. In understanding how these elements are connected, issues can be addressed more adeptly through community and policy interventions. Needs include more comprehensive safety training, sufficient access to safety equipment, fair wages, access to transportation and health care, adequate housing, and enforcement of standards. Farm workers in Vermont are a particularly vulnerable population because of their proximity to the northern border, putting them at extremely high risk of coming in contact with border patrol. All the occupational risks and barriers to health that they face are made worse by the specter of detainment. An environment needs to be created where workers feel safe speaking up. Addressing these issues would help to minimize the occupational risks of dairy farm work and lead to better health outcomes.

This study is valuable because it uses community member perspectives who work closely with immigrant workers to highlight and delve into the issues brought up by workers in the surveys. A limitation of this study was that it relied on interview data from community members that work closely with farm workers, not the actual farm workers themselves, though it was used in conjunction with secondary survey data that came from interviews immigrant farm workers.

CONCLUSION

In this study, the environmental and occupational health hazards of migrant dairy farm workers were detailed, as well as their barriers to health and health outcomes. Our results show that health outcomes are poor due to risks such as long hours, exposure to chemicals, and accidents from animals/heavy machinery. The importance of understanding the interrelatedness between risk, resources, and outcomes is highlighted. As more immigrants come to address the labor shortage in Vermont dairy, adequate access to socioeconomic and environmental resources need to be properly addressed, and dignified working and living conditions are needed. By exploring environmental and occupational health risks and their subsequent health outcomes for migrant dairy farm workers, the author hopes to bring awareness to the risks and barriers to health that this vulnerable population faces so that stronger health, housing, income, and training infrastructure can be developed. This population is integral to the food system, image, and economy of Vermont, and yet they are incredibly at risk. Structural inequalities need to be addressed to ensure the health and safety of some of these essential workers in the United States' food system.

Recommendations for further study include looking into individual, specific environmental and occupational risks and performing quantitative analyses to see how they lead to certain health outcomes. Looking further into chemical exposures on dairy farms is also necessary, especially given how complicated these multiple exposures are and the long-term effects that chemicals have on health. Another aspect our research did not touch on is the state of rural health care systems in Vermont and their ability to provide culturally and linguistically appropriate health services, but this will be important to look into going forward.

References

Anderson, D., Adcock, F., & Rosson, C. (2015). *The Economic Impacts of Immigration on US Dairy Farms*. Paper presented at the National Milk Producers Federation and Texas AgriLife Research.

Arcury, T., & Quandt, S. (1998). Chronic agricultural chemical exposure among migrant and seasonal farmworkers. *Society & Natural Resources, 11*(8), 829-843.

Arcury, T., & Quandt, S. (2007). Delivery of Health Services to Migrant and Seasonal Farmworkers. *Annual Review of Public Health, 28*, 245-263.

Baker, D. (2013). Latino Dairy Workers in Vermont. *Communities & Banking, 24*(2), 5-7.

Baker, D., & Chappelle, D. (2012). Health Status and Needs of Latino Dairy Farmworkers in Vermont. *Journal of Agromedicine, 17*(3), 277-287.

Bauer, S., & Kantayya, V. (2010). Improving Access to Primary Care and Health Outcomes in Migrant Farm Worker Populations: Challenges and Opportunities. *Disease-A-Month, 56*(12), 706-718.

Beck, J., Heutelbeck, A., & Dunkelberg, H. (2007). Volatile organic compounds in dwelling houses and stables of dairy and cattle farms in Northern Germany. *Science of the Total Environment, 372*(2), 440-454.

Bragg-Leight, S. (2003). The Application of a Vulnerable Populations Conceptual Model to Rural Health. *Public Health Nursing, 20*(6).

Buckheit, C., Pineros, D., Olson, A., Johnson, D., & Genereaux, S. (2017). Improving Health Care for Spanish-Speaking Rural Dairy Farm Workers. *Journal of the American Board of Family Medicine, 30*(1), 91-93.

Chapman, L., Brunette, C., Karsh, B., Taveira, A., & Josefsson, K. (2011). A 4-year intervention to increase adoption of safer dairy farming work practices. *American Journal of Industrial Medicine, 54*(3), 232-243.

Colby, M. (2018). Vermont negligent on monitoring dairy use of antibiotics. *VtDigger*.

Colt, J., Stallones, L., Cameron, L., Dosemeci, M., & Zahm, S. (2001). Proportionate Mortality Among US Migrant and Seasonal Farmworkers in Twenty-Four States. *American Journal of Industrial Medicine, 40*(5), 604-611.

Connor, A., Layne, L., & Thomisee, K. (2010). Providing Care for Migrant Farm Worker Families in Their Unique Sociocultural Context and Environment. *Journal of Transcultural Nursing, 21*(2), 159-166.

Dalphin, J., A., D., Monnet, E., Gora, D., Westeel, V., Pernet, D., Depierre, A. (1998). Prevalence of asthma and respiratory symptoms in dairy farmers in the French province of the Doubs. *American Journal of Respiratory and Critical Care Medicine, 158*(5 Pt 1), 1493-1498.

Doane, M., & Sarenbo, S. (2014). Exposure of Farm Laborers and Dairy Cattle to Formaldehyde from Footbath Use at a Dairy Farm in New York State. *Science of the Total Environment, 487*, 65-71.

Douphrate, D., Rosecrance, J., Stallones, L., Reynolds, S., & Gilkey, D. (2009). Livestock-handling injuries in agriculture: An analysis of Colorado workers' compensation data. *American Journal of Industrial Medicine, 52*(5), 391-407.

Douphrate, D., Stallones, L., Lunner-Kolstrup, C., Nonnenmann, M., Pinkze, S., Hagevoort, G., Lower, T. (2013). Work-Related Injuries and Fatalities on Dairy Farm Operations- A Global Perspective. *Journal of Agromedicine, 18*(3), 256-264.

Flaskerud, J., & Winslow, B. (1998). Conceptualizing Vulnerable Populations Health-Related Research. *Nursing Research, 47*(2), 69-78.

Galloway, A. (2016). Report: Herbicide, chemical fertilizer use doubled on Vermont dairy farms in a decade. *VT Digger*.

Gee, G., & Payne-Sturges, D. (2004). Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts. *Environmental Health Perspectives, 112*(17), 1645-1653.

Hansen, E., & Donohoe, M. (2003). Health issues of migrant and seasonal farmworkers. *Journal of Healthcare for the Poor and Underserved, 14*(2), 153-164.

Harrison, J., & Getz, C. (2014). Farm size and job quality: mixed-methods studies of hired farm work in California and Wisconsin. *Agriculture and Human Values, 32*, 617-634.

Harrison, J., & Lloyd, S. (2013). New Jobs, New Workers, and New Inequalities: Explaining Employers' Roles in Occupational Segregation by Nativity and Race. *Social Problems, 60*(3), 281-301.

Jenkins, P., Stack, S., May, J., & Earle-Richardson, G. (2009). Growth of the Spanish-Speaking Workforce in the Northeast Dairy Industry. *Journal of Agromedicine, 14*(1), 58-65.

Jordan, M. (2020). Farmworkers, Mostly Undocumented, Become 'Essential' During Pandemic. *The New York Times*.

Juarez-Carrillo, P., Liebman, A., Reyes, I., Ninco-Sanchez, Y., & Keifer, M. (2017). Applying Learning Theory to Safety and Health Training for Hispanic Immigrant Dairy Workers. *Health Promotion Practice, 18*(4), 505.

Kades, V. (2019). *Stress and stressors affecting Latino migrant dairy farmworkers in Vermont: An exploratory analysis.* (Master of Science), University of Vermont, Burlington, VT.

Keifer, M., Magurany-Brotski, C., Guerrero-Silva, F., & Ellis, T. (2012). Development and implementation of an agricultural safety consultation program to protect dairy farm workers. *Injury Prevention, 18*(1), A159.

Lantz, P., Dupuis, L., Reding, D., Krauska, M., & Lappe, K. (1994). Peer Discussions of Cancer Among Hispanic Migrant Farm Work. *Public Health Reports, 109*(4), 512.

Liebman, A., Franko, E., Reyes, I., Keifer, M., & Sorenson, J. (2018). An overview and impact assessment of OSHA large dairy local emphasis programs in New York and Wisconsin. *American Journal of Industrial Medicine, 61*(8), 658-666.

Liebman, A., Juarez-Carrillo, P., Reyes, I., & Keifer, M. (2016). Immigrant dairy workers' perceptions of health and safety on the farm in America's Heartland. *American Journal of Industrial Medicine, 59*(3), 227-235.

Mares, T. (2017). Cultivating Comida: Dignity and Devastation in Vermont's Dairy Industry. *Journal of Agriculture, Food Systems, and Community Development, 8*(3).

Mares, T. (2019). *Life on the other border: farmworkers and food justice in Vermont*. Oakland, CA: University of California Press.

Migrant Justice (2016). The Milk with Dignity Program. Retrieved from https://migrantjustice.net/sites/default/files/2016-1-19%20MD%20Program%20Description.pdf

Migrant Justice (2019). Mission and Program. Retrieved from https://migrantjustice.net/node/171

Migrant Justice (2020). Health and Safety Conditions on Vermont Dairy Farms.

Norton, K. (2020). Some Vermont Dairy Farms Dump Milk Amid Uncertainty of Coronavirus Crisis. *VT Digger*.

Parsons, B. (2011). *Vermont's Dairy Sector: Is There a Sustainable Future for the 800 lb. Gorilla?* Retrieved from https://scholarworks.uvm.edu/cgi/viewcontent.cgi?article=1008&context=fsagriculture

Quandt, S., & Arcury, T. (2007). Delivery of Health Services to Migrant Seasonal Farmworkers. *Annual Review of Public Health, 28*, 345-363.

Radel, C., Schmook, B., & McCandless, S. (2010). Environment, transnational labor migration, and gender: case studies from southern Yucatan, Mexico and Vermont, USA. *Population and Environment, 32*(2), 177-197.

Regeneration Vermont (2016). The High Price of Vermont's Degenerative Agriculture. Retrieved from https://regenerationvermont.org/the-high-price-of-vermonts-degenerative-agriculture/.

Stimson, D. (2019). *Improving Health Literacy Among Latino Migrant Dairy Farmworkers.* University of Vermont, Burlington, VT.

Shahbandeh, M. (2020). Top U.S. states based on milk production 2018 & 2019. Retrieved from https://www.statista.com/statistics/194968/top-10-us-states-by-milk-production/#statisticContainer

Susanto, D., Rosson, C., Anderson, D., & Adcock, F. (2010). Immigration policy, foreign agricultural labor, and exit intentions in the United States dairy industry. *Journal of Dairy Science, 93*(4), 1774-1781.

Thompson, V., Wiley, R., Stapleton, K., & Barewicz, M. (2017). *The Vermont Economic-Demographic Profile*. Retrieved from Montpelier, VT: Vermont Department of Labor

Teddlie, C. (2009). *Foundations of mixed methods research: integrating quantitative and qualitative approaches in the social and behavioral sciences*. Los Angeles: SAGE.

Trombly, J. (2020). Undocumented Farmworkers Essential, But Excluded, in Coronavirus Response. *VT Digger*.

U.S. Congress. (1934) United States Code: National Labor Relations, 29 U.S.C. §§ 151- 166 Suppl.

U.S. Congress (2011). *The Fair Labor Standards Act of 1938, as amended*. Washington, D.C.: U.S. Dept. of Labor, Wage and Hour Division.

USDA. (2020). Farm Labor. *Economic Research Service:* Retrieved from https://www.ers.usda.gov/topics/farm-economy/farm-labor/

USDA. (2020). State Fact Sheets: Vermont. *USDA Economic Research Service.*

Vermont Agency of Agriculture, Food, and Markets, 2015. Milk Matters: The Role of Dairy in Vermont. Retrieved from https://vermontdairy.com/wpcontent/uploads/2015/12/VTD_MilkMatters-Brochure_OUT-pages.pdf

Wolcott-MacCausland, N. (2014). *Health access negotiations and decisions among Latino/a diary workers in Vermont.* (M.S.), University of Vermont, Burlington, VT.

Appendix A: Results from the farmworker surveys published by Migrant Justice

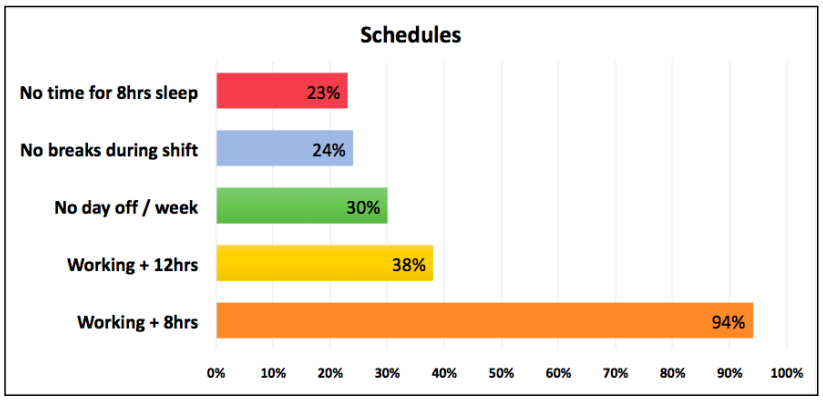
Health and Safety Conditions on Vermont Dairy Farms

Migrant Justice farmworker leaders designed and carried out a survey between 2018 and 2019 with over 100 dairy farmworkers across Vermont to collect detailed information about the working and living conditions faced by workers outside the Milk with Dignity Program. The survey was designed in collaboration with a researcher in the Tufts Friedman School of Nutrition, Science, and Policy and the Tufts School of Public Health; results were then analyzed by the Columbia Law School Human Rights Clinic.

The surveys posed a series of questions to workers about their working and living conditions, including their exposure to various health and safety risks, training and safety precautions, access to medical services, the adequacy of housing, their relationship with their employer, equal treatment on the farms, and mental health concerns. The results of this survey show high rates of workplace injuries and illnesses and a severe lack of safety equipment and training.

HOURS, REST, LIVING CONDITIONS

Many workers reported inadequate rest and living conditions.



Housing

20% of workers reported living in or near the barn.

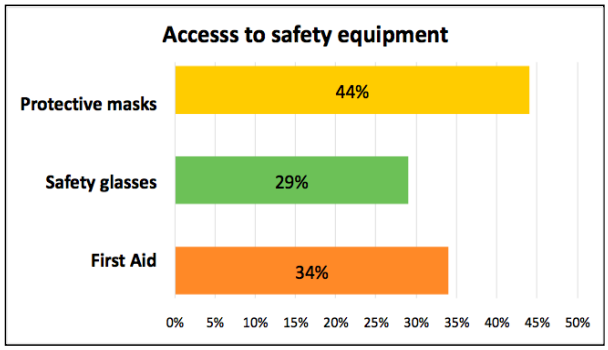
7% of workers reported lack of heating in their housing.

23% reported running out of food at some time.

ACCESS TO SAFETY EQUIPMENT AND HEALTHCARE

Only 51% of workers reported being able to talk to their boss about health and safety concerns, and only 63% of workers reported having access to a doctor/medical services. Significantly, only 16% of workers reported being covered by insurance.

Workers also reported a significant lack of safety equipment for all categories of risks:



Appendix B: IRB Approval

CHRBSS (Behavioral) #STUDY00000022 Approved: 5/31/2019

Human Subjects Research Protocol

PROTOCOL SUMMARY

Project Title:	**Protocol Version Date (required for each protocol modification):**
What does Environmental Justice look like in Vermont	April 24, 2019

Principal Investigator: Bindu Panikkar

TYPE OF REVIEW

Which type of IRB review are you requesting? Full [ ] **Expedited** [X] Complete category.

Your research may be expeditable if the research activities (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the following categories: (CHECK THE CATEGORY(IES) THAT APPLY.

[ ] (1) **Clinical studies of drugs and medical devices only when condition (a) or (b) is met.**
(a) Research on drugs for which an investigational new drug application (21 CFR Part 312) is not required. (NOTE: Research on marketed drugs that significantly increases the risks or decreases the acceptability of the risks associated with the use of the product is not eligible for expedited review).
(b) Research on medical devices for which (i) an investigational device exemption application (21 CFR Part 812) is not required; or (ii) the medical device is cleared/approved for marketing and the medical device is being used in accordance with its cleared/approved labeling.

[ ] (2) **Collection of blood samples** by finger stick, heel stick, ear stick, or venipuncture as follows: (a) from healthy, non-pregnant adults who weigh
at least 110 pounds. For these subjects, the amounts drawn may not exceed 550 ml in an 8 week period and collection may not occur more frequently than 2 times per week: or (b) from other adults and children, considering the age, weight, and health of the subjects, the collection procedure, the amount of blood to be collected, and the frequency with which it will be collected. For these subjects, the amount drawn may not exceed the lesser of 50 ml or 3 ml per kg in an 8 week period and collection may not occur more frequently than 2 times per week.

[ ] (3) Prospective **collection of biological specimens** for research purposes by noninvasive means.

[ ] (4) **Collection of data through noninvasive procedures** (not involving general anesthesia or sedation) routinely employed
in clinical practice, excluding procedures involving x-rays or microwaves.

[ ] (5) Research involving **materials** (data, documents, records, or specimens) that have been collected, or will be **collected**
solely for nonresearch purposes (such as medical treatment or diagnosis). (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 .CFR 46.101 (b)(4). This listing refers only to research that is not exempt.)

[X] (6) **Collection of data from voice, video, digital, or image recordings** made for research purposes.

[X] (7) **Research on individual or group characteristics or behavior or research employing survey, interview, oral**
history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3)).

PURPOSE AND OBJECTIVES

Purpose: The importance of the research and the potential knowledge to be gained should be explained in detail. Give background information.

Vermont does not have an Environmental Justice (EJ) Policy, though some aspects of EJ have been addressed by many of the state departments. As a part of Environmental Justice (EJ) 2020 Action Agenda and US Environmental Protection Agency (EPA) Performance Agreement Plan (2016-2020), the Vermont Department of Environmental Conservation (VTDEC) has pledged to develop an EJ policy within the State. On October 3, 2018 at a meeting convened with VTDEC, EPA, and the PIs (including Toxics Action Center and Vermont Law School) discussed a collaborative approach to design an EJ policy that stems from research and an understanding of EJ issues across the communities in Vermont. This research is designed to further these state goals to identify how Vermonters define and experience EJ within the rural context and to design a community-based EJ policy for Vermont. To fulfill this agenda we will conduct comprehensive assessment of the structural inequities—distributive, procedural, and epistemic justice that drive environmental and health burden in minority/low income communities in Vermont. We will conduct spatial analysis, hold community panels, interviews, and