

## **Mothers' Concerns about Children's Exposure to Pesticide Drift in the Red River Basin of the North: A Novel Application of Photovoice**

Maggie Stedman-Smith, Ph.D., M.P.H., M.S., R.N.<sup>1</sup>

Patricia M. McGovern, Ph.D., M.P.H., R.N.<sup>2</sup>

Cynthia J. Peden-McAlpine, Ph.D., R.N.<sup>3</sup>

Linda R. Kingery, M.S.<sup>4</sup>

Kathryn J. Draeger, Ph.D.<sup>5</sup>

<sup>1</sup> Assistant Professor, Kent State University, College of Public Health, Environmental Health Sciences, [mstedman@kent.edu](mailto:mstedman@kent.edu)

<sup>2</sup> Bond Professor of Environmental and Occupational Health Policy, University of Minnesota, School of Public Health, Division of Environmental Health Sciences, [pmcg@umn.edu](mailto:pmcg@umn.edu)

<sup>3</sup> Associate Professor, University of Minnesota, School of Nursing, [peden001@umn.edu](mailto:peden001@umn.edu)

<sup>4</sup> Executive Director, University of Minnesota Regional Sustainable Development Partnerships, [kinge002@umn.edu](mailto:kinge002@umn.edu)

<sup>5</sup> Statewide Director, University of Minnesota, Regional Sustainable Development Partnerships, [draeg001@umn.edu](mailto:draeg001@umn.edu)

### **Abstract**

Women of childbearing age and children living in agricultural regions are at-risk for pesticide exposure from many pathways, including occupational track-in from parents, residential use, dietary intake, and drift from farming. Little is known about mothers' concerns regarding the potential for their children to become exposed to pesticides in these regions. Photovoice was used as a community needs assessment to learn mothers' perceptions of exposure pathways to pesticides and other environmental health concerns. This article reports the perceptions of women raising children regarding children's potential for exposure to pesticide drift. Recruitment occurred among three distinct groups living in the Red River Basin of the North: Caucasians living adjacent to actively treated farmland, enrolled in the Women, Infant and Children's nutrition program (WIC); Native Americans surrounded by active farmland, affiliated with a local tribal college; and new American Immigrants from East Africa affiliated with a local immigrant development center. Perceived sources of exposure included agricultural-aerial and tractor spraying, and truck fogging for mosquito control. Mothers wanted advanced notice of spraying or fogging so they could take their children and toys indoors as protective measures, and education to prevent pesticide exposure, delivered in tailored formats for each group. The findings provide real-world insights from mothers and prevention strategies that can be utilized by public health professionals, extension educators, and primary care providers with the aim of reducing pesticide exposure to children in agricultural regions. Contents are solely the authors' responsibility and do not represent the official views of any funding source.

**Keywords:** Children, Pesticide exposure, Pesticide Drift, Aerial Spray, Photovoice

## **Mothers' Concerns about Children's Exposure to Pesticide Drift in the Red River Basin of the North: A Novel Application of Photovoice**

Pesticides are substances that are intended to prevent, destroy, or repel organisms and are classified by the pests they work against, including, herbicides, insecticides, fungicides, rodenticides, nematocides, and biocides. While the benefits of pesticides are well established (United States Environmental Protection Agency, 2009), the potential for adverse effects on human health from chronic exposure is less clear. Cancer is currently the leading cause of death by illness for children in the United States (National Cancer Institute, 2011). Numerous studies have examined possible associations between pesticide exposure and the development of childhood cancer, as well as adverse reproductive and developmental effects. No firm conclusions can be drawn because of methodological problems including incomplete exposure assessments, small sample sizes, and the potential for differential recall bias in self-report (Daniels, Olshan, & Savitz, 1997; Weselak, Arbuckle, & Foster, 2007; Zahm & Ward, 1998). A more recent meta-analysis concluded that an association does exist between pesticide exposure and childhood cancer; however, causation cannot be inferred due to methodological difficulties and a lack of consideration for the role of genetics (Infante-Rivard & Weichenthal, 2007).

Exposure to pesticides may occur through inhalation, ingestion, or dermal absorption and children have unique exposure vulnerabilities. Due to a smaller weight and higher metabolic and respiratory rates, they breathe more air, eat more food, and drink more fluid per pound of body weight than adults. Their breathing zones are closer to the floor where pesticide residues may settle. Crawling, hand-to-mouth activity, and playing outdoors on contaminated soil may result in greater exposure. A 2-fold increase in skin surface to body weight in children compared to adults creates greater potential for dermal absorption in children versus adults. In acute exposure, children's immature livers or kidneys may reduce the ability to clear pesticides. Since, growth is still occurring, acute exposures may inhibit the development of systems targeted by toxic exposure. Lastly, children have more future years of life to develop adverse health outcomes that have long latency periods and are associated with environmental exposures (American Academy of Pediatrics Committee on Environmental Health, 2003; Landrigan, et al., 1998; Landrigan, 2011; National Research Council, Committee on Pesticides in the Diets of Infants and Children, 1993). Pesticide exposure pathways for children include consumption of conventional foods and contaminated well-water (Eitzer & Chevalier, 1999; Lu et al., 2006), tracking in pesticide residues from occupational settings into family vehicles and residences by working parents (Loewenherz, Fenske, Simcox, Bellamy, & Kalman, 1997), residential usage (Gurunathan et al., 1998), and proximity to drift (Weppner et al., 2006).

Drift is the "physical movement of a pesticide through the air at the time of application or soon thereafter, to any site other than that intended" (United States Environmental Protection Agency [US EPA], 2008). Direct exposure may occur in the vicinity of agricultural spraying. All major organs are susceptible to the toxic effects of pesticide poisoning, with symptoms varying by substance and dose from mild to severe (Reigart & Roberts, 1999). Although the US EPA receives thousands of complaints annually related to pesticide exposure through drift (US EPA, 2008), the magnitude of acute pesticide induced illness from this pathway is unknown.

A study using American Association of Poison Control narratives found 46 cases of acute pesticide illness among bystanders from 32 events in four southern states during 2001 (Bryden, McKnight & Westneat, 2005). Sixty-five percent were referred to or examined in a health care facility, and aircraft crop dusters were the source of exposure for 28%. "Bystanders" were exposed persons who were not using pesticides. Records from three statewide and national

surveillance systems between 1998-2002 revealed 2,593 workers and children sustained acute pesticide induced illnesses while in school and daycare. Of 409 cases with detailed descriptions, 125 were associated with pesticide drift from neighboring farms and 62 were students. The number of persons who develop acute illness from pesticide exposure may be substantially under-estimated for several reasons: non-occupational exposures are not universally mandated for reporting; symptoms can mimic common maladies, including, allergic reactions and gastrointestinal infections, and clinicians typically receive little training for recognition of pesticide induced illnesses (Alarcon et al., 2005).

This article describes the results of a community-health needs assessment that used *Photovoice* to gain insight into mothers' concerns about pesticide exposure for themselves and their children in the Red River Basin (RRB) of Minnesota and North Dakota. The effort was part of a one-year grant for planning an intervention to prevent pesticide exposure to children. Although several pathways to pesticide exposure and other environmental health concerns were identified, this article focuses on perceptions of exposure to pesticides through drift.

### Methods

The Minnesota segment of the RRB extends over 37,100 square miles in northwestern Minnesota and eastern North Dakota. The region is one of the nation's highest producers of wheat, corn, sugar beets, and soy through conventional agricultural practices (Minnesota Pollution Control Agency, 2010). A 2004 survey and focus groups found 50% of residents believed that pesticide exposure could cause cancer and birth defects, while 70% reported they did not have enough information to gauge their risks. Due to broad concern and lack of knowledge, a collaborative partnership emerged between the University of Minnesota Regional Sustainable Development Partnerships (UMSDP), faculty researchers from the University of Minnesota, School of Public Health, Division of Environmental Health Sciences, and local communities to address issues related to pesticide use and potential exposure among women of childbearing age and children.

The methodology of *Photovoice* provides cameras to individuals from vulnerable populations and allows them to document experiences in their daily lives. Images are shared with key stakeholders to promote dialogue for the purpose of improving local conditions that impact health (Wang & Burris, 1997). *Photovoice* can be adapted for assessment, evaluation and asset mapping. The approach has effectively engaged women of childbearing age and youth, and has been used by local county public health officials, academics, health care educators, and practitioners (Catalani & Minkler, 2010).

Theoretical foundations of *Photovoice* are grounded in Freireian education for critical consciousness, feminist theory, and community-based documentary photography. Freire promotes experientially-based discussion among members of marginalized groups to analyze root causes of inequities to create social change (Freire, 1973). Feminism asserts that power accumulates for those who have voice, set the terms of discourse, and participate in decision making, and it seeks inclusion of those left out of policy deliberations (Backer, Costello-Nickitas, Mason, McBride, & Vance, 1998). Community-based documentary photography engages members of disadvantaged groups in visual representation of their daily conditions to increase social awareness (Hubbard, 1994).

Methods from this *Photovoice* are described in detail elsewhere (Stedman-Smith, McGovern, Peden-McAlpine, Kingery, & Draeger, 2011). Briefly, convenience samples of three groups of six women (n=18) raising children from at-risk populations, who were not represented in past studies were recruited: Caucasians residing near the Minnesota-Canadian border, living

adjacent to actively treated farmland, and enrolled in the Women, Infant and Children’s nutrition program (WIC); Native Americans living on a reservation near the center of the RRB, surrounded by farms and affiliated with a Tribal College; and new American immigrants predominantly from East Africa, affiliated with a local immigrant development center in Fargo-Moorhead (See Table 1). Recruitment was conducted by local stakeholders who were community leaders that had contact with the mothers in these administrative settings. The study was performed in accordance with the University of Minnesota Institutional Review Board (IRB).

Mothers from each group attended two, three-hour workshops during the peak growing season. Workshop I provided training about pesticides, the method of Photovoice, the ethics of taking pictures, and instructions with hands-on-experience in using digital cameras. Participants reflected upon and captured images that depicted concerns about how their children may become exposed to pesticides, and other health and safety issues; one month later, they attended workshop II to share and discuss the meaning of their photos, community assets, and changes they wanted, if any, to better protect their children. Major themes were identified with team input; a report was written for funders, and a poster with images and quotes from the mothers was shown at a community stakeholder meeting in the RRB with ensuing dialogue. A three-year intervention to reduce pesticide exposure to families in this region was funded by Blue Cross and Blue Shield Foundation of Minnesota. Upon completion of these activities, analysis was conducted to examine deeper themes and meanings, triangulate findings with existing literature, and make further recommendations for public health practice, policy, and research.

Transcripts were verified with audio tapes and corroborated with photos and field notes; themes and sub-themes were generated within groups using techniques from grounded theory (Strauss & Corbin, 1998) and across groups using cross-case analysis (Miles & Huberman, 1994). Cross-case analysis reconciles unique and generic processes across cases. Since three distinct groups of mothers participated within one large agricultural region, cross-case analysis allowed for similarities and differences within and across cases to be highlighted. Trustworthiness was promoted by member checks and peer review prior to, during, and after analysis. Data analysis and decisions were documented in memos, thereby, creating an audit trail to enable method replication.

Table 1.

Demographics of the Three Cultural Groups of Mothers and Grandmothers Raising Children (n=16)

<b>Cultural Groups</b>	<b>Caucasians</b>		<b>Native Americans</b>		<b>New American Immigrants</b>	
	<b>(n=6/6)</b>		<b>(n=4/6)</b>		<b>(n=6/6)</b>	
<b>Information</b>	<b>Mean</b>	<b>Range</b>	<b>Mean</b>	<b>Range</b>	<b>Mean</b>	<b>Ranges</b>
<b>Participant Ages</b>	31.5	24-41	41	28-48	28	22-47
<b>Number of Children</b>	4	3-6	4	4-5	4	2-6
<b>Ages of Children</b>	-----	Infancy- 12 years	-----	Infancy- 18 years	-----	1.5- 18 years

## Results

Two major themes were identified regarding potential pesticide exposure sources that mothers identified for themselves and their children: agricultural activities and mosquito control. Sub-themes were related to the place for potential community exposures and precautions to prevent exposure.

### Potential Pesticide Exposure to Drift from Agricultural Activities

Concerns were identified in multiple locations during daily experiences. Caucasian and Native American mothers identified sources of agricultural drift exposure when at their residences and when traveling on roads. Native American's voiced additional concern about exposure at school and day care. New American immigrants raised concerns about exposure to agricultural drift in the general region, without identifying specific sources and places.

#### Agricultural spray.

This young mother was concerned about the potential for pesticide exposure to children at school through drift from aerial spraying. She took two photos from different directions while standing on school property.

*“The school is located across the road from a potato field. My little brother goes to school there and my mom pulls him out on the days that they spray the field. I don't think it's fair that parents have to protect their kids from getting contaminated while at school.”* (Native American mother)

Apprehension was voiced about children's pesticide exposure from drift while in daycare on the reservation.

*“There's a field right on the other side of their daycare, and when I went to pick them up, you could just smell that. ‘Should they be out there? I would get them inside.’”* (Native American grandmother)

This mother snapped a photo of a wet area located on a highway that was surrounded by open farm fields.

*“[On this stretch of highway] there are always puddles ... from the overspray. I was driving through the area. The puddle was all the way across the road and it was spraying our car. I know that you can get chemical burns from this stuff, so I shut my car window, but still, that spray shouldn't be sprayed on the road or near me or my car.”* (Native American mother)

Another mother photographed an expanse of open farm fields with a plane spraying over a community road.

*“And we were driving and... I'm pregnant and I can smell things, and I'm like—‘What's that smell?’ We got around the corner and on one side of the road was a farm, then there was the road, and the field right across. And he was swooping right over the road, right*

*over the cows and spraying.... I was literally almost holding my nose 'cause it was so thick.” (Caucasian mother)*

Another participant took a picture of a plane flying close to her home. She describes the impact of the noise on her two year old son in terms of interrupting his morning sleeping patterns.

*“I’m parked at the end of my driveway and he [farmer-neighbor] has just come over my house and that’s him spraying. ...Cause they go right over the house. Zoom...and the kids will [wake up] ... and Ben will say, ‘It’s scared –it’s scared’”. (Caucasian mother) (See Figure 1)*

Figure 1. “Parked at my driveway”



Yet another mother took a photo of a large actively treated farm field next door to their home; she described concerns about potential exposure to her son, who plays near or on the field:

*“That is the closest field. ...they [the children] play ...on that edge ... so they could walk into the field if they wanted to.” (Caucasian mother)*

This mother photographed a large tractor spraying on an expanse of a black-dirt field adjacent to her backyard, and expressed the realization of how frequently her children were playing outdoors while this farmland was being sprayed.

*“...Every time there was a sprayer, we were outside. Every time...” (Caucasian mother)*

The same mother expressed a desire for advanced warning before her neighbor sprays.

*“...The kids are outside playing and we have two dogs. There’d be no way of warning that we could get all of our toys in— but just our animals and our kids inside and turn off the air conditioning.” (Caucasian Mother)*

A Native American mother raising two small grandchildren took a picture of a large tractor spraying on an open field.

*“Just driving down the road and getting exposed to it ‘cause they’re spraying...This happens a lot....Since I’ve usually got my babies on board, how do I try to stay away from that stuff? You really can’t get away from it” (See Figure 2)*

Figure 2. “Just driving down the road”



### **Community truck fogging.**

Mothers from all three groups discussed the risks of insecticide exposure from community truck fogging to reduce mosquitoes versus the risks of contracting West Nile Virus. Participants wanted their communities to spray, however, with advanced notice so they could take children and toys indoors before fogging to reduce the potential for dermal and inhalation exposure. This mother snapped a picture to document the fog from community truck spraying drifting across the street from her home.

*“This is in my driveway. The spray for the city had come around. It’s out of the back of a pickup. And that’s the mist after he’s gone by. It lingers, for mosquitoes.” (Caucasian mother) (See Figure 3)*

Figure 3. “It lingers for mosquitoes”



Yet another mother relays that her son thinks his asthma is becoming aggravated from pesticide fog wafting into the home after community spraying.

*“... And I see him spray at night... My son - he never have asthma. The time he comes to America have very bad asthma - my son and my daughter. And the time inside the house, my son tell me, ‘Mom I swear to God... I smell the spray of the mosquitoes.’ I tell him, how? You inside the house” (new American Immigrant mother) `*

This participant expressed concern about children’s exposure to pesticide fogging while at a Head Start day care.

*“They sprayed the whole city for mosquitoes and we could smell the pesticides coming in through the screens. And there’s a Head Start and a Day Care in our building .... It was like 4:00 in the afternoon. Cause they have the playground equipment for the Head Start and day care right out in back of the apartment building.” (Native American grandmother)*

A mother took a photo of a 12 year old boy next door who was fogging. He was standing in a cloud of fog, wearing shorts, and a short-sleeved tea shirt, without personal protective clothing, a face mask or eye goggles, and asked, “Should he be doing this?”

Mothers from all three groups expressed a desire for a longer period of advanced warning in group discussions.

*“I’m really worried about the insecticide exposure for my children, but I’m also worried about West Nile virus...And I wish there was some way short of just seeing the truck come by to know that they’re going to spray, just to get my kids and my toys in. If your yard is full of toys and they’re all of a sudden coming down the block, you don’t have time to pick up all your toys.....” (Caucasian mother)*

## Discussion

This research provided real-world insights into the concerns of mother's about pesticide exposure. The results generate hypotheses for how children's pesticide exposure may occur in these groups, and when triangulated with current scientific literature can be used to make recommendations for future research, public health practice, and policy. Since, the study employed convenience sampling with a small group of women (n= 16), it cannot be generalized to all mothers in the RRB or elsewhere. However, qualitatively derived findings may be "transferrable" to other like contexts (Lincoln, 2001). The type of pesticides used, whether exposure occurred, the amount of exposure, and the impact on health are not known.

Pesticide exposure through drift was perceived as an important pathway. Yet, limited research elucidates this pathway and the health effects in children. Weppner et al. (2006) found higher levels of pesticides on playground equipment at six and 11 hours after spraying compared to baseline levels. Elevated levels on the hands of children and increased metabolite levels in spot urine samples following spraying indicated that youth were directly exposed. The results lend credence to this study's findings of mothers' perceptions of drift on toys and playgrounds as pathways for children's pesticide exposure, and mothers' desire for advanced warning to bring children and toys inside before agricultural spraying. While Weppner and colleagues did not find pesticide residues in the home, a study in Arkansas did (Richards et al., 2001). Homes that had wind blowing toward them, and were closest to the field had the highest levels of residue; however, biological measures of exposure were not collected, limiting interpretation of health impact.

Concern about children's exposure to pesticide drift at school and day care is supported by limited research documenting acute pesticide induced illnesses from national surveillance systems between the years 1998-2002. The School Environment Protection Act (SEPA) was introduced by Representative Rush Holt, D-NJ12, on March 20, 2012 (H.R., 4225-112<sup>th</sup> Congress). SEPA would amend the Federal Insecticide, Fungicide and Rodenticides Act to mandate protections at schools including: integrated pest management programs; advanced notice to parents before pesticide usage; identification of sources of pesticide drift; and written plans to develop school environments protected from pesticides. The bill offers minimum uniform protection to exposure from agricultural drift across the states for children at school. Successful policies to protect children from exposure to pesticide drift in the school setting have been enacted on the state level. Nine states have mandated buffer zones ranging from 300 feet to 2.5 miles around schools during school activities and commuting hours as a prevention strategy, and enactment of these restrictions to control pesticide drift in areas neighboring schools represent a 6% increase since 1998 (Kagan, 2009).

Perceptions of the relative risks of pesticide exposure from fog generated by truck fogging versus contracting WNV were consistent with findings from a human health risk assessment that included children and multiple exposure routes. The risk assessment compared potential chronic and acute residential exposures to toxicological and regulatory effect levels and concluded that the risks of contracting WNV exceeded the risks of pesticide exposure from fogging (Peterson, Macedo, & Davis, 2006). Although, mosquito control commonly uses Pyrethroid insecticides, which can cause respiratory irritation, studies conducted in New York City found no increases in hospital admissions for asthma exacerbations during local spray campaigns (Karpati et al., 2004; O'Sullivan et al., 2005). However, these studies did not account for the possibility of milder asthma exacerbations occurring that did not require hospitalization.

The US Centers for Disease Control and Prevention has documented 133 cases of acute insecticide-induced illnesses associated with mosquito control in nine states from 1999-2002. Of the assessed cases, 36 were work-related and 96 were non-work related, including one documented illness of high severity in a person with respiratory disease when a Pyrethroid insecticide compound passed through operating window fans and an air conditioner during neighborhood spraying (MMWR, 2003). This report supports the question and concern voiced from the new American immigrant mother from Somalia about the possibility of fog entering her home and irritating her children's asthma. In addition, it underscores worry about children conducting fogging without wearing personal protective equipment.

### **Implications for Professional Practice**

All mothers wanted community education about the health effects of pesticides and how to reduce exposure to develop strategies to protect their children. Caucasian mothers wanted written material from primary care practitioners, visiting public health nurses, and WIC providers. Native American women wanted written and verbal information from WIC, Head Start, the Indian Health Services, and at events where food is served. New American immigrants wanted information delivered verbally by trained and trusted community members in their homes and at church gatherings.

Recommendations for professional practice, policy, and future research are consistent with the *Precautionary Principle*, which states that “when an activity raises threat of harm to human health and the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically” (Kriebel et al., 2008, p. 871, citing Raffensperger & Tickner, 1999).

According to the American Academy of Pediatrics Council on Environmental Health (2012), precaution is an integral aspect of preventive medicine and disease management. In public health, it is seen in primary prevention, such as neonatal screening and childhood immunizations, while in clinical medicine, it is seen in the ethical principle of, “First, do no harm” (p.838). The American Nurses Association includes policy advocacy to promote the health of populations within the scope and standards for public health nurses (PHNs). Moreover, the Precautionary Principle has been endorsed as a central tenet for guiding policy advocacy in professional practice for environmental health nursing (American Nurses Association, 2007).

PHNs are in a unique position to address the environmental health needs of children using the Precautionary Principle. They are the largest professional group practicing public health (National Research Council, Committee on Educating Public Health Professionals for the 21<sup>st</sup> Century, 2003), and they practice at key places in the community where they can directly assess the potential for adverse environmental exposures and promote salient interventions. Consistent with the ecological framework, such approaches may be implemented on multiple levels, including the individual, family, community, population, and systems domains to promote and protect health. Children's heightened vulnerabilities to exposure from pesticides and other environmental agents compels public health nurses to apply the Precautionary Principle in collaborative multidisciplinary professional practice for the purpose of safeguarding the health status of children and to protect the developmental potential and well-being of future generations.

Rural PHNs can collaborate with members of the local multidisciplinary public health team as well as all involved stakeholders on the state level to increase awareness and advocate for policies that protect children from exposure to pesticide drift while at school. In addition, more awareness is necessary for providers in recognizing and reporting pesticide induced illnesses.

Rural health PHNs can assess the location of a home in relation to actively treated farmland, and ask parents where their children spend most of their time. Such information may lead to an opportunity for providing health education about pesticide exposure and developing strategies to better protect the health of children. A toolkit for pediatric environmental exposures, including pesticides, is available from Physicians for Social Responsibility (Physicians for Social Responsibility, 2009), which can be adapted for use in professional practice.

PHNs can take an active role as partners in interdisciplinary research conducted to inform professional practice. Specifically, studies are needed to clarify the relationship between pesticide exposures and adverse maternal and child health outcomes; such studies would utilize longitudinal designs, and include samples that mirror the nation's diversity with data collection of biological specimens, environmental samples, and self-reported data to associate actual and perceived exposures with outcomes. Research is also needed to generate evidence-based recommendations for how long children and pets should remain indoors after agricultural aerial and truck spraying, as well as to explore the most effective community approaches for advanced warning before truck fogging.

An important role of PHNs includes performing community health needs assessments, assisting members of the community to voice their perceptions with regard to environmental health advocacy, and utilizing qualitative data (American Public Health Association, Public Health Nursing Section [APHA], 2012; APHA Public Health Nursing Section, 2005). As a method, Photovoice integrates these activities, and is within the role of the PHN. In addition to generating a needs assessment that successfully led to securing funding for a regional intervention to reduce children's pesticide exposure, other venues for this Photovoice project were implemented to promote community awareness and dialogue. The images and voices of the mothers were incorporated into pesticide applicator re-certification courses by a University of Minnesota Extension educator, and a traveling exhibit of the photos and captions from the mothers was presented at select community events. Utilization of approaches that include a consideration of pathways to pesticide exposure in maternal child health needs assessments in conjunction with collaborative methods, such as, Photovoice, have the potential to increase awareness among community members and promote local and state measures for reducing pesticide exposure.

### **Funding**

BC / BS Foundation of Minnesota, the UM Office of Clinical Research, Medical School's Program in Health Disparities Research; graduate fellowship in environmental health from SOPHE / ATSDR; Midwest Center for OSH (NIHOSH T420H008434) Ruth Horton Fund, UMNRS Partnership.

### **Acknowledgements**

We thank the following members for their contributions to this Photovoice study: Fowzia Adde, Kirstin Eggerling, Abby Gold, Stephanie Williams, Ruth Rasmussen and Kathy Smith.

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