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CHALLENGES AND BENEFITS OF CONDUCTING ENVIRONMENTAL JUSTICE RESEARCH IN A SCHOOL SETTING

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Abstract

Environmental justice (EJ) research requires attention to consequences for research participants beyond those typically considered by institutional review boards. The imbalance of power between impacted communities and those who create and regulate pollution creates challenges for participation, yet research can also benefit those involved. Our community-academic partnership designed the Rural Air Pollutants and Children's Health (RAPCH) study to provide positive impacts while measuring health effects at three low-resource public middle schools near concentrated animal feeding operations (CAFOs) in North Carolina. We evaluated perceived benefits and challenges of study involvement by interviewing school staff and community liaisons who facilitated data collection. Reported benefits included enhancement of students' academic environment and increased community environmental awareness; challenges were associated mainly with some participants' immaturity. Leadership from a strong community-based organization was crucial to recruitment, yet our approach entailed minimal focus on EJ, which may have limited opportunities for community education or organizing for environmental health.

Keywords

environmental justice; schools; industrial livestock production; community-based research

Researchers working in contexts of environmental injustice should consider the unmet needs of affected communities as well as the potential for research to expose participants to retaliation from polluters. Although primarily designed to contribute knowledge for improving population health, environmental justice (EJ) research may also impact participants, their communities, researchers, research institutions, and society at large in the course of its conduct. Human subjects review boards regulate potential dangers to individual participants, such as negative side effects of interventions or breaches of confidentiality that may occur when participant identities are revealed. In contrast, a breach of confidentiality involving individual participants in EJ research can place others in danger if polluters target EJ advocacy organizations or entire communities that are organizing to reduce impacts of the polluting industry [1].

In this paper, we explore these issues as they have arisen in the design and conduct of research into the health impacts of industrialized livestock production. North Carolina ranks second in the United States for both pork and turkey production [2]. It has a statewide

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inventory of 10 million hogs and 18 million turkeys, with roughly half of these animals concentrated in several counties in the eastern coastal plain [3]. The vast majority of these livestock are housed in concentrated animal feeding operations (CAFOs); their waste is stored in open cesspools (swine) or piles (poultry) and then spread on nearby land [4]. Neighbors of livestock operations are exposed to air pollutants including ammonia, hydrogen sulfide, and bioaerosols [4]. In North Carolina, residents near swine CAFOs are disproportionately low-income people of color [5, 6]. Air pollution from swine CAFOs is associated with acute mucous membrane irritation, respiratory symptoms, stress, acute blood pressure increases, and reduced quality of life among adults in surrounding communities [7-18].

Proximity of homes and schools to swine CAFOs has also been associated with increased prevalence of asthma and wheeze in children [19-21]. Children are required to attend school, where they could be exposed to CAFO air pollution. Children attending schools in North Carolina where staff members noticed livestock odor inside the school twice or more per month reported increased prevalence of wheezing and doctor-diagnosed asthma [22]. Elementary and secondary schools in low-income communities of color are especially vulnerable to environmental health risks due to a lack of federal policies ensuring environmental health protections [23]. Public school districts in the study area have a majority of nonwhite students (mean 57.5%) [24] and an average of 73.4 percent of students who applied for free or reduced-price lunch [25]. Additionally, asthma prevalence is high (20.3% statewide) in the middle school age group [26]. School environmental injustice can occur when a school is sited on or near a hazardous location or when the inequitable distribution of funding among schools favors environmental health protections for some and not for others [23]. Environmental injustice may also occur when polluting industries, such as swine or poultry CAFOs, are sited near existing schools.

Furthermore, vertically integrated corporations that own the animals, feed, veterinary supplies, and slaughterhouses can create a climate of intimidation and fear that discourages local residents from speaking out about health problems or environmental injustice [1], while corporate political influence hampers adoption and enforcement of regulations despite evidence of harms to public health [27]. The pork industry's legal threats and influence over government funding can also discourage researchers from investigating the health effects of practices related to industrial agriculture [1]. Industry influence over research funding, environment science, and public health research occurs at local, regional, and national scales [28]. Yet the failure to conduct this health research contributes to lack of public awareness and the maintenance of systems that perpetuate environmental injustice.

The Rural Empowerment Association for Community Help (REACH) was founded in 2002 to promote the social, economic, and environmental well-being of communities in southeastern North Carolina [29] by building coalitions between citizens and local agencies that achieve a better quality of life for all [30]. REACH has also been involved in environmental and public health research. REACH and scientists from the University of North Carolina at Chapel Hill (UNC-CH) have worked together since 2005 on environmental justice and public health issues. Previous collaboration included a community-based, participatory study for which members of REACH were actively

involved in identifying study locations and sites for positioning air pollution monitors [31]. Community members attended local meetings about environmental health and justice, some of which were organized by REACH, prior to enrollment. After completion of two to three weeks of twice-daily data collection, participants, community organizers, and researchers convened to review results from health diaries and air pollution monitors. This level of participation, from the initial meetings through training, data collection and review of findings, increased community awareness about environmental health and environmental justice with the goal of promoting community capacity to play a role in improving public health conditions [31].

REACH and UNC-CH researchers identified air quality near CAFOs and impacts on children's respiratory health as an important topic for further investigation. This topic was chosen based on community concerns as well as results of prior studies of asthma symptoms and CAFO odors in relation to the proximity of public middle schools to swine CAFOs [20, 22]. We designed the Rural Air Pollutants and Children's Health (RAPCH) study to provide educational benefits and increase environmental health awareness among students, teachers, and community members as well as to investigate acute health impacts from exposure to airborne CAFO pollutants using the repeated-measures design developed for the previous study [31, 32].

The purpose of this manuscript is to describe our approach to study recruitment and data collection at public schools given the local context of environmental injustice. After briefly summarizing the repeated measures protocol and describing supplemental activities to enhance environmental health education, we describe an evaluation of benefits and drawbacks of study participation conducted at the conclusion of data collection. We conclude with a discussion of perceived benefits as well as challenges we encountered during RAPCH recruitment and data collection. Our experience can inform future public health studies and increase consideration of how study participation can benefit affected communities, especially those experiencing environmental injustice.

METHODS

Repeated Measures Study

Three public middle schools in eastern North Carolina participated. School exposures ranged from nine to 56 swine barns, six to 16 swine waste lagoons, and four to 25 poultry barns within two miles of each school. REACH made initial inquiries to identify rural school principals who would be comfortable making air pollution measurements at their schools. With administrator approval, REACH and UNC-CH research staff met with school staff to discuss study participation. School staff chose participating classes based on class size, anticipated student ability to adopt the protocol, and scheduling ease. All students in participating classes were eligible and invited to participate. We collected data in five waves from February through May and September through November 2009. Each wave of data collection included three science classes from a single school. Of 358 students in the 15 selected classes, 340 (95%) participated in the study. In addition to weekly meetings of our collaborative research team, we reviewed study progress at monthly REACH meetings attended by 30 to 40 community members.

In brief, the repeated measures protocol included the following steps: 1) student participants completed a baseline survey reporting demographic data and respiratory health status at baseline; 2) for three to five weeks, students used a structured daily diary to record current symptoms of illness, odor observations in the past 24 hours, asthma medication use, absences due to respiratory illness since last entry, and time outside; and 3) students completed three lung function measurements with a handheld electronic Mini-Wright Digital peak flow meter (Clement Clarke International, Harlow, UK). Daily data collection was facilitated by two community liaisons who were REACH members and former educators that learned the study protocol and completed research ethics training required by the UNC-CH Institutional Review Board (IRB). Community liaisons were responsible for distributing and collecting health diaries in each classroom, monitoring use of peak flow meters, checking diaries for completion, and checking air pollution monitors. Particulate matter less than 10 micrometers in diameter (PM_{10}) and hydrogen sulfide, a toxic gas produced by anaerobic decomposition of fecal waste, were measured continuously inside and outside the schools during periods of student data collection.

We consulted with former local educators regarding educational activities that would complement the research protocol while limiting interference with the daily classroom schedule. To support the middle-school science curriculum, we incorporated concepts of scientific inquiry, technological design, air pollution, and human respiratory physiology into several steps of the research process [33]. Prior to data collection, collaborating teachers and community liaisons from REACH participated in a two-hour training about study design and protocol. During our first classroom visit, we gave an interactive presentation about respiratory health and urban versus rural air pollution before introducing the study. Participants were then trained in diary completion and peak flow measurement. During training steps, we emphasized scientific principles such as systematic technique, honest reporting, and accurate recording of observations. Engineers on the research team demonstrated the air monitoring instruments to each participating class. We also exhibited the process of downloading data from a peak flow meter for digital display. Research team members sought to reinforce scientific principles during daily interactions as well, such as identifying specific activities that corresponded to steps of the scientific method. Finally, at the request of the principal, participants from one of the schools came to UNC-CH for a field trip, which included demonstrations in several different laboratories, a discussion of the EJ movement in North Carolina, and a campus tour.

Former educators also recommended appropriate research incentives. Based on this advice and prior experience with participatory research, participating classes earned a pizza party when 90 percent of parental consent forms were returned (achieved by 14 of 15 classes), student participants received a box of school supplies, teachers received $50 if 90 percent of parental consent forms were returned (regardless of whether consent was given), as well as $25 a week during data collection and $100 upon completion, while schools received $500 each.

After each wave of data collection, we returned to participating classes to present preliminary results. We shared the prevalence of reported odors, respiratory symptoms, allergies, and smoking; reported average pulmonary function values stratified by grade and

sex; and discussed mean air pollutant concentrations. Researchers displayed data using simple graphs and solicited student interpretations for discussion. We then distributed a table of data from which students generated their own bar graph depicting study results, with assistance from the research team.

Evaluation of Study Participation

After data collection with the students was complete, we invited 14 of 16 collaborating principals, teachers, and community liaisons to participate in semi-structured in-person interviews about the participatory study approach. Two collaborating teachers could not be reached because they had changed jobs.

For school staff, a pair of interviewers, one from REACH and one from UNC-CH, conducted interviews in May and June 2010. We conducted semi-structured in-person interviews for the following reasons: 1) we had a strong rapport with collaborators that we believed would lend itself to productive and critical discussion; 2) in-person interviews provided the opportunity to discuss unanticipated topics; and 3) staff participation required only attending a brief after-school meeting. Two teachers participated in a joint interview for their convenience. For community liaisons, a UNC-CH researcher familiar with the study conducted a focus group in June 2010. Interview and focus group guides were developed by the research team with input from consultants at REACH to ensure consistency of content and clarity of questions (see Appendix). We obtained informed consent and permission to digitally record all interviews. The UNC-CH IRB annually reviewed and approved these activities.

We began the interviews with a reminder of study activities. We then asked all interviewees about benefits and limitations of our study approach, confidentiality, and recommendations for future studies. In anticipation that observations about limitations might be suppressed due to social desirability, this question was typically asked multiple ways with some additional probing. Additionally, we asked principals about motivations to participate, teachers about the study's impact on learning objectives, and liaisons about logistical challenges associated with data collection.

One research team member experienced in qualitative analysis transcribed and coded interviews to identify themes. A second research team member also experienced in qualitative analysis reviewed the coding. The two researchers reconciled coding and agreed on primary themes. We grouped the final themes and sub-themes into three categories: motivation for school participation (principals only), benefits of participation, and challenges with participation.

RESULTS

Of the 14 school staff members and community liaisons invited to participate in our evaluation, 13 took part in an interview, including all three principals, six teachers, and all four community liaisons. The nonparticipant was unavailable due to illness. Here we present interview themes by category with illustrative supporting quotes.

Motivation for Participation

School principals were primarily responsible for deciding whether their school would participate. Two principals were motivated by potential academic benefits, citing the "academic piece" and the potential for expanding understanding of science through a "practical, hands-on approach." The third was motivated by concerns about prevalent respiratory illness among students.

Benefits of Participation

Academic Enhancement—All respondents said they observed enhancement of the students' academic environment, which they credited to hands-on research activities and interaction with the research team. Teachers and principals cited the importance of having activities that gave students "something concrete to experience" and said hands-on learning can be hard to provide via typical classroom activities. Several teachers and liaisons noted that discussion topics, such as air pollution and respiratory physiology, and skills used (e.g., recording data and interpreting graphs) complemented the science and math curricula. School staff stated that the project was "meaningful" to the students because students were so involved in data collection.

> The data recording, having them keep track, reading their instruments, making sure they're in the right place in their diaries, recording the data appropriately, all this is really important for these kids because they are so weak in these areas.
>
> —Teacher

> The whole scientific method was reinforced . . . they were actively involved in gathering the data and then when you showed them the graphs, that gave them practice interpreting findings, so they really could see the scientific method in action . . . so they're seeing that science is more than the textbook.
>
> —Teacher

Increased Interest in Science and Research—Principals and teachers also reported greater student interest in science and research following involvement in this participatory study. Several respondents said that students wanted to know more about other studies that had been done and even suggested additional projects to undertake. One principal said that the opportunity to participate in a study of "real-life" topics that directly affect the students (i.e., air quality and respiratory health) contributed to this increased interest. Community liaisons observed an increase in scientific questions from students over the course of the study, speculating that rapport built over several weeks of data collection contributed to students' comfort in seeking further information. Numerous respondents said the scientific instrumentation used was engaging for students. Interviewees mentioned that students were "thrilled" to observe and work with air quality monitors and peak flow meters.

> A lot of kids hate science, it's just too hard and they can't figure it out, and it's just a bunch of people in white lab coats pouring things into test tubes and all that—that's their mental image. Being involved with the study, they realized that it was not all completely dry, bland stuff, that it could be interesting.

—Teacher

> Kids in this area don't really get out. With public school funding slashed, the opportunities are limited. So we have to look at other ways to get them out there . . . and get them engaged in activities like this, that are going to help them, and pique their thinking.

—Principal

Increased Environmental Health Awareness—Respondents also reported an increase in environmental health awareness as a benefit of study participation. School staff said that the students resonated with the respiratory health topic due to the prevalence of asthma in the student population. School staff also commented that for many students, this was the first time they had considered how the environment could affect their health, and realized that air pollution occurs in rural as well as urban areas.

> For the sixth-graders, air quality is something they haven't even considered . . . it helped them to see that we can't take what we breathe for granted.

—Teacher

Community liaisons from REACH also experienced an increase in environmental awareness after assisting with the study.

> I know before I started working on this I wasn't aware of the environment, I'd just ride down the road . . . going where I need to go. Once you learn, you're more aware and you start looking and seeing different things.

—Community liaison

Challenges of Study Participation

When asked about potential drawbacks of the study approach, four of 13 respondents (two principals and two teachers) did not report any observed limitations or challenges, even when probed.

Other respondents reported several challenges related to age and maturity of participants (mean age = 13.4 years). One teacher expressed concern that some students were too immature for study participation, stating that this may have resulted in inaccurate reporting and inappropriate handling of the peak flow meters, as well as disciplinary challenges. Community liaisons and teachers mentioned challenges with discipline in some classrooms, although the community liaisons noted that prior experience working in schools was extremely useful in managing students and minimizing the escalation of minor problems. Some community liaisons observed inaccurate reporting of diary data. Liaisons described rapid diary completion with inattention to detail (e.g., drawing one rapid line through the “None” response option for the column of 11 current symptoms) and witnessed participants recording lung function values before making measurements. Liaisons said they tried to use these situations to reinforce the importance of accuracy in scientific reporting.

> You have to be observant . . . when you see them writing something down you don't ask them what they're writing, you say, “Now wait a minute, did you see

those results on your meter?" "No, I know what I'm going to get." "No, you don't. In science, you do the research first and then you get the results and the conclusion comes last."

—Community liaison

One of the challenges of conducting a study in a classroom setting was that in the five classes with less than 100 percent participation there was potential for nonparticipants to feel excluded or bored. Community liaisons reported perceptions that nonparticipating students felt excluded; teachers mentioned nonparticipants distracting participants.

DISCUSSION

Partnering with schools to investigate health concerns in situations of environmental injustice can result in increased challenges as well as positive consequences. The RAPCH study built on previous experience conducting community-based public health research that sought to provide education and support for community organizing [31]. We intended to enhance academics for the students while also producing ripple effects of environmental health awareness in the broader community. Other school-based studies have demonstrated that providing direct benefits increases the value of a research study to school staff, with principals being essential advocates [34, 35].

According to evaluation respondents, students enjoyed study participation and experienced enhanced academics via direct engagement in a new activity that reinforced aspects of the science curriculum. Some benefits to students may be latent. It was too early to evaluate interest in high school science courses, environmental health, or scientific careers. Other child health studies using participatory principles suggest a resulting increase in youth empowerment and interest in health research, although more rigorous assessment of these effects is needed [36]. Our interviews immediately followed data collection, so we do not yet know the impact of disseminating results to the broader community.

One limitation of our evaluation was the possibility that negative reports could have been reduced by social desirability bias in a face-to-face interview. We took steps to overcome this possibility: interviewers typically were not primary study staff, we asked about challenges in multiple ways and at different times during the interview, and when coding we looked for indications of challenges in statements beyond direct responses to those questions. A fully structured questionnaire could suffer from the same problem without producing the depth, detail, and context provided by semi-structured interviews. The collaborating schools are located in low-resource communities, which may have influenced the openness to a study that would supplement science education while also limiting critical feedback from interview respondents. Finally, our evaluation assessed only the perspectives of adult collaborators, rather than student participants. Student participation in the evaluation would have required securing additional parental consent and student assent, and we believed that adult collaborators would provide sufficient critical reflection on potential benefits and drawbacks.

There may have been additional benefits that were not addressed during the interviews. For example, other school staff members who knew of and supported the study, including custodial staff, librarians, administrative staff, and other teachers were not interviewed for feedback. According to our own observations, learning about the efforts of the study seemed to give REACH members more initiative to organize for environmental health improvements and willingness to collaborate on additional efforts to document health impacts from CAFOs. REACH also earned credibility in the community and gained additional opportunities to interact with residents about environmental health concerns. Some high-school seniors approached REACH for mentoring on science projects, such as water sampling and comparisons of manure with chemical fertilizer. While the impact of these interactions is difficult to quantify, they have the potential to strengthen environmental health interest in the wider community.

The recognition of industrial livestock production as an environmental injustice in North Carolina necessitates sensitivity to potential impacts for research participants beyond typical concerns for physical or mental harm. Confidentiality can be especially challenging to maintain in small, rural communities where research participants or locations can be deductively identified with minimal information. Additionally, five of the top 10 largest employers in the study area are associated with livestock production [37]; therefore, research participation may threaten livelihoods and personal relationships.

Some studies have limited these concerns by investigating health and EJ impacts of CAFOs in North Carolina via analysis of secondary data [5] and anonymous surveys [22]. Successful recruitment for primary data collection in affected communities has relied on partnerships with local community-based organizations that are familiar with the social and political climate and bring an initial level of trust to research participation. Local collaborators have facilitated door-to-door surveys [9] or led recruitment of volunteers [31] and are instrumental in building community relationships with academic researchers. These studies were conducted with close attention to the preservation of confidentiality, recommending caution when participants discuss study involvement with others and not reporting locations of study areas. The RAPCH study presented a new challenge because we were publicly recruiting participants who, as children, also required parental consent in order to participate.

Consequently, the study team determined it would be prudent to use several strategies to minimize the focus on CAFOs as the exposure of concern. We used “Rural Air Pollutants” in the study title to deemphasize CAFOs, which also accurately represented our ability to measure pollutant concentrations, but not their sources, and acknowledged our interest in potential confounding from non-CAFO pollution sources. While introducing the study to school officials, teachers, and students, we discussed numerous sources of rural air pollutants, including CAFOs. Reports of several odors—exhaust, livestock, and smoke from fires—were requested in the structured daily diary.

To address recruitment challenges within schools, REACH led the recruitment effort. REACH staff are most familiar with community dynamics and could approach administrators at schools that were closer to CAFOs while keenly observing administrators’

reception of the opportunity. REACH successfully recruited four of five schools to participate in a pilot exposure assessment study. The fifth required extra administrative approvals from the school board that precluded their participation. Although we did not emphasize the contributions of CAFOs to local air pollution, REACH staff felt that some principals did not want to be involved because of the economic and political clout of the agribusiness. Two of the schools in the pilot study satisfied inclusion criteria for the epidemiologic study: they were middle schools with detectable air pollutant levels on site. A third middle school in close proximity to CAFOs was also recruited. Recruitment of students followed a more traditional approach: after describing the study to students in science classes, we provided parental consent forms for the students to take home for completion, accompanied by a letter of support from the principal and corresponding science teacher. We collected student assent from those that obtained parental consent.

Our recruitment strategies had advantages and disadvantages. REACH staff's knowledge of local schools and administrators guided recruitment strategies and conveyed the community-driven nature of the study to potential collaborators. The focus on all “rural air pollutants” was potentially less controversial than focus on the area's main industry would have been, and may have eased concerns about participation among school administrators, teachers, students and parents. We hoped that this broad exposure definition would eliminate potential claims that schools or students threatened the livestock industry with their involvement. These efforts may have contributed to collaboration from all three schools recruited for the health study and the participation of 95 percent of invited students.

On the other hand, this broad focus limited our ability to provide education about known exposures and health effects from CAFOs or to openly discuss the concept of environmental justice and evidence that CAFOs disproportionately affect low-income communities and communities of color in eastern North Carolina. Referring only to “rural air pollutants” also may be interpreted as disingenuous, although many school staff members commented about the potential for CAFOs to be pollution sources and welcomed the opportunity to contribute to an investigation of these exposures.

Additionally, we limited the opportunity for study involvement to contribute to community efforts to address local polluters by not explicitly discussing CAFOs as a pollution source. It was our hope that schools’ participation in the study would raise community environmental health awareness—a potential effect of involving so many school staff members, students, and consenting parents. This potential benefit had to be balanced against concerns about conflict or even possible retaliation from industry or closely associated government officials. As in other partnerships between members of exposed communities and researchers who live elsewhere, researchers should respect the decisions of community members who are most vulnerable and who will live with the consequences of research that could cause conflict.

As in other cases of industrial exposure (e.g., tobacco, asbestos, and lead), new knowledge about health effects of CAFO pollution will not produce systemic change on its own [38]. Public health professionals often focus on engineering, behavioral, and medical interventions, yet organizing by people who experience health problems resulting from

hazardous conditions, such as those in the labor, women's, civil rights, and EJ movements, have been important historical forces for improved environments that are essential to health [39]. Community partners often have both the networks and the skills to most effectively spur change toward improved public health [39-41]. We hope that teachers, students, and residents who attend community meetings about RAPCH will be better equipped to play this role.

Public health researchers can support these efforts by engaging with communities, regardless of research results. Community–academic partnerships should consider how research could be designed to influence popular participation in health promotion, as well as advance knowledge, through research that is respectful of participant values and local needs [42, 43]. Such a collaborative approach may enhance the value of research to the public, increase participation, promote fair use of resources, and support change to improve public health [44].

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APPENDIX

RURAL AIR POLLUTANTS AND CHILDREN'S HEALTH STUDY INTERVIEW GUIDES AND PROTOCOL RECAP

Principal Interview Guide

1. What motivated you to allow your school to participate in this study?
2. How did the students benefit from participating?
3. How did the teachers and staff benefit from participating?
4. What were some drawbacks of being a part of this study?
5. What are your recommendations for conducting similar joint studies in the future?

Teacher Interview Guide

1. What was your overall impression of participating in the study with your science class?
2. Do you think participating in the study was a positive or negative experience for your students?
3. What were some benefits of participating?

4. What were some drawbacks of participating in the study? (Prompts: student behavior, distraction from normal school activities, equipment noise, time constraints, jealousy from non-participating students.)
5. Without naming individual students, what feedback did you receive or overhear from students regarding their participation in the study activities?
6. Did you have any concerns about keeping students' participation in the study confidential? (Prompts:Concerns about others not in the study finding out who was participating, concerns about keeping diary responses confidential.)
7. How could we have better protected or enforced confidentiality?
8. How could the daily logistics of diary completion have been improved?
9. Which activities best supported the learning objectives for your science class?
10. Any final comments you'd like to share?

Community Liaison Interview Guide

1. What were some of the challenges of your role?
2. What were some of the positive aspects of your role? (Follow-up: How did you benefit from your role as a community liaison?)
3. How could we have improved the logistics of daily diary completion?
4. How could we have improved the logistics of other activities such as student training, demonstrations, or the report back to students?
5. Did you have any concerns about keeping students' participation in the study confidential? (Prompts: Concerns about others not in the study finding out who was participating, concerns about keeping diary responses confidential.)
6. How could we have better protected confidentiality?
7. Do you think that REACH benefited from being a partner in the study? If so, please describe.
8. Did REACH experience any drawbacks from being a partner in the study? If so, please describe.
9. Do you think the broader community benefited from school participation in the study? If so, please describe.
10. Did the broader community experience any drawbacks from school participation in the study? If so, please describe.
11. Any final comments you'd like to share?

Reminder of Study Protocol Presented to Participants at Beginning of Interview

1. **Intro:** Presentation about healthy breathing and air pollution, which ended with illustrations explaining study activities. Parental consent forms were sent home.

2. **Training days:**
    a. Reading and signing the student assent forms.
    b. Completing a baseline survey about demographics and breathing history, which included video clips of people having difficulty breathing.
    c. Learning to complete the diary and operate the Mini-Wright Digital peak flow meter.
    d. Measuring height.
    e. Decorating the diary.
3. **Diary completion:** Each day for 3-5 weeks, students answered questions about respiratory symptoms and odor, then measured their lung function with a Mini-Wright Digital.
4. **Other activities:**
    a. Demonstrating air quality instruments
    b. Demonstrating the process of downloading data from Mini-Wrights
    c. Reminders of important characteristics of scientific measurement (honesty, accuracy, proper technique, etc.)
5. **Report**: We reviewed data collected by each class via charts and figures, then students completed a graphing activity.

Biography

VIRGINIA T. GUIDRY, PhD, MPH, is a postdoctoral fellow at the University of North Carolina at Chapel Hill Department of Epidemiology. She has been working on environmental health education and research in North Carolina for 10 years. Her recent work includes community-based, participatory research on health impacts on neighbors of industrial livestock production. She can be contacted at virginia.guidry@unc.edu.

AMY LOWMAN, MPH, is a research associate at the University of North Carolina at Chapel Hill Department of Epidemiology. She has over 10 years of experience managing and conducting community-based participatory studies about the health effects of polluting industries on surrounding communities. Ms. Lowman has coauthored publications about the community health impacts of industrial hog operations and the application of treated municipal sewage sludge on farmland. She has also co-developed a protocol for tracking and investigating residents' reported health concerns related to the land application of treated sewage sludge. She can be contacted at alowman@email.unc.edu.

DEVON J. HALL, Sr. is the Program Manager for the Rural Empowerment Association for Community Help (REACH) in Warsaw, NC. He has worked on several environmental projects in collaboration with UNC-Chapel Hill, including the MRSA Livestock Project; the Maple Creek Watershed Awareness Project; the Hazardous Substances/Arsenic Project; and the Rural Air Pollutants and Children's Health (RAPCH) Study. Mr. Hall is a strong

advocate of traditional agriculture and has extensive knowledge in raising healthy plants and animals. His training as an electrician and wealth of knowledge about agriculture have been valuable in monitoring industrial agricultural practices and conducting environmental research in rural communities. He can be contacted at djhall7@aol.com.

DOTHULA BARON has utilized her graduate degrees in Library Services and Conflict Resolution to improve quality of life for low income families and people of color socially, economically and environmentally. For the past twelve years, she was Executive Director of the Rural Empowerment Association for Community Help (REACH) working closely with the Epidemiology Department at UNC-Chapel Hill to research and address the public health impact of industrial livestock operations in rural Eastern North Carolina. Ms. Baron is now self-employed as a consultant helping to build strong, sustainable grassroots organizations with the capacity for effectively challenging society's many injustices. She can be contacted at dothula@aol.com.

STEVE WING received his Ph.D. in epidemiology from The University of North Carolina at Chapel Hill where he is an associate professor. Recent work has focused on environmental injustice and health effects of ionizing radiation, industrial animal production, sewage sludge, and landfills. He has collaborated on health and exposure studies with communities and workers impacted by threats to environmental and occupational health. He can be contacted at steve_wing@unc.edu.

NOTES

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