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Mobility Patterns of Migrant Farmworkers in North Carolina: Implications for Occupational Health Research and Policy

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Occupational health research often relies on longitudinal data to link exposures and health outcomes. Studies of migrant and seasonal farmworker health face special challenges. Farmworkers are difficult to track, and many occupational health outcomes require considerable time to develop. Using data from two longitudinal studies of farmworker health in North Carolina, we: 1) describe migration during one summer (amount, reasons, destinations); and 2) discuss the implications of these patterns for conducting different types of environmental and occupational health research. Approximately 30 percent of farmworkers migrated over the course of the summer. Analysis of specific work sites revealed both in- and out-migration. Work availability and work-related illness were major causes of out-migration. These data suggest that failing to document reasons for migration may result in underestimation of the occupational illnesses and injuries under study. If research on migrant farmworkers is to be used to establish worksite health and safety policies, traditional research designs and data analysis techniques must be adapted to the realities of worker migration.

Key words: farmworkers, immigrants, medical anthropology, research design, North Carolina

The last few years have seen the increasing prominence and convergence of two trends in population-based health research. Taken together, they pose a potential dilemma for researchers. The first is attention to *health disparities*. Put simply, this is the investigation of why socially and economically disadvantaged persons fare more poorly than the majority population in most measures of health, disease incidence, mental health, morbidity, and mortality (Lillie-Blanton et al. 1996). Of particular interest are underserved populations, including minorities and rural residents. Numerous National Institutes of Health requests for applications have focused on health disparities over the past several years, leading to the establishment of the National Center on Minority Health and Disparities, whose mission includes the conduct and support of research about minority health conditions and about populations with health disparities. The assumption that health disparities result from cultural and social determinants often brings practicing anthropologists and other applied social scientists into such investigations.

The second trend is *evidence-based health promotion and prevention research*. This is the emphasis placed on using sound scientific methods to determine the efficacy of health promotion and disease prevention efforts. Although debates have examined appropriate methodology—whether positivist inquiry or alternative methods such as interpretivist or critical methods are most appropriate (WHO 1998; Milburn et al. 1995)—there has been increasing pressure in health promotion to produce evidence of the effectiveness and even cost savings of health promotion approaches (Tilford 2000). These trends have come together in several funding initiatives of the National Institutes of Health, the Centers for Disease Control and Prevention, and other government agencies, which are aimed at developing and testing culturally appropriate interventions to reduce health problems in underserved populations. These initiatives require that researchers focus on issues of health disparities. Careful evaluation of the effectiveness of interventions is also required, with preference given to randomized trials. Borrowing from clinical medicine (Psaty et al. 2000; Friedman, Furberg, and DeMets 1998), the best designed community trials utilize adequate randomization, blinding, and follow-up (Murray 2001).

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While each of these trends in health research has obvious merits, their combination can raise significant difficulties for researchers. Populations subject to health disparities often lack access to reliable means of communication (e.g., no telephone, no permanent mailing address, limited literacy) and transportation (e.g., no private automobile, lack of access to public transportation). Both of these—communication and transportation—are factors that normally facilitate research participation. In addition, members of these populations are sometimes unfamiliar with research or suspicious of it (Corbie-Smith et al. 1999; Freedman 1998).

In this paper we focus on the use of longitudinal studies in one underserved population, seasonal and migrant farmworkers. In particular, we examine issues related to follow-up and ascertainment of outcomes. We argue that many of the research designs most commonly used in community cohort studies make assumptions about sampling and measurement that are hard to justify in populations of migrant farmworkers. This makes it extremely difficult, for example, to demonstrate the effectiveness of health promotion programs in this population and may lead to further disparities between the health of farmworkers and the rest of the population.

After presenting background data on farmworker health and pesticide exposure, we use data from two occupational health studies of migrant and seasonal farmworkers to examine how the nature of this population affects the ability to use rigorous scientific designs. One study is a community trial and the other is a surveillance study. We present data from these two studies to characterize the degree and type of migration of these farmworkers in North Carolina. We then discuss the implication of this for different research designs. Further, we consider how research practices of applied anthropologists and community participatory research can minimize attrition and help researchers understand how mobility and the process of migration affect study integrity.

Background

Migrant and seasonal farmworkers face serious occupational and environmental health risks. Agriculture is the second most dangerous occupation in the United States (Myers and Hard 1995). Hazards in the work environment include chemicals, equipment, animals, and water. For farmworkers, the problems can be exacerbated by lack of power to control the workplace environment, inadequate safeguards initiated by employers, lack of training in health and safety, communication problems, and limited access to health care (Arcury and Quandt 1998). There are 4.2 million farmworkers in the United States today. Eighty-one percent are foreign born, 95 percent of those were born in Mexico and they work in 42 of the 50 states (Mehta et al. 2000). Thus, the health and safety issues for farmworkers cross state, regional, and national boundaries (HRSA 1990).

Data from the National Agricultural Workers Survey 1997-1998 indicate that 56 percent of farmworkers across the United States are migrant farmworkers (Mehta et al. 2000). This means that they travel more than 75 miles to obtain a job in agriculture. Seventeen percent of farmworkers are follow-the-crop migrants, who hold at least two jobs more than 75 miles apart. Thirty-nine percent are shuttle migrants, who travel between their home and one or more agricultural jobs. Forty-two percent of all farmworkers maintain a home base outside the United States. In general, those who migrate for work are more likely than nonmigrant farmworkers to be foreign born, to be younger, and to be less experienced in farmwork.

North Carolina ranks fourth in the U.S. in the number of seasonal and migrant farmworkers employed (Mines, Gabbard, and Steirman 1997). The farmworker population in North Carolina has undergone a transformation from African American and white to almost exclusively Latino in the past 10 years (Arcury et al. 1999b; Quandt et al. 2001a). North Carolina farmworkers are not presently unionized, but the Farm Labor Organizing Committee (FLOC) is presently attempting to organize them. North Carolina is the major participant in the federal H2A visa program, so approximately 12,000 workers come into the state on labor contracts each year.[1] All of the H2A workers and many of the other farmworkers in North Carolina come directly from Mexico, not through the traditional East Coast migrant stream from Florida. Quite a number are from southern Mexico. Some speak Indian languages first, Spanish second. Farmworkers are rapidly settling out to take construction, landscaping, and service jobs in the booming North Carolina economy, having a major impact on the demographics of cities and of small rural communities (US Census Bureau 2001).

Although farmworkers are acknowledged to be a population at risk for occupational and environmental health problems, research to support or explain this is surprisingly meager (Zahm and Blair 1993). It is limited to cross-sectional surveys and case studies. The largest of these is the NAWS, National Agricultural Workers Survey (Metha et al. 2000). Although it added health-related questions to the survey in 2000, the NAWS and other surveys (e.g., Kamel et al. 2001) cannot be used to understand the process of injury or to test ways of preventing it. Thus, additional studies with longitudinal designs or with the ability to link outcomes to exposure are required.

Research Projects

Data for these analyses come from two research studies our group has conducted over the past five years with farmworkers in North Carolina. The first is entitled PACE, Preventing Agricultural Chemical Exposure. It is a four-year study to develop and test culturally appropriate educational programs to reduce pesticide exposure. PACE is a community-participation study in which the farmworker community, through a community-based organization, has entered into a partnership with university-based scientists to address the problem of pesticide exposure (Arcury et al. 1999a; Quandt,

Arcury, and Pell 2001). This partnership conducted formative research to develop a pesticide-safety training program. To test this program, PACE uses a group randomized design in which migrant farmworker housing sites are randomized to intervention or control status. Housing sites include barracks on farms, trailer parks, old houses, and other arrangements used by farmworkers for living quarters. All workers at the intervention sites receive pesticide safety training, and one or more workers at the site receives additional training and materials to be a field safety promoter (Quandt et al. 2001a). No training is provided at the control sites. The effect of this intervention on knowledge, beliefs, and behavior is tested with pre- and postintervention surveys in both intervention and control housing sites.

The second study is GTS, the epidemiology of Green Tobacco Sickness. GTS is acute nicotine poisoning caused by the absorption of nicotine through the skin when working in tobacco fields (Arcury et al. 2001; Arcury, Quandt, and Preisser 2001; Quandt et al. 2000, 2001b). Workers whose skin is wet, either from perspiration or from dew and rain on the plants, absorb nicotine. The effects build up over the day, resulting in nausea, vomiting, dizziness, and headache that typically affect the worker at the end of the workday and into the next (Arcury et al. 2001; Ballard et al. 1995; Gehlbach et al. 1974). In severe cases, GTS can result in dangerous levels of dehydration. Because farmworkers are under pressure to work, they frequently do not seek treatment and continue working when sick. This study used a longitudinal surveillance design to track a cohort of farmworkers through the summer at two-week intervals for 10 weeks to measure the incidence of GTS and risk factors for the condition. At each interview farmworkers provide a saliva sample to be tested for cotinine, a major metabolite of nicotine, and answer a series of questions about their work over the previous week, any GTS symptoms, and exposure to known risk factors (e.g., working in wet clothes).

In both studies, considerable attention was given to gaining entrée into farmworker residence sites and to obtaining informed consent. In PACE, members of the community-based partner organization visited farmworker residence sites with other PACE staff on several occasions to explain the study before it began (Arcury et al. 1999b). The casual conversations allowed the staff to be sure the site was inhabited and get an estimate of the number of farmworkers present, and they gave farmworker residents opportunities to assess the staff and their intentions. In GTS, contacts were made by three bilingual, female interviewers (Arcury et al. 2001). Each had worked with farmworkers before. One had been the outreach worker for a migrant health clinic in the study area. As in PACE, preliminary visits were made to camps that served research purposes (e.g., camp censuses were taken) and gave residents a chance to become comfortable with the researchers. Workers at two PACE sites and one GTS site refused to participate. All were H2A workers and expressed concern about reprisals from their employers. Aside from these sites, very few farmworkers refused to participate.

Migration of PACE Project Participants

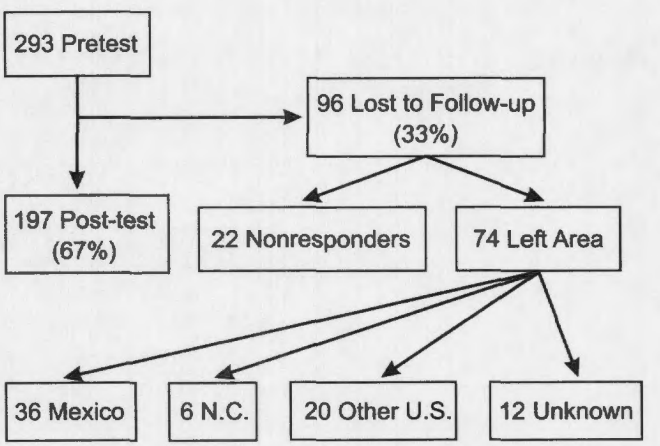
The pre- and postintervention data collected in PACE allow us to estimate the migration out of North Carolina residence sites over the summer of 1999. During this season, we placed considerable emphasis on tracking farmworkers to maximize the number for whom a post-test interview was completed. Interview teams returned to residence sites in late summer to reinterview those farmworkers who had completed pretest interviews in early summer. Interview teams queried other camp residents to learn where any missing workers had gone. Some could be traced to other nearby housing sites, where interviews were attempted as though the workers were in the original site.

For the pretest, a total of 293 workers were interviewed. At the end of the summer 197 completed a post-test, for a follow-up response rate of 67 percent. This proportion is similar to results from the previous summer when we conducted a test of our preliminary intervention. Using data collected by the interview teams, we were able to reconstruct the sample to see where those missing workers were and to evaluate whether workers had actually left, whether we were simply doing a poor job of finding workers, or whether workers were refusing to participate in the post-test.

Figure 1 shows a breakdown of the follow-up. Of the 96 workers not interviewed at the post-test, 22 were still living at the housing sites but were not interviewed. Of these 22 nonresponders, 12 refused, 1 could not be traced due to the omission of a name on the pretest form, 1 could not be interviewed because his crew leader would not allow it, and the remaining 8 were never at home during multiple attempts to find them.

The remaining 74 lost to follow-up had left the communities. According to information gathered by querying those still living in the residence sites, 36 had gone back to Mexico, 20 had gone to other states, 6 were elsewhere in North

Figure 1. PACE Study Follow-up, Showing the Status of Those Lost to Follow-up



Carolina, and 12 had left for unknown destinations. These 74 account for 25 percent of the original sample. If we reconsider this follow-up, almost all (92%) of the *available* farmworkers from the pretest who remained in the area were interviewed. This is a much more respectable follow-up response rate, which leads us to conclude that inadequate follow-up was not the source of the apparently low response rate for the post-test. Rather, the movement of farmworkers from the study area accounts for three-fourths of the attrition.

Movement of Participants in the GTS Surveillance Study

The GTS surveillance data allow us to estimate farmworker movement over the course of the summer, including movement in and out of the area. During early summer of 1999, interviewers recruited farmworkers at 36 housing sites. The initial goal was to recruit an average of five workers per site. At 13 sites with fewer than five workers, all were recruited. At 21 sites with at least five workers, four to seven workers were recruited. The interviewers returned four additional times at two-week intervals to measure symptoms of GTS and risk factors and to collect saliva samples for cotinine analysis: 164 farmworkers who worked in tobacco were initially recruited at Time 1 (T1); at T5, 107 of the original 164 were still present, though 9 of these had been missing for one or more of the biweekly interviews; and 57 left some time before the T5 visit, for a loss of 35 percent (Figure 2). This figure is comparable with the pre- and post-test experience in PACE. Eighteen workers were recruited after the first visit as replacements in camps with the highest turnover.

A review of the records kept at the five contacts across the summer with each farmworker site gives insight not available with PACE into the movement of farmworkers over the season. These records showed that 39 percent of sites experienced *no* change in residents over the summer, meaning that the same residents were present at all five contacts. Fourteen percent experienced changes in residents, but no net change in total numbers. Another 14 percent had a decrease in the number of workers present. At 33 percent of sites, there was a net increase in the number of residents. This trend toward more workers being present later in the season is consistent with harvesting which requires the greatest number of workers.

Data obtained by interviewing residents at individual sites convey the fluidity masked by summary pre- and postmeasurements, such as those recorded in PACE. Three sites exemplify the in- and out-migration of workers.

Site 1010 experienced a net increase: 8 workers were present at T1 and 21 at T5 (Figure 3). At the intervening visits the camp census increased progressively through the summer, but with considerable movement in and out of camp. The first informal contact with workers at the site took place in early June. At that time the tobacco plants were still small, and there were only five workers present. They said that 15 other workers were scheduled to arrive June 21, when more work would be available. When the interviewers returned for the T1 visit on June 23, they found the numbers had increased to only eight. Six of these were randomly selected and recruited. Seven additional workers arrived between T1 and T2, for a total of 15. At T3, the number present was still 15, but residents reported that 7 residents had left and 7 others had replaced them. The seven who had left included three study participants, so replacements were selected. At T4, the camp census had increased to 18. Residents reported that in the intervening time, three workers had arrived, then three left, and three more had just arrived that day. One of those who left was a study participant who had been recruited at T3. His coworkers reported he went back to Mexico because he did not like working in tobacco. Between T4 and T5, three new workers arrived at the site.

Site 1015 experienced less in- and out-migration and a net increase of one worker (Figure 4). Only two workers were present at the initial contact on June 23, but they reported others were coming. At T1 on June 28, 12 workers were present and 5 were randomly chosen for the study. The camp census declined to seven at T2: five left to return to Mexico because they had been getting sick from tobacco, according to their coworkers. Four were study participants; they were replaced. There were still only seven present at T3, but they reported six new workers had come in the intervening time, and all left after becoming sick from the tobacco. At T5, residents reported that three had left and three new people had arrived. Those who left were not sick.

Site 1040 experienced an overall decline in workers over the summer (Figure 5). At T1, eight workers were present, and five were recruited for the study. Two had left by T2; both reportedly went to Raleigh to do factory work because the grower did not have enough tobacco work. Between T3 and T4 another worker left to work in construction. Coworkers reported that none of these workers had been sick from tobacco. All the workers who left had been study participants.

Figure 2. GTS Study Participation from Early Summer (T1) to Late Summer (T5)

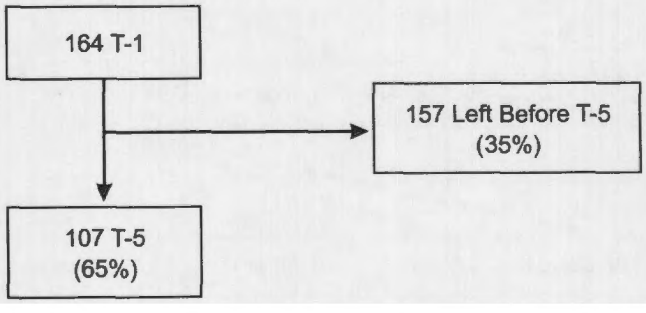
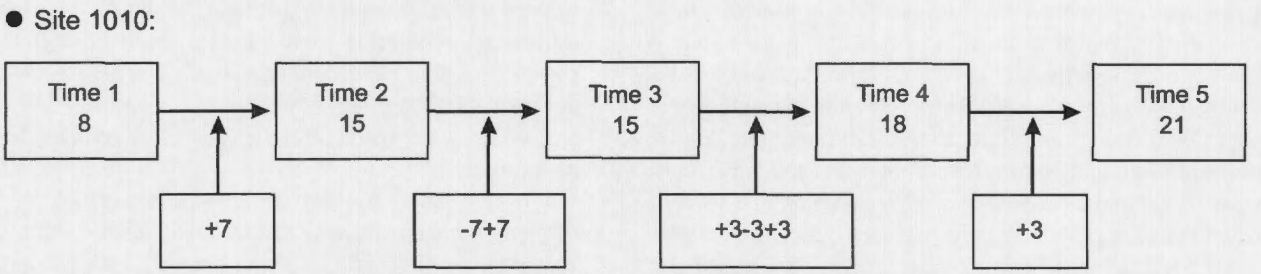
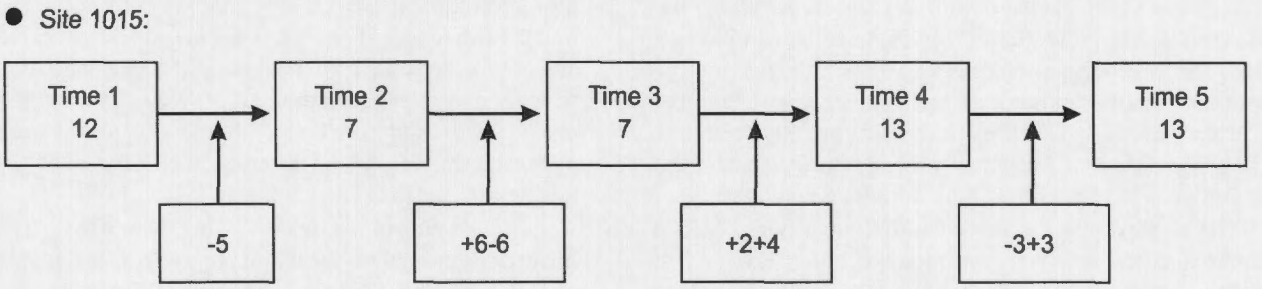


Figure 3. Example of Site Census Changes from T1 to T5 for Site 1010.



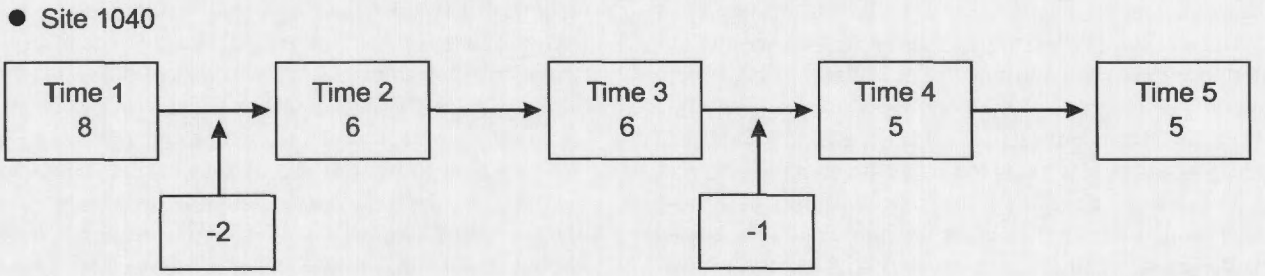
Note: Upper row gives total number of farmworkers present. Lower row indicates in- and out-migration.

Figure 4. Example of Site Census Changes from T1 to T5 for Site 1015.



Note: Upper row gives total number of farmworkers present. Lower row indicates in- and out-migration.

Figure 5. Example of Site Census Changes from T1 to T5 for Site 1040.



Note: Upper row gives total number of farmworkers present. Lower row indicates in- and out-migration.

Discussion

Together, the results of PACE and GTS give an indication of the problems involved in addressing health disparities through rigorous scientific designs among farmworkers in North Carolina and probably elsewhere on the East Coast. While it is common knowledge that migrant farmworkers move from place to place, the number moving within such a short period of time, when work was continuously available in North Carolina, was surprising. Twenty-five percent left in PACE and 35 percent in GTS, certainly a nontrivial proportion. The fluidity within housing sites in GTS resulted in complete turnover of residents in some sites.

How does this movement threaten the integrity of the research designs? The PACE design assumes random assignment of sites and their residents to intervention and control conditions. Loss of respondents leads to loss of statistical power, potentially biased results, and reduced confidence in the findings. We compared those lost to follow-up with those remaining. They did not differ in demographics such as age,

place of origin, and years of farmwork. However, those remaining were more likely to be H2A workers who come to the U.S. on work contracts. Such workers are generally not free to move—they must work for the grower to which they are assigned or return to Mexico, sometimes having to pay their own transportation home if they leave before the season is over. Because they have H2A visa status to work in the United States doing farmwork, they should not have fear of the Immigration and Naturalization Service (INS). Farmers can get H2A "replacements" if workers are unable to work. Thus, reliance on H2A workers introduces bias in the sample.

All occupational health research must deal with the "healthy worker effect" (Choi 2000; Howe, Chiarelli, and Lindsay 1988; Li and Sung 2000). That is, those hired for work tend to be healthier than the general population ("healthy hired effect"). Those who suffer illness and injury tend to leave the labor force ("healthy worker survivor effect"). Yet occupational health research with migrant farmworkers has added problems of migration. There is movement of workers independent of occupational illness--due to better job opportunities, family obligations, and problems with employers or coworkers—as well as movement directly related to illness. Movement independent of illness affects statistical power; that related to illness may introduce bias as well.

The greatest threat to the scientific integrity in PACE is the potential bias resulting from an association between loss to follow-up and the outcome variables. The research design was based on comparing an early summer pretest and late summer post-test to measure behavior, knowledge, and symptoms of pesticide exposure. The post-test was not obtained on those leaving, so it is not possible to know if their behavior, knowledge, or exposure differed from those who stayed. If these outcomes did vary, this could affect the evaluation of the intervention. For example, if those in the control sites experienced greater exposure to pesticides, suffered more pesticide poisoning, and therefore had a greater proportion of their less-knowledgeable workers leave, the final data analysis would be less likely to find an effect of the intervention on exposure than if they had stayed. Similarly, if those at intervention sites left because the intervention increased their knowledge and concern about pesticides, the evaluation would underestimate the effect of the intervention on knowledge. Thus, the effectiveness of the intervention would be underestimated in both cases. Because no interim assessments of behavior, knowledge, or health were made, it is not possible to know in PACE whether any of these events occurred. There was no difference between control and intervention sites in the percentage lost to follow-up, but the workers who left in the two types of sites may have been different. An association between loss to follow-up and the possibly unobserved post-test outcomes of interest is referred to as nonignorable nonresponse because, to obtain valid statistical inference, the pattern of missing data must be modeled in addition to specifying a model for the outcomes of interest (Little 1995). When dropout depends on the possibly unobserved post-test response, the statistical methods involved are more complex than standard methods for data with random dropout, and they rely on strong assumptions that are not possible to verify with the data. Sensitivity analyses are typically conducted to see the degree to which the estimated intervention effect varies according to different assumptions about the dropout mechanism. These methods are not yet routinely employed due to the paucity of readily available computer software and the specificity of many missing data problems.

In GTS, surveillance is designed to detect the occurrence of green tobacco sickness symptoms over the course of the summer. Integrity of the design depends on persons being uniformly exposed to the basic risk factors for GTS—working in tobacco—throughout the season. If some workers leave to work in other crops, but return, they are not uniformly at risk. The prevalence of GTS will therefore be underestimated. Incidence is validly estimated because it takes time at risk, measured as the number of days or hours worked in tobacco, into consideration. However, if workers who have GTS leave and are lost to follow-up, both the prevalence and incidence of GTS may be underestimated. In the GTS study, incomplete data resulted from both of these problems: farmworkers moved between crops and farmworkers left because they were unable to tolerate GTS symptoms.

The extent and nature of missing data in the GTS study illustrates the need for the use of appropriate statistical methods in conducting longitudinal research on migrant farmworkers. The past 15 years has seen important advances in statistical tools, as indicated by treatises on the analysis of longitudinal data (Diggle, Liang, and Zeger 1994), on the analysis of missing data (Little and Rubin 1987), and, specifically, on the analysis of longitudinal studies with missing data (Laird 1988). Some statistical methodologies, particularly the general linear mixed model for continuous responses, are now widely applied to the analysis of unbalanced longitudinal data and give valid results under a wide range of plausible missing data mechanisms (Cnaan, Laird, and Slasor 1997), where an analysis of only subjects with complete data would fail. Likelihood-based methods such as these specify the joint distribution of a worker's multivariate response (i.e., the set of outcomes observed across all occasions) and give valid results when the missing data are ignorable, so that specifying an explicit model for the missing data process is unnecessary.

There are two "ignorable" missing data mechanisms, and they are important to delineate for migrant farmworker research. The first has been called "data missing completely at random" and states that whether the outcome is missing does not depend upon any outcomes or covariates, whether observed or unobserved. In the GTS study this would mean that data being missing do not depend upon the potentially unobserved current GTS outcome, any previous GTS outcomes, or any farmworker characteristics. This is a stringent assumption and seems unreasonable for the GTS study. The second has been called "data missing at random" and describes the situation where dropout may depend upon

covariates or observed outcomes but not on unobserved data (e.g., whether the farmworker would have experienced GTS if he or she had not migrated). For example, in the GTS study, if dropping out of the study depended only upon having a previously recorded GTS event, and recorded farmworker characteristics, this would be data missing at random. This assumption seems reasonable if measurement occasions are not too far apart.

Longitudinal data analysis of dichotomous data (e.g., GTS/No GTS) or count data is more complicated because full specification of the joint likelihood of a subject's multivariate discrete data is often not feasible. This issue arises because some workers are more prone to GTS than others, and so there is an intraworker correlation that must be taken into account with cluster data methods. Popular methods for the analysis of longitudinal categorical data (Liang and Zeger 1993; Lavange et al. 1994) give valid results only when the data are missing completely at random or when their absence depends only on covariates. Such methods were used in the GTS study to model GTS incidence and prevalence (Arcury, Quandt, and Preisser 2001). However, if farmworkers leave the study area because of reasons related to a previously recorded GTS event, then dropouts are missing at random and the estimates of GTS incidence and prevalence may be underestimated. More complicated statistical methods are available to address these concerns (Preisser et al. 2000), but unlike analysis of continuous outcomes when data are missing at random, they require modeling the missing data mechanism as a function of previous GTS episodes. Although there was evidence that the probability of dropout depended upon previously recorded GTS events, such evidence was not statistically significant and so standard analyses were applied in the GTS study. Although, in principle, dropout could have been modeled, and even the reasons for missingness (migration, refused, etc.) taken into account, such methods require more data than were available to estimate the dropout mechanism with adequate precision and, in turn, have greater confidence in estimates of GTS prevalence and incidence.

What are the solutions? In cases where the loss of farmworkers during the study may lead to loss of power, recruiting larger samples is a solution. The data on dropout rates presented here may help to justify the planned sample size in grant applications. However, increasing a sample by a third is very expensive. And, in cases where the loss of farmworkers leads to bias, larger samples alone may not reduce or eliminate the bias. Recording of detailed information on subjects, such as reason for dropout, will permit an evaluation of the degree and nature of the bias problem. It may also enable a statistical solution to the problem of bias when alternative methods or adjustment to standard ones are needed. With this in mind, investigators should monitor farmworkers to keep records of movement and its causes, differentiating migration related to study outcomes from routine migration. Frequent contact such as that in GTS can explain loss to follow-up and help ascertain the missing data mechanism that is likely to give the pattern of data that is observed and, in turn, identify appropriate methods of statistical analysis. Whether additional subjects are recruited, or additional information per subject is collected, granting agencies will need to be convinced that the added costs have scientific justification.

However, frequent contact can be problematic. Overly intensive data collection can be reactive, leading to changes in behaviors. If farmworkers feel they are under surveillance, they may demonstrate less risky behavior than if left alone. Monitoring farmworkers is expensive, difficult, and sometimes unsafe. It requires personnel to travel to dispersed rural sites at night and on weekends. Finally, such frequent contact may lead to greater attrition of those who consider the study a bother or who become suspicious of the tracking. Our experience in a preliminary test of PACE in which we visited camps on several occasions early in the summer was that workers became suspicious of our real motives. Many workers fear the Immigration and Naturalization Service, as well as other government agencies. In addition, farmworkers in North Carolina are frequently victims of crime, particularly burglary, and are wary of strangers. The success in GTS of tracking farmworkers over the summer without causing suspicion may have been due to the nonthreatening approach of the interviewers. One set of sites was interviewed by two young women and the other set by only one. These interviewers were clearly interested only in health information. The principal investigator accompanied the women on several occasions to monitor the study, but he visited only a few of the camps.

Not all studies require that repeated measures be taken longitudinally on the same individuals. Repeated cross-sectional surveys are often used instead. Such designs are better suited to monitoring change in the general farmworker population (e.g., the NAWS); however, they require recruitment of a greater number of farmworkers than community cohort designs to achieve similar statistical power (Donner and Klar 2000).

Ethnographic research, in combination with community trials or surveillance studies, can help delineate the causes of farmworker movement and attrition of study participants. Such research, frequently consisting of observation and qualitative interviewing, may be effective for discovering how much of the loss to follow-up is simply random. Ethnographic research can also be a vehicle for involving the farmworker community in the research process—assuring that the work is culturally appropriate and minimally intrusive—and assisting researchers in gaining entrée. In PACE, interview teams involved members of the community as interviewers in formative research and then as interviewers in fixed response pre-and post-test interviews (Arcury et al. 1999a). Service providers such as outreach workers can also participate in data collection and tracking, as farmworkers may be more comfortable with their repeated contact than with that of nonfarmworkers who arouse suspicions.

Clearly there is no single solution. However, researchers and granting agencies should consider the nature of the

farmworker population and its mobility when promoting research with farmworkers. Careful attention should be given to choosing among different research designs and statistical techniques that can accommodate missing data. Researchers need to be cognizant of the likelihood of producing null results when not tailoring the design to the migrant population. It is also necessary to understand the nature of the target migrant population. Our experience in North Carolina indicates that many members of the current migrant farmworker population do not follow the traditional East Coast migrant stream. Instead of following crops back and forth to winter residence in Florida, many are recruited by labor contractors directly in Mexico. They return there when the work season is complete or—in the case of GTS—when the symptoms force them to leave their jobs.

The current focus for research and programs on eliminating health disparities and on rigorously testing the efficacy of interventions presents a challenge. Many of the factors related to health disparities make the use of traditional research designs difficult. Migrant farmworkers provide one example. Population movement contributes to less access to health care, to reduced continuity of care, and to greater health risks relative to the general population. Movement also makes it difficult to link these factors with health outcomes. Overcoming the obstacles in such research is an area for fruitful collaboration of applied medical anthropologists and sociologists familiar with the population and experts in design and statistical analysis who can apply methods to take account of missing data and reduce bias.

Notes

[1]The H2A program provides farm labor to employers who can demonstrate a labor shortage. An H2A visa allows an individual to enter the United States to work in agriculture for a specified period of time for a particular farmer. An individual worker can be employed by more than one farmer ("dual employment") and can transfer from one area to another (working on a tobacco farm from July through September and transferring to a Christmas tree farm from October through December), if he files the appropriate request. The farmer is obligated to meet all safety requirements and provide workers an average of 30 hours of work per week, a specific hourly wage, and inspected housing.

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