

National Farmworker Database: Establishing a Farmworker Cohort for Epidemiologic Research

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Background *There is little research into the long-term health effects of pesticides and other agricultural exposures among seasonal and migrant farmworkers in the United States. We present results of a feasibility study that established a cohort of farmworkers for use in epidemiologic research.*

Methods *Subjects consisted of migrant and seasonal farmworkers who joined the cohort while seeking social services through members of the Association of Farmworker Opportunity Programs (AFOP) and were entered in the National Farmworker Database (NFD) between the end of 1997 and March 1999. We designed an add-on interview with information that enhanced the utility of the database for epidemiologic research.*

Results *We recruited and obtained basic demographic and employment information on 5,597 farmworkers at very modest cost and effort. Subjects were mostly seasonal (61.5%), female (56.7%), and Hispanic (67.4%), with a median age of 27. Most (62.6%) had not completed high school; almost all (99.1%) reported being U.S. citizens or permanent residents, an eligibility requirement for some of the services provided by AFOP. The majority (62.5%) had engaged in farmwork for less than 10 years, but had performed a wide variety of tasks on different crops, including row crops and tree fruits. Picking was the most common task reported. Most subjects had performed farmwork in Florida, North Carolina, Texas, Michigan, or Georgia. For usual source of health care, 63.7% reported use of U.S. hospitals or emergency rooms/clinics, 42.0% U.S. private physicians, and 29.7% migrant health clinics. Among subjects reporting a prior diagnosis of cancer, primary sources of health care for treatment of that cancer included U.S. private physicians (61.9%), U.S. hospitals or emergency rooms/clinics (23.8%), and migrant health clinics (10.5%).*

Conclusions *Results suggest that by adding a brief interview to the existing NFD data collection process, which was designed for other purposes, it is feasible to create an efficient tool for conducting longitudinal epidemiologic research among farmworkers.*

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INTRODUCTION

An estimated three million migrant and seasonal farmworkers are employed in the United States [Wilk, 1988]. Exposure to pesticides and chemical fertilizers, as well as physically demanding work conditions, may increase their risks of certain diseases such as cancer, neurological damage [Drenth et al., 1972; Misra et al.,

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1988; De Bleecker et al., 1992; Ray and Richards, 2001], and adverse reproductive or developmental outcomes [Krickler et al., 1986; Schwartz et al., 1986; Schwartz and LoGerfo, 1988; Arbuckle and Sever, 1998; Slutsky et al., 1999; Engel et al., 2000]. Studies of farm owners/operators have consistently shown elevated risks of cancers of the lymphatic and hematopoietic systems, lip, stomach, skin, prostate, brain, testes, and connective tissue [Zahm et al., 1997]. However, there has been very little research on cancer or other chronic diseases among farmworkers [Zahm and Blair, 1993].

This lack of farmworker research stems, in part, from perceived difficulties in tracking such a mobile population. Concerns about the ability to follow migrant farmworkers and assess agricultural exposures, prospectively or retrospectively, and to monitor disease incidence in this population, has led researchers to pursue other, more stable, study populations (e.g., farmers). However, farmworkers receive exposures which likely differ in both degree and type from those experienced by other agriculturally-employed persons such as farmers, warranting further investigation.

The Association of Farmworker Opportunity Programs (AFOP), through its member organizations, provides employment, training, health, and support services in agricultural areas to farmworkers in 48 states within the United States. AFOPs member organizations receive grants from the U.S. Department of Labor's Workforce Investment Act, Title I, Section 167 program (formerly the Job Training Partnership Act [JTPA] Title IV, Section 402). AFOPs member organizations conduct extensive needs assessment and intake interviews with migrant and seasonal farmworkers receiving their services. These data are collected and housed at the national level through AFOPs National Farmworker Database (NFD). AFOP is unique in its ability to gather in-person information from its members in the field, which are serving farmworkers on a daily basis and which provide services, at least annually, to most persons participating in one or more AFOP programs.

The National Cancer Institute (NCI) and AFOP used this capability to assess the feasibility of establishing a large farmworker cohort for the purposes of epidemiologic research. The intake interview was modified to include a brief questionnaire assessing certain lifestyle, occupational, and health care utilization factors. This information, together with data obtained from other sources such as disease registries or surveillance systems, could be used to study disease patterns and associated risk factors in this population. Thus, this effort represents an efficient means of transforming an existing data collection system into one which is useful for epidemiologic research. The feasibility study enrolled 5,597 subjects into the cohort over 16 months.

MATERIALS AND METHODS

All farmworkers requesting services from AFOP service providers (e.g., employment offices, job training offices, daycare centers, housing offices, English language programs, and other support services) are given extensive needs assessment and intake interviews to determine eligibility for those services. The provider collects information including name, address, social security number, date of birth, race and ethnicity, country of origin, gender, citizenship status, years of education, employment status, farmworker status (migrant vs. seasonal), employers during the previous 2 years, and number of dependents. Migrant farmworkers are defined as persons whose primary employment is in agriculture on a seasonal basis and who establish temporary residences for such employment. Seasonal farmworkers are persons whose primary employment is in agriculture on a seasonal basis but who remain in the area year-round. A small proportion of farmworkers, mostly in California, Texas, and Florida, is employed in agriculture year-round; because they tend to be demographically similar to the seasonal farmworkers and use similar AFOP services, they are grouped with seasonal farmworkers in the present analyses.

Participating service providers invited farmworkers who completed the intake interview to answer additional questions to enroll in the cohort. The informed consent assured them that receipt of services was in no way tied to their participation in the study. Although the survey was initially restricted to enrollees in the JTPA Section 402 employment and training program, which required that participants be legally authorized to work in the U.S., this restriction was subsequently lifted to allow inclusion of all farmworkers, including those of undocumented status. At all service centers, farmworkers were assigned to an intake interviewer on a next-available basis. Because of limited time and other resources, a subset of intake interviewers at each participating center administered the cohort enrollment questionnaire. All farmworkers who completed the intake interview with one of these interviewers were invited to complete the additional questionnaire. These farmworkers should therefore be representative of all farmworkers requesting services from these providers.

Persons who agreed to participate were interviewed for approximately 10–15 min using a pre-tested cohort enrollment questionnaire. The questionnaire asked about the subject's smoking history (i.e., ever vs. never, current smoking status, total years of smoking, and average number of cigarettes smoked per day), farmwork history (including first year of farmwork and total years of farmwork, which are not requested in the standard intake interview), the most common four crops or commodities with which they worked during the preceding 12 months, the activities performed on each crop, the number of children of 18 years of age or

younger, the number and ages of children engaged in farmwork, and both the subject and family history of cancer (for each family member ever reportedly diagnosed with cancer: name and birth date, relation to subject, type of cancer, age at diagnosis, and history of farmwork). Service providers sent to AFOP the computer-entered data along with a copy of the original questionnaire. All subjects included in the present analyses, except the first 300 involved in questionnaire pre-testing, were interviewed between the end of 1997 and March 1999. The study protocol was approved by the National Cancer Institute’s Institutional Review Board.

The purpose of this study was to assess the willingness of farmworkers to participate in an epidemiologic study and to identify a practical means of locating and enrolling them. For this reason, we collected only self-reported medical information; medical records were not examined, nor were biological specimens obtained. Based on results of a questionnaire pre-test, the initial interview was kept short (i.e., 10–15 min) to maintain high subject and interviewer cooperation.

RESULTS

Demographics

Of the 5,597 farmworkers interviewed for this feasibility study, 61.5% were seasonal and the rest were migrant (Table I). Slightly over half (56.7%) were female. They were predominantly Hispanic (67.4%), followed by 22.9% non-Hispanic white, and 8.7% non-Hispanic black. The median age was 27 years, with only 8.1% as of 50 years of age or older. About half of the respondents (53.4%) had completed only elementary or part of secondary school; 37.4% had completed at least a high school education. About 95% reported being U.S. citizens and virtually all provided Social Security numbers. One quarter of participants reported being current cigarette smokers, and 16.7% reported being former smokers. Ever smokers reported an average of 6.4 pack-years of smoking, while current smokers reported an average of 8.7 pack-years.

Work History

The 1987 Standard Industrial Classification Codes (SIC) categorize the agricultural industry into five major groups: “Agricultural Production—Crops;” “Agricultural Production—Livestock and Animal Specialties;” “Agricultural Services;” “Forestry;” and “Fishing, Hunting, and Trapping.” Participants reported current, or most recent (if unemployed at the time of interview), work activities predominantly in four of the five areas, with most reporting “Agricultural Production—Crops” (63.8%) and “Agricultural Services” (25.6%) (Table II). “Agricultural

TABLE I. Demographic Characteristics of NFD Cohort Members

Characteristic	n (%) N = 5,597
Farmworker status	
Migrant	2155 (38.5)
Seasonal	3442 (61.5)
Gender	
Female	3176 (56.7)
Male	2421 (43.3)
Race	
Hispanic	3770 (67.4)
White (non-Hispanic)	1282 (22.9)
Black (non-Hispanic)	484 (8.7)
American Indian or Alaskan Native	28 (0.5)
Asian	28 (0.5)
Unknown	5 (0.1)
Age (years)	
< 20	982 (17.5)
20–29	2130 (38.1)
30–39	1251 (22.4)
40–49	764 (13.7)
50–59	311 (5.6)
≥ 60	140 (2.5)
Unknown	19 (0.3)
Highest educational level	
None	515 (9.2)
Elementary or secondary	2991 (53.4)
High school or equivalent	2010 (35.9)
College or post secondary	81 (1.5)
Citizenship status reported	
U.S. citizen	5312 (94.9)
Permanent resident	237 (4.2)
Work permit	28 (0.5)
Temporary resident	20 (0.4)
Social Security number reported	5594 (99.9)
Smoking history	
Never smoked	2907 (51.9)
Former smoker	935 (16.7)
Current smoker	1396 (24.9)
Unknown	359 (6.4)

Production—Crops” includes work in the production of crops, plants, vines, trees (excluding forestry), sod, cranberry, mushrooms, bulbs, flower and vegetable seeds, and hydroponic crops. “Agricultural Services” includes work in soil preparation, crop planting, cultivating and protecting, mechanical crop harvesting, and farm management and supervision.

The majority of subjects (62.6%) had engaged in farm work for less than 10 years, with the largest group (36.7%) reporting less than 5 years (Table II). Most participants

TABLE II. Employment Characteristics of NFD Cohort Members

Characteristic	n (%) N = 5,597
Current or most recent employment, by Standard Industrial Classification (SIC) code ^a	
Agricultural production—crops (01)	3571 (63.8)
Agricultural production—livestock (02)	409 (7.3)
Agricultural services (07)	1432 (25.6)
Forestry (08)	28 (0.5)
Fishing, hunting, trapping (09)	157 (2.8)
Total years of farm work	
< 5	2051 (36.7)
5–9	1449 (25.9)
10–19	1375 (24.6)
20–29	526 (9.4)
30–39	112 (2.0)
40–49	68 (1.2)
≥ 50	16 (0.3)
Labor status	
Unemployed	3449 (61.6)
Employed	1659 (29.6)
Not in labor force	335 (5.9)
Other	154 (2.9)

^aMost recent employment was ascertained if subject was unemployed at the time of the interview.

(61.6%) reported being between agricultural jobs or unemployed at the time the survey was conducted.

Participants handled a wide variety of commodities, mostly fruits and vegetables (Table III). Tobacco, beets, corn, oranges, and cotton were reported by 10.7–11.4% of subjects, although a number of other crops were also commonly reported. Subjects also reported engaging in a large number of tasks (Table III). The two most common tasks were picking (39.7%) and planting (22.6%). Packing, cutting, hoeing, sorting, loading, weeding, pulling, and grading were less commonly reported, ranging between 6.4 and 9.7%. The ten most common task-crop combinations all involved picking (Table III), with oranges, tobacco, beets, corn, watermelon, onions, cotton, strawberries, tomatoes, and apples being reported by 6.5–9.7% of subjects.

The most common state in which farmwork was performed by these subjects was Florida, with 27.9% of all farmwork jobs being reported for that state (Table III). This was followed by North Carolina (13.1%), Texas (10.3%), Michigan (9.0%), and Georgia (6.8%), with no other state accounting for more than 3%.

Usual Sources of Health Care

Most subjects reported their usual source of health care to be U.S. hospitals or emergency rooms (45.2%) or U.S.

TABLE III. Ten Most Common Commodities, Tasks, and Locations of Farmwork Employment Reported by NFD Cohort Members

Commodity, task, or location of employment	# (% of subjects reporting such work N = 5,597)
Commodity	
Tobacco	636 (11.4)
Beets	629 (11.2)
Corn	627 (11.2)
Oranges	600 (10.7)
Cotton	599 (10.7)
Tomatoes	555 (9.9)
Apples	533 (9.5)
Onions	497 (8.9)
Watermelons	489 (8.7)
Strawberries	474 (8.5)
Task	
Picking	2222 (39.7)
Planting	1285 (22.6)
Packing	543 (9.7)
Cutting	531 (9.5)
Hoeing	489 (8.7)
Sorting	404 (7.2)
Loading	398 (7.1)
Weeding	386 (6.9)
Pulling	386 (6.9)
Grading	360 (6.4)
Task-commodity combination	
Picking oranges	544 (9.7)
Picking tobacco	498 (8.9)
Picking beets	441 (7.9)
Picking corn	440 (7.9)
Picking watermelon	425 (7.6)
Picking onions	422 (7.5)
Picking cotton	411 (7.3)
Picking strawberries	401 (7.2)
Picking tomatoes	388 (6.9)
Picking apples	365 (6.5)
State/country of farmwork employment	
Florida	1563 (27.9)
North Carolina	733 (13.1)
Texas	576 (10.3)
Michigan	504 (9.0)
Georgia	380 (6.8)
Indiana	152 (2.7)
Virginia	144 (2.6)
South Carolina	134 (2.4)
Missouri	100 (1.8)
Minnesota	69 (1.2)

TABLE IV. Sources of Health Care Reported by NFD Cohort Members

Source	# (%) of subjects reporting source
Usual sources of health care ^a	N = 3,678
Migrant health clinics	1093 (29.7)
U.S. hospitals/emergency rooms	1661 (45.2)
Other U.S. emergency care clinics	679 (18.5)
U.S. private physicians	1546 (42.0)
Curanderos or other folk healers	46 (1.3)
Care outside the U.S.	504 (13.7)
None	226 (6.1)
Sources of health care for treatment of cancer	N = 105
Migrant health clinics	11 (10.5)
U.S. hospitals/emergency rooms	15 (14.3)
Other U.S. emergency care clinics	10 (9.5)
U.S. private physicians	65 (61.9)
Curanderos or other folk healers	1 (1.0)
Care outside the U.S.	4 (3.8)
None	0 (0.0)

^aInformation concerning usual sources of health care was solicited only from the first 3,678 subjects. Total exceeds 100% because some subjects provided multiple usual sources.

private physicians (42.0%) (Table IV). Fewer subjects reported use of migrant health clinics (29.7%) or U.S. emergency care clinics (other than U.S. hospitals/emergency rooms) (18.5%). About 14% received their care outside the U.S. and 6.1% reported no usual source of health care. Only 1.3% received their care from curanderos or other folk healers.

Among the 105 subjects who reported being ever diagnosed with cancer, the majority (61.9%) had received cancer treatment from a U.S. private physician (Table IV). This was followed by a U.S. hospital or emergency room (14.3%), migrant health clinic (10.5%), or U.S. emergency care clinic (other than a U.S. hospital/emergency room) (9.5%). Only 3.8% reported receiving cancer treatment outside the U.S., and only one person received treatment from a curandero or other folk healer.

DISCUSSION

This paper presents results of a study assessing the feasibility of establishing a farmworker cohort for epidemiologic purposes through the AFOP. Almost 5,600 farmworkers were enrolled in this cohort over a 16 month period. This was achieved by taking an existing data collection system designed for providing social services and adding a few variables such as lifetime farmwork history, smoking, and subject and family history of cancer to create a database which can be invaluable for prospective epidemiologic research.

The 5,597 farmworkers enrolled in this cohort represent the largest prospective cohort of farmworkers ever established. Few researchers have performed prospective studies specifically of, or including, U.S. farmworkers [Landrigan et al., 1983; Fenster and Coye, 1990; McGwin et al., 2000], and these studies have typically included small numbers for a relatively short period of follow-up. The National Agricultural Workers Surveys (NAWS), commissioned by the U.S. Department of Labor, have collected data on over 25,000 farmworkers since 1988. However, these surveys—which sample all crop farmworkers, both documented and undocumented, and which individually contain about 2,500 persons each—are cross-sectional only and provide no means of follow-up [Mines et al., 1991]. The size of the present cohort also compares favorably with that of prospective farmer and industrial cohorts, most of which have numbered in the hundreds to thousands.

A major reason for the dearth of follow-up studies of farmworkers is the perceived difficulty of tracking over extended periods of time a population seen as being highly mobile. However, long-term tracking of farmworkers can be practically achieved in some cases. Seasonal farmworkers tend to be more stable than migrant farmworkers, and may be easier to track over extended periods. Many migrant farmworkers often return annually to a permanent home. A recent follow-up feasibility study in Texas [see Cooper et al., 2001 (this issue)] reported a 91% success rate in locating 100 male and 96 female migrant farmworkers who had participated in two health studies 10 years prior. Most (83.2%) of these farmworkers were located and were living, while 7.6% were determined to be deceased. Results were similar for males and females. Another feasibility study [see Nordstrom et al., 2001 (this issue)] attempted to locate 100 migrant farmworkers who had registered with a migrant health center in Wisconsin 10 years earlier. The researchers found only 6% of them in Wisconsin, but were able to locate or ascertain vital status information on 54% of a subsample ($n=46$) in Texas. These results suggest that it would be harder to achieve an acceptable degree of follow-up among individuals identified at upstream locations (i.e., away from their home state, typically in more northern states with shorter growing seasons). Follow-up of subjects in the present cohort would be facilitated by the repeated use, typically at least annually, of AFOP services by many subjects, and by update of the subject's contact information at each visit, identification of a subject's home state, and through tracking by social security number using public records such as driver's licenses, income tax returns, and the National Death Index.

The interviews in the present study took place in 18 states. The largest proportion of participants reported their home state to be Texas (49.5%). The primary domicile, defined as the location where the farmworker has a permanent address and the area to which the family returns

following a migrating season, is important to identify for epidemiologic tracking purposes. An expanded cohort of persons utilizing AFOP services could include participants from at least 48 states; with inclusion of undocumented farmworkers in the survey population, a substantial number would likely list primary domiciles in Mexico.

The 5,597 members of this NFD cohort are representative in most respects of the general farmworker population as described in NAWS [Mines et al., 1991]. The age distributions, average numbers of years of farmwork, and the types of crops and tasks in which subjects were engaged are similar, although the cohort contains more farmworker families (including females). In addition, the cohort is more highly educated, with 37% reporting completion of high school compared to 25% of farmworkers nationally. One important difference between NAWS and NFD cohort participants is that the NAWS represents only crop workers, while the NFD cohort includes crop workers, livestock, forestry, fishing, and other agricultural workers; thus, some tasks and agricultural products reported by the NFD cohort are not found in the NAWS.

The very high proportion of subjects in the NFD reporting U.S. citizenship can be explained by the fact that the survey was initially restricted to enrollees in the JTPA Section 402 employment and training program, which required legal authorization to work in the U.S. The survey was subsequently broadened to include all farmworkers requesting services from AFOPs member organizations, including workers of undocumented status. However, it is possible that some of the subjects are incorrectly reporting U.S. citizenship or legal residency. AFOP does not verify this information unless JTPA Section 402 employment and training services are requested; any verification occurs at a later time, after completion of the survey.

Collection of smoking data from subjects in the present cohort represents a rare opportunity to consider this factor in epidemiologic investigations of agricultural exposures. Smoking is known to be a major risk factor for certain cancers and cardiovascular diseases, as well as other illnesses. Most cohort studies involving farmworkers have been retrospective, which has precluded adjustment for smoking in analyses due to the lack of such information in most retrospective data sources. The present study collected smoking information at the time of subject enrollment into the cohort. The young age of participants may be a contributing factor to the low number of pack-years of smoking reported.

Such a cohort offers the opportunity to estimate standardized rate ratios (SRRs), which can be invaluable in studies of disease etiology. This would be particularly useful for the study of associations between many chronic diseases and agricultural and other exposures, which have been difficult to study in the farmworker population. It would also be possible to estimate standardized mortality ratios (SMRs)

for various diseases in this population. This overcomes a major limitation of many prior farmworker studies, which have been forced to rely on proportionate mortality ratios (PMRs) to assess disease burden. PMRs can be difficult to interpret, particularly in a population such as farmworkers who are generally quite young. PMR studies in this population are strongly influenced by the large proportion of accidental and infectious disease deaths in this group [Carlson and Petersen, 1978; Petersen and Milham, 1980; Kan and Brockert, 1982; Milham, 1983; Stubbs et al., 1984; Colt et al., 2001 (this issue)]. PMR studies in this young population are also affected by the fact that cancer typically occurs at older ages, when a person is less likely to be engaged in farmwork; therefore, another occupation is likely to be recorded on the death certificate. In contrast, SMR studies allow assessment, unbiased by other causes of death, of the relative burden of death from a given disease in this population. Study of chronic diseases such as cancer would likely require expansion of the cohort.

One important issue to consider in using the NFD cohort for epidemiologic research is the choice of an appropriate reference population. Farmworkers represent a unique demographic group in terms of age, ethnicity, lifestyle, and socioeconomic status. Many standard reference populations, such as those obtained through the National Health and Nutrition Examination Surveys (NHANES) or other cohort studies, likely have very different distributions of these factors and, therefore, may not be well suited for use as comparison groups in epidemiologic research on farmworkers. One option would involve use of an internal comparison group, e.g., participants with few years of farmwork experience, or persons reporting work in only lower pesticide exposure tasks or crops. An alternative, which might be appropriate in certain situations, would be to obtain data from other, demographically similar, populations such as U.S.–Mexico border communities employed principally in factory or service work.

Several changes in this study would have facilitated recruitment of, and data collection from, farmworkers using AFOP services. Training and utilization of all intake personnel at AFOP service organizations would have allowed for more rapid enrollment of farmworkers into the cohort. Additional demographic, lifestyle, reproductive, and exposure information, and biological specimens such as buccal cell samples, could also have been collected, either at entry into the cohort or in subsequent visits to AFOP service organizations. Such material could also have been collected via telephone or mail, linkage to birth records, or examination of medical records, using additional contact and service utilization information available from AFOP service providers. However, the additional costs for increased staff time and for materials for biospecimen collection and processing exceeded the funding that was available for this feasibility study, although it was modest in

comparison to that needed in many other prospective cohort studies.

Establishment of an NFD cohort would offer the opportunity to study a variety of health outcomes related to agricultural exposures in a large, relatively traceable farmworker population. Ability to track subjects who use AFOP services over time could facilitate study of diseases of long latency, such as cancer or neurological disorders. Prospectively-collected information related to occupational and demographic factors could help to improve exposure assessment and to reduce bias and confounding in analyses. Establishment of this cohort represents an important step in facilitating and improving epidemiologic research of this large, but understudied, population. Further development and follow-up of this cohort would improve understanding generally of the relationship between agricultural exposures and long-term health-related outcomes.

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