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UNIVERSITY OF CALIFORNIA, SAN DIEGO

SAN DIEGO STATE UNIVERSITY

Impact of Individual, Environmental, and Policy Level Factors

on Healthcare Utilization among United States Farmworkers

A dissertation submitted in partial satisfaction of the requirements for the degree

Doctor of Philosophy

in

Clinical Psychology

by

Katherine D. Hoerster

Committee in charge:

University of California, San Diego

Professor Richard G. Kronick
Professor Maria L. Zuniga

San Diego State University

Professor Joni A. Mayer, Chair
Professor Vanessa L. Malcarne
Professor Scott C. Roesch

2010

The Dissertation of Katherine D. Hoerster is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

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Chair

University of California, San Diego

San Diego State University

2010

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Finally, I thank the farmworker participants who provided their time and insights for the National Agricultural Workers Survey. I am grateful for their participation and for the work they do on United States farms every day.

VITA

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EDUCATION

2010   Doctor of Philosophy in Clinical Psychology
                San Diego State University/University of California, San Diego
                Joint Doctoral Program in Clinical Psychology
                Specialty Track: Behavioral Medicine

2009-2010   Psychology Intern
                Veterans Affairs, Puget Sound Healthcare System, Seattle Division

2009   Master of Public Health
                San Diego State University
                Concentration in Health Promotion

2001   Bachelor of Arts in Clinical Psychology
                Connecticut College

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1. **Hoerster, K. D.,** Beddawi, S., Peddecord, K. M., & Ayala, G. X. (in press). Healthcare use among California farmworkers: Predisposing and enabling factors. *Journal of Immigrant and Minority Health.*

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PRESENTATIONS

1. Mayer, J. A., Slymen, D. J., Woodruff, S. I., **Hoerster, K. D.**, Pichon, L. C., Sallis, J. F., Weeks, J. R., & Belch, G. E. (2008, October). Correlates of indoor tanning among teens: Key findings from CITY100. Paper presented at the annual meeting of the American Public Health Association, San Diego, CA.
2. **Hoerster, K. D.**, Pichon, L. C., Rubio, D. A., Woodruff, S. I., Forster, J. L., & Mayer, J. A. (2008, March). Enforcement of state-level indoor tanning laws in the U.S. [Abstract]. Paper presented at the annual meeting of the Society of Behavioral Medicine, San Diego, CA. *Annals of Behavioral Medicine, 35,* s15.
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10. **Hoerster, K. D.**, Pichon, L. C., & Mayer, J. A. (2005, April). Ethnoracial-specific outcomes from a sun safety intervention trial with outdoor workers. Poster presented at the American Cancer Society Conference Exploring Models to Eliminate Cancer Disparities

among African American and Latino Populations: Research and Community Solutions, Atlanta, GA.

11. **Hoerster, K. D.**, Chrisler, J. C., & Gorman, J. G. (2001, June). Attitudes toward and experiences with menstruation in the United States and India. Poster presented at the Society for Menstrual Cycle Research Conference, Avon, CT.

12. Chrisler, J. C., Gorman, J. G., & **Hoerster, K. D.** (2001, June). Menarche stories II: reminiscences of college students from Austria, India, Lebanon, and Nigeria. Poster presented at the Society for Menstrual Cycle Research Conference, Avon, CT.

ABSTRACT OF THE DISSERTATION

Impact of Individual, Environmental, and Policy Level Factors

on Healthcare Utilization among United States Farmworkers

by

Katherine D. Hoerster

Doctor of Philosophy in Clinical Psychology

University of California, San Diego, 2010

San Diego State University, 2010

Professor Joni A. Mayer, Chair

Farmworkers face significant disease burden. Meanwhile, farmworker healthcare utilization is low. This study examined individual, environmental, and policy level correlates of U.S. farmworker healthcare utilization, guided by the Behavioral Model for Vulnerable Populations and the Ecological Model.

The 2006-2008 administrations of the National Agricultural Workers Survey (NAWS) (N=4,891) provided the primary data for this cross-sectional study. Geographic Information Systems, the 2005 and 2006 Uniform Data System, and rurality/border proximity indices provided environmental variables. To identify factors associated with healthcare use, logistic regression was performed using Hierarchical Linear Modeling. Probability weights were applied in descriptive, bivariate, and multivariate analyses. The alpha level was set at .05 for all analyses.

The majority of farmworkers were Hispanic (80.0%) and male (78.4%), with an average age of 35.6 (SE=.3) years. Annual family income (M=22,668.0; SE=304.9) and educational

attainment (M=7.7; SE=.1) were low. Just over half (57.3%) used formal U.S. healthcare in the previous two years. Multiple factors were independently associated with healthcare use in multilevel models (all in the expected direction), including, at the individual level: sex, immigration and migrant status, English proficiency, access to transportation, and need; at the environmental level: total FQHC full-time equivalent medical professionals/staff and U.S.-Mexico border proximity; and, at the policy level: insurance status and payment structure. Findings were consistent with those from previous studies of Hispanic populations, as well as the limited literature documenting healthcare use correlates for farmworkers. Numerous individual and policy level moderators of associations between environmental level variables and healthcare use were identified.

Using Stata, rates of healthcare use among farmworkers were compared to those among U.S. and other subpopulations with similar sociodemographic characteristics (from the 2006 Medical Expenditure Panel Survey). Rates of use were significantly lower for farmworkers than for the U.S. and low-income populations. However, they were significantly higher than rates for U.S. Hispanics and a comparison group (i.e., Hispanic, low income, and no educational degree). The low rate of use is concerning due to farmworkers' disproportionate disease burden. Multilevel recommendations for change, emphasizing change to the FQHC system, are made so that healthcare access can be improved for this vulnerable population.

INTRODUCTION

Background and Significance

Over three million farmworkers work in the United States (A. Larson, 2000). According to the National Agricultural Workers Survey (NAWS), the majority of farmworkers are Hispanic, have an average highest grade completed of seventh grade, and have limited English proficiency (Carroll et al., 2005). Roughly half (53%) of farmworkers report being unauthorized to work in the U.S. (Carroll et al., 2005). While relatively little is known about the health of this population, these social vulnerabilities appear to have resulted in high disease burden (Villarejo, 2003) and excesses in proportionate mortality rates (Mills, Beaumont, & Nasseri, 2006).

Possible explanations for these disparities are multifarious and likely stem from the population's occupational exposures common to all who work in agriculture, in addition to the abovementioned socioeconomic, cultural, and political vulnerabilities. Agriculture is an inherently dangerous occupation. The 2005 injury fatality rate was 32.5/100,000 for agricultural workers (vs. 4/100,000 for all workers) (U.S. Department of Labor & Bureau of Labor Statistics, 2006). Injuries caused by activities such as working with animals, machinery, and motor vehicles are common among those employed in agriculture (Rautiainen & Reynolds, 2002). Pesticide exposure occurs frequently, with a multitude of negative health outcomes, including acute symptoms such as dizziness, nausea, and flu-like symptoms; reproductive and teratogenic effects; neuropsychological dysfunction; and certain cancers (Kirkhorn & Schenker, 2002). Respiratory disease and certain cancers have been found to be disproportionately high among those working in agriculture (Kirkhorn & Schenker, 2002). Finally, outdoor workers may be susceptible to developing skin cancer because of the long hours they spend outside without appropriate protection from the sun (English, Armstrong, Kricker, & Fleming, 1997; Holman, Gibson, Stephenson, & Armstrong, 1983; Kricker, Armstrong, & English, 1994).

Farmworkers are a subset of the agriculture labor sector and the health vulnerabilities that are relevant to the broader population of agricultural workers are undoubtedly relevant to this population as well (Ciesielski, Hall, & Sweeney, 1991; Dodge, Mills, & Riordan, 2007; Krejci-Manwaring et al., 2006; McCurdy, Samuels, Carroll, Beaumont, & Morrin, 2003; Mills et al., 2006; Mills & Kwong, 2001; Mills & Zahm, 2001; Reeves & Schafer, 2003). Literature documenting epidemiological data for farmworkers and comparison groups is presented in Table 1. Data presented in Table 1 suggest that there are several risk factors or conditions that are elevated for the farmworker population (e.g., certain cancers, injury, tuberculosis, pesticide exposure) while comparatively, other health issues (e.g., smoking, heart disease) appear to pose less of a threat. However, epidemiological data for farmworkers are scarce and mostly rely on self-report. Moreover, studies have been conducted on mostly a small scale in a specific region, meaning that the representativeness of the data to the national population is poor. Thus, these apparent equities may reflect the lack of epidemiological data and/or undiagnosed conditions among farmworkers who have underutilized medical care. More and higher quality epidemiological data are needed in order to make conclusions about their disease burden.

Because farmworkers often have less stable employment and/or are undocumented, they are less likely to be afforded some of the basic labor rights (Passel, Capps, & Fix, 2004). Not only do farmworkers face the same challenges as others employed in agriculture, they also face greater obstacles due to ethno-racial discrimination, United States policies that hinder the empowerment and equality of farmworkers, and language and educational barriers. All of these factors disempower the farmworker in both the workplace and the healthcare system and, in turn, likely lead to the health disparities we have observed for this population.

Healthcare Utilization among Farmworkers

Despite the marked disease burden facing farmworkers, healthcare utilization appears to be low (Arcury & Quandt, 2007; Villarejo, 2003). However, rates of healthcare use vary widely,

which may in part reflect the issue that most data have been collected on a small scale, resulting in poor generalizability to the national population of farmworkers. Still, rates of healthcare use do appear to be low for at least some farmworker groups. See Table 2 for a summary. While only 5% of California farmworkers reported never having received medical care, only 48% had received medical care in the previous 12 months (Rose & Quade, 2006). Relatively similar rates of recent use (48.4% of males and 73.6% of females in the prior two years) were reported in another study but the proportion of male farmworkers who had never received medical care (31.8%) was substantial (Villarejo et al., 2000). Similar rates of recent use were reported elsewhere (Littlefield & Stout, 1987; Slesinger & Cautley, 1981). Comparison with national data reveals that healthcare use among farmworkers is low, although perhaps not lower than rates for Hispanic individuals. Rates of health services use among Hispanics in 2005 were low, with 53.2% having made an ambulatory care visit in the previous year, compared with 75.7% of non-Hispanic whites (Ezzati-Rice, Rohde, & Greenblatt, 2008).

Utilization of preventive services appears to be low for farmworkers. Among Colorado farmworkers who had received medical care, they sought care for illness (36.6%), injury (12.6%), checkup (9.8%), pregnancy care (9.1%), or other (31.9%) (Littlefield & Stout, 1987). Among Wisconsin farmworkers, nearly one-third had never received a routine physical examination, although physical exams accounted for 20.9% of the physician visits made in the previous year (Slesinger & Cautley, 1981). Over one-quarter of female farmworkers living in California reported never having received a Pap smear (Goldsmith & Sisneros, 1996). Conversely, 2005 Medical Expenditure Panel Survey (MEPS) data revealed that 13.5% of non-Hispanic white and 15.6% of Hispanic U.S. adult females had not received a Pap smear in the past three years (Soni, 2007b). Among female farmworkers aged 50 and older, 61% had never received a mammogram (Goldsmith & Sisneros, 1996). Comparable rates of adherence were reported among female farmworkers living in the Lower Rio Grande Valley (R. C. Palmer, M. E. Fernandez, G.

Tortolero-Luna, A. Gonzales, & P. Mullen, 2005b) but were higher (59.0%) among female farmworkers in California, New Mexico, and Texas (R. C. Palmer, M. E. Fernandez, G. Tortolero-Luna, A. Gonzales, & P. Mullen, 2005a). Still, they do not match those found in the general population. In 2005, 72.6% of non-Hispanic white (and 62.7% of Hispanic) women 40 years and older received a mammogram in the last two years (Soni, 2007a).

While these estimates of health services receipt are illuminating, little is known about the volume of visits made by farmworkers who *have* used medical services. These data were captured in only one study, in which mean visits to a doctor in the previous year among normal weight, overweight, and obese farmworkers was 1.2, 2.1, and 3.1, respectively (Hubert, Snider, & Winkleby, 2005). Means were generally higher among Hispanic females (3.9-6.7) and males (2.2-4.1) assessed in a corresponding community sample (Hubert et al., 2005). National data from 2006 indicate that the U.S. general population made an average of 3.8 medical visits in the previous year and Hispanic individuals' rates (3.5) were not significantly lower (Schappert & Rechtsteiner, 2008), suggesting that while realized access may not be lower among farmworkers than the general population of Hispanics, the volume of visits does appear to be poorer for farmworkers.

Access to dental care is problematic for farmworkers. Data from the California Agricultural Workers Health Survey (CAWHS) indicated that 49.5% of male farmworkers and 44.4% of female farmworkers had never received dental care (Villarejo et al., 2000). Fewer California and Wisconsin farmworkers reported that they had never received dental care (16% and 24.7%, respectively) (Rose & Quade, 2006; Slesinger & Cautley, 1981). Nearly all California farmworkers who reported having received dental care, however, had received it over two years ago (Rose & Quade, 2006). Rates of recent dental care were higher in a sample of Colorado farmworkers, with approximately one-third having received dental care in the previous year (Littlefield & Stout, 1987). Comparable rates were reported for Wisconsin farmworkers (25%)

(Slesinger & Cautley, 1981) and for North Carolina and Virginia farmworker families, with 47% of females and 37% of their spouses having received dental services in the previous year (Quandt, Clark, Rao, & Arcury, 2007). But nearly all of the remaining adults in those families had never received dental care. By comparison, approximately one-half of non-Hispanic whites had a dental visit in the previous year, with rates substantially lower for Hispanics (28.9%) (Manski & Brown, 2007). Additionally, vision care is rare among farmworkers—more than two-thirds of California farmworkers interviewed in the CAWHS and 35.5% of Wisconsin farmworkers never received such services (Slesinger & Cautley, 1981; Villarejo et al., 2000). In summary, rates of general medical, preventive, dental, and vision care are disproportionately low among farmworkers.

Barriers to care among farmworkers. There are a number of barriers to health services utilization among farmworkers (Arcury & Quandt, 2007; Hansen & Donohoe, 2003; Villarejo, 2003). Inability to afford healthcare is a primary barrier, with lack of health insurance and/or knowledge of how to use/obtain insurance (Goertz, Calderon, & Goodwin, 2007; Rose & Quade, 2006) and cost (Goertz et al., 2007; Goldsmith & Sisneros, 1996; Lantz, Dupuis, Reding, Krauska, & Lappe, 1994; Littlefield & Stout, 1987; Rose & Quade, 2006) reported as barriers. Other access factors are barriers, such as lack of transportation (Goldsmith & Sisneros, 1996; Lantz et al., 1994; Perilla, Wilson, Wold, & Spencer, 1998; Rose & Quade, 2006), knowledge of where to go for care or how to access services (Goertz et al., 2007; Perilla et al., 1998; Rose & Quade, 2006), lack of services in area (Perilla et al., 1998), difficulty getting out of work to go to medical appointments (Lantz et al., 1994), and lack of time (Goldsmith & Sisneros, 1996; Lantz et al., 1994; Littlefield & Stout, 1987).

Barriers associated with the population's language, which is primarily Spanish, have been noted (Goertz et al., 2007; Lantz et al., 1994; Rose & Quade, 2006; Villarejo et al., 2000), as have discrimination-associated barriers, with some farmworkers reporting fear of the medical system

(Goldsmith & Sisneros, 1996), of losing employment (Rose & Quade, 2006), and of immigration officials (Perilla et al., 1998) as barriers. In fact, when beliefs of farmworker employers regarding green tobacco sickness were analyzed, farmers minimized the need for farmworkers to seek medical treatment when ill with it and actively promoted over-the-counter treatment of symptoms (e.g., Dramamine) instead (Arcury, Quandt, & Simmons, 2003). Finally, some researchers have speculated that embarrassment, fatalism (or *fatalismo*), and/or lack of knowledge regarding need for preventive care may be partially responsible for poor preventive care among farmworkers, especially for activities such as cancer screening (Goldsmith & Sisneros, 1996; Lantz et al., 1994). Also, high use of herbal remedies among farmworkers has been documented, so it is possible that reliance on such practices may be seen as a substitute for healthcare professional contact (J. Poss, Pierce, & Prieto, 2005).

Barriers to receiving dental care for adult members of North Carolina and Virginia farmworker families included cost of services, lack of transportation, services being too far away, clinics having limited hours of operation, and postponing care to get it in Mexico (Quandt et al., 2007). Several Georgia farmworkers reported not being able to obtain dental and vision care due to lack of those services for their community (Perilla et al., 1998). Interviews with staff from community/migrant health centers providing dental services to farmworkers indicated that the most significant barriers were cost and transportation, followed by lack of knowledge about the clinic, limited clinic hours, fear of dental work, language, and not having evening hours (Lukes & Simon, 2006).

Very few studies have examined such barriers' associations with health services utilization among farmworkers. Exceptions are studies about adherence to mammography recommendations among female farmworkers, where acculturation, self-efficacy, decisional balance, regular source of care, age, income, place of residence, and insurance status were found to be associated with utilization of services (Palmer et al., 2005a; Palmer et al., 2005b).

Additionally, among Colorado farmworkers, sex and permanent residence (U.S. vs. non-U.S.) was associated with use of services (Littlefield & Stout, 1987). Studies about access for farmworkers' children to health services have examined correlates of access and use more systematically (Seid, Castaneda, Mize, Zivkovic, & Varni, 2003; Weathers, Minkovitz, O'Campo, & Diener-West, 2003, 2004). However, health services utilization among children of farmworkers is not the focus of the current investigation. Only one study extensively examined correlates of health services use among farmworkers and found that age, sex, education, and language were associated with receipt of various types of medical services (e.g., physical exam, dental) (Slesinger & Cautley, 1981). However, this study describes data collected in the late 1970s, making it quite outdated. While self-reported barriers to healthcare help to characterize the health services needs of the farmworker population, more information is needed regarding how these factors are associated with actualized care among farmworkers.

Programs promoting healthcare use among farmworkers. Recognizing the need for tailored health services provision to this vulnerable population, a number of programs have been created to serve farmworkers (Arcury & Quandt, 2007), with a variety of approaches, including interpretation/translation services (Goldsmith & Sisneros, 1996; L. Heuer, Hess, & Klug, 2004; L. J. Heuer, Hess, & Batson, 2006; J. Poss & Meeks, 1994), outreach (Diaz-Perez Mde, Farley, & Cabanis, 2004; Forst et al., 2004; Goldsmith & Sisneros, 1996; Littlefield & Stout, 1987; Olney, Warner, Reyna, Wood, & Siegel, 2007; J. Poss & Meeks, 1994; J. E. Poss & Rangel, 1997), intensive follow-up (J. E. Poss & Rangel, 1997), connection with Medicaid (J. Poss & Meeks, 1994), voucher programs (Goldsmith & Sisneros, 1996; L. Heuer et al., 2004; Lausch, Heuer, Guasasco, & Bengiamin, 2003; Slesinger & Ofstead, 1996), mobile, satellite, or evening clinics (Diaz-Perez Mde et al., 2004; L. J. Heuer et al., 2006; Lausch et al., 2003; J. Poss & Meeks, 1994), *promotoras de salud* (Forst et al., 2004; Goldsmith & Sisneros, 1996; Olney et al., 2007), health promotion skits (J. E. Poss & Rangel, 1997), and culturally tailored care (Diaz-Perez Mde

et al., 2004; L. Heuer et al., 2004; Lausch et al., 2003). The vast majority of articles in this area focused on single programs and/or delivery sites, with limited (if any) analytic data presented. Outcomes of the programs were rarely evaluated, with a few exceptions (Diaz-Perez Mde et al., 2004; Forst et al., 2004; Goldsmith & Sisneros, 1996; L. Heuer et al., 2004; Hooks et al., 1996; Olney et al., 2007; Slesinger & Ofstead, 1996), none of which constituted a formal program evaluation. Thus, little is actually known about the efficacy of care provision to the farmworker population.

Summary

Health services utilization is poor for farmworkers, despite there being substantial need. Farmworkers have endorsed a number of barriers to health services utilization and programs have been created around the country to promote improved use. Most of the literature to date is limited in scope and offers only piecemeal explanation of the barriers to utilization and areas where improvements could be made. Of particular relevance is that very few studies have analyzed correlates of health services utilization and those that have are limited in scope with regard to factors analyzed and representativeness of sample to the national population of farmworkers. The current study sought to resolve this matter by examining a number of correlates of health services use at the individual, environmental, and policy levels of influence (Sallis, Owen, & Fisher, 2008) in a nationally representative sample of farmworkers. Use of U.S. healthcare (rather than healthcare use outside the U.S.) was selected as the outcome because barriers and facilitators under investigation are of particular relevance to use of care in the U.S. (e.g., federal healthcare resources in community, immigration status). Correlates of U.S. health services utilization have been selected based on the barriers to healthcare for farmworkers cited above, as well as the Behavioral Model for Vulnerable Populations, which specifies a number of predictors of health services use for vulnerable groups (Gelberg, Andersen, & Leake, 2000). Theoretical models are described in greater detail in the following section.

Correlates of Health Services Utilization

Theoretical Framework for Exploring Farmworker Healthcare Utilization

Two theoretical models were utilized in this study. The Ecological Model (EM), which specifies several levels of influence on behavior (e.g., policy, environment, intrapersonal) (U.S.D.H.H.S., 2005), served as the overall theoretical framework. To explain human behavior, Ecological Models hypothesize that behavior is influenced by a dynamic interaction among intrapersonal, sociocultural, physical-environmental, and policy factors (Sallis et al., 2008). For the current study, only three levels of influence (i.e., individual, environmental, and policy) were assessed. To guide selection of variables specific to healthcare use, constructs from the Behavioral Model of Health Services Use were utilized (Andersen, 1968, 1995). The model and its modifications have been used to explore health services use in many populations (Phillips, Morrison, Andersen, & Aday, 1998), such as the homeless (Lemming & Calsyn, 2004), and individuals with panic disorder (Goodwin & Andersen, 2002), disabilities (Krahn, Farrell, Gabriel, & Deck, 2006), and prostate cancer (Miller et al., 2008).

Andersen and his colleagues have modified the Behavioral Model numerous times since its conception (Andersen, 2008). For example, outcomes of health services utilization (e.g., perceived and evaluated health, consumer satisfaction) were added to the model from the 1970s to the 1990s (Andersen, 2008). However, certain core constructs have remained throughout the past forty years. The model posits that predisposing (e.g., demographics, health beliefs), enabling (e.g., personal and community resources), and need (e.g., perceived and/or evaluated health status) characteristics influence individuals' use of health services (Andersen, 1995). In other words, individuals seek care if they are predisposed to using it, have resources that enable them to seek it, and believe that it is needed. Figure 1 depicts the model as provided in an article by Gelberg and colleagues (Gelberg et al., 2000).

Predisposing ⟶ Enabling ⟶ Need ⟶ Health Behavior ⟶ Outcome
(e.g., health services use) (e.g., health status)
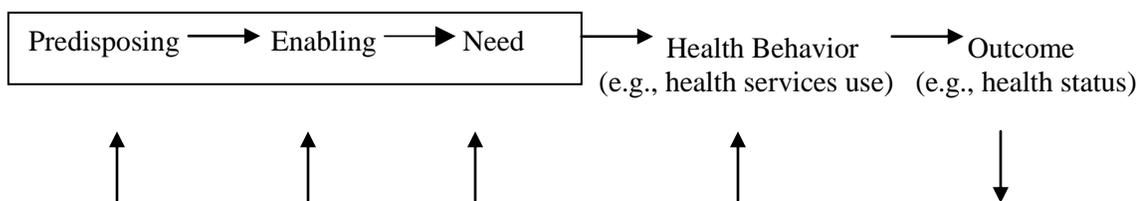
Figure 1. Behavioral Model of Health Services Use

The model's author and his colleagues now acknowledge the potential influence of contextual

factors (e.g., physician supply, geographic distribution of resources) in determining health

services utilization (Andersen & Newman, 1973; Phillips et al., 1998) and have recommended

that investigators incorporate them into their studies of health services use (Phillips et al., 1998),

thereby making the model compatible with the Ecological Model framework.

Of particular utility to the current study is the model modification generated by Gelberg

and colleagues, titled the Behavioral Model for Vulnerable Populations (BMVP) (Gelberg et al.,

2000). This modification to Andersen's model builds upon the original predictors of health

services utilization (i.e., predisposing, enabling, and need) (Andersen, 1968). However, the

Behavioral Model for Vulnerable Populations distinguishes between traditional factors and those

factors specific to vulnerable populations. For example, traditional predisposing factors are

demographic characteristics, such as age, gender, and marital status. Within the vulnerable

domain are factors such as level of acculturation, immigration status, mobility, and literacy

(Gelberg et al., 2000). Traditional enabling resources are factors such as insurance status, region

of residence, and health services resources, while vulnerable enabling factors include community

availability of social services and public benefits. In their description of the Behavioral Model

for Vulnerable Populations, Gelberg and colleagues list a number of potential factors falling

within each domain (Gelberg et al., 2000). The variables examined in this study are listed in

Table 3, along with how the variables correspond with constructs of the Behavioral Model for

Vulnerable Populations and the Ecological Model. The remainder of this section describes

previous research on all variables under investigation, organized by their level in the Ecological Model.

Individual Level Correlates of Healthcare Utilization

   Race/ethnicity. The majority of farmworkers are Hispanic. In the 2001-2002 NAWS, 83% of farmworkers identified themselves as being Hispanic (Carroll et al., 2005). There are disparities in access to medical care between Hispanic and non-Hispanic whites. According to 2005 MEPS data, the proportion of the Hispanic population having made at least one ambulatory visit in the past year (53.2%) was significantly lower than that for all other ethno-racial groups (ranged from 58.5% to 75.7%) (Ezzati-Rice et al., 2008). Data from the 2003 Community Tracking Study (CTS) reveal that, when compared to whites, Hispanics are significantly less likely to have a regular health care provider (55.4% vs. 76.3%), a doctor visit in the last 12 months (62.8% vs. 79.0%), and a visit with a specialist (24.3% vs. 27.5%) (Hargraves, 2004). Additionally, Hispanic individuals are significantly less likely than non-Hispanic whites to have participated in a number of preventive care measures (e.g., screening for colorectal cancer, receipt of flu vaccination) (Centers for Disease Control and Prevention, 2004). A similar pattern has been found for Hispanic young adults (age 19-29) (Callahan, Hickson, & Cooper, 2006), and for mental health (Cabassa, Zayas, & Hansen, 2006), oral health (Manski & Brown, 2007), and pain treatment (Nguyen, Ugarte, Fuller, Haas, & Portenoy, 2005) services.

   Explanations for these disparities are numerous but perhaps the most significant source is the disproportionately high level of Hispanics who are uninsured (Callahan et al., 2006; Centers for Disease Control and Prevention, 2004; Hargraves, 2004; Roberts, 2006). According to 2002 MEPS data, Hispanic adults are nearly three times more likely than non-Hispanic whites to be uninsured (Roberts, 2006). Rates of uninsurance among young adults with Central/South American, Mexican, and Puerto Rican origins ranged from 28% to 73%, all of which were significantly higher than those for whites (22%) in the 1999-2002 National Health Interview

Survey (NHIS), even after adjustment for sociodemographic factors (though not for Puerto

Ricans) (Callahan et al., 2006). This suggests that disparities in insurances rates are not solely

attributable to sociodemographic factors. Perhaps one source of these disparities in insurance

rates is the differential rates of employer-sponsored insurance for working adults. Data from

2002 MEPS demonstrated that Hispanic workers were least likely to have employer-sponsored

health insurance (Roberts, 2006). This is especially the case for low-income Hispanics

(Hargraves, 2004). These gaps in insurance coverage have remained fairly stable over time

(Hargraves, 2004).

       While low rates of insurance likely play a role in health services utilization disparities,

such disparities persist after controlling for a number of important factors (e.g., socioeconomic,

insurance coverage, availability of services, need) (Mayberry, Mili, & Ofili, 2000). In a review

of the literature, Ruiz suggested that observed ethno-racial disparities in access to both health and

mental health services are due to a number of factors above and beyond those more readily

apparent (e.g., low socioeconomic status, low insurance); they are language and cultural barriers,

too few Hispanic healthcare professionals, and prejudice and discrimination (Ruiz, 2002).

Language barriers are discussed in greater detail later in this section and likely contribute to

disparities in healthcare utilization. However, discrimination and cultural barriers also warrant

consideration. Hispanics may be subject to ethno-racial discrimination, which manifests in a

number of ways in healthcare facilities. Hispanic individuals are less likely to seek mental

healthcare due to fear of stigma and discrimination from community members and in the

healthcare setting (U.S. Surgeon General, 1999). In fact, several farmworkers participating in

focus groups reported discriminatory practices encountered in the medical system (Perilla et al.,

1998). Cultural barriers, another factor that may interfere with seeking medical care, may

account for some of the disparities in health services utilization. For example, fatalism (or

fatalismo) may be partially responsible for poor preventive care among farmworkers (Goldsmith

& Sisneros, 1996; Lantz et al., 1994). Such barriers may be even greater for those born outside the U.S. Thus, despite the fact that place of birth (U.S. vs. foreign born) was not associated with mammography adherence in one study of female farmworkers (Palmer et al., 2005b), it is also important to examine the impact of birthplace in addition to race/ethnicity. Birthplace and acculturation may be associated with U.S. healthcare use due to cultural beliefs about, and experiences/familiarity with, conventional U.S. healthcare. In sum, existing research indicates a multitude of reasons that health services utilization is lower among Hispanics. A number of the individual level factors likely involved (i.e., income, educational attainment, language and literacy, immigration status, migratory lifestyle, health status, and additional sociodemographic variables) are discussed in greater detail below, as they are variables assessed in the current study.

Income. Farmworkers tend to be poor. Data from the 2001-2002 NAWS indicated that among farmworkers, the average hourly wage was $7.25, the average individual income ranged from $10,000 to $12,499, and the average family income ranged from $15,000 to $17,499, meaning that 30% of the farmworkers interviewed were living below the poverty threshold (Carroll et al., 2005). The fact that farmworkers have low annual incomes has been cited as a primary barrier to receipt of services in a report produced by the Secretary of Health and Human Services (Leavitt, 2006) and also by farmworkers (Goertz et al., 2007; Goldsmith & Sisneros, 1996; Lantz et al., 1994; Littlefield & Stout, 1987; Rose & Quade, 2006).

Low income is associated with lowered healthcare utilization (Scheppers, van Dongen, Dekker, & Geertzen, 2006). Conversely, high income has been found to be associated with use of mental health services among Hispanics (Cabassa et al., 2006). Income was significantly associated with mammography adherence in one (Palmer et al., 2005a) but not another study conducted with female farmworkers (Palmer et al., 2005b).

Income may be associated with health services utilization due to its association with health insurance coverage. Among low-tier income Hispanic workers, only 34.7% obtained

employer-sponsored health insurance, as opposed to 72.9% of workers in the high-tier income bracket (Roberts, 2006). As possible evidence that there is not a strong association, however, data from the 2002 MEPS indicate that Hispanic individuals were the least likely ethno-racial group to be insured, regardless of income (Roberts, 2006). Thus, income does appear to have some association with health insurance status, but this relationship likely will not entirely explain the association between income and health services utilization. Further exploration of the relationship between income and farmworker health services use is needed.

Educational attainment. Educational attainment is generally low for the farmworker population. Seventh grade was the average highest grade completed by farmworkers and completion of 12th grade was attained by only 13%, according to the 2001-2002 NAWS data (Carroll et al., 2005). Low educational attainment contributes to low healthcare utilization (Scheppers et al., 2006). For example, among Hispanic individuals interviewed in 1987 with the National Medical Expenditure Survey (NMES), educational attainment was significantly associated with health services utilization (Schur, Albers, & Berk, 1995). Utilization of mental health care also is more likely among Hispanics with greater educational attainment (Cabassa et al., 2006). The relationship between educational attainment and health services use among farmworkers is not straightforward. Among Wisconsin farmworkers, those with higher educational attainment were significantly less likely to have received a general physical examination or to have visited a dentist (Slesinger & Cautley, 1981). Data from a study conducted among Colorado adult farmworkers indicated that education level was not significantly associated with time since last dental visit (Littlefield & Stout, 1987), nor was adherence to mammography recommendations for female farmworkers (Palmer et al., 2005a; Palmer et al., 2005b). Further study of the relationship between educational attainment and farmworker use of healthcare is needed.

English language proficiency. According to the 2001-2002 NAWS survey data, Spanish is the primary language for 81% of farmworkers and English is the primary language for 18% (Carroll et al., 2005). Many farmworkers do not speak (44%) or read (53%) English at all (Carroll et al., 2005). In a report produced by the Secretary of Health and Human Services, limited English proficiency (LEP) was suggested as a likely barrier to receipt of medical care for farmworkers (Leavitt, 2006). A similar assessment was made in a review of the literature (Hansen & Donohoe, 2003). In several studies, farmworkers have noted language as a significant barrier to health services receipt (Goertz et al., 2007; Lantz et al., 1994; Rose & Quade, 2006; Villarejo et al., 2000).

LEP is associated with lowered healthcare utilization (Scheppers et al., 2006). In one review of the literature, more than half of the studies discussed found a significant adverse effect of LEP on health services use among Hispanics (Timmins, 2002). In one study, rates of utilization of care were highest among non-Hispanic whites (57%) and lowest among those Hispanics uncomfortable speaking English (35%)—a difference that was statistically significant (E. M. Cheng, Chen, & Cunningham, 2007). Similar results were generated from multivariate analysis of the 2005 Behavioral Risk Factor Surveillance System (BRFSS), with individuals who completed the interview in Spanish significantly less likely to have health insurance, a personal healthcare provider, and/or to have had a routine checkup in the last five years (Pearson, Ahluwalia, Ford, & Mokdad, 2008).

The effect of language does not appear to be limited, however, to those who have very little familiarity with English. In one study, receipt of ten recommended healthcare services was analyzed using the 2003 MEPS, and Hispanic individuals who did not speak English at home (whether or not they were comfortable speaking English) were significantly less likely to receive all services, after controlling for sociodemographic, health status, and access to care factors (E. M. Cheng et al., 2007). Only one study has focused on the association between language use and

use of health services among farmworkers. Wisconsin farmworkers who spoke only Spanish were significantly more likely to have never had their vision checked (Slesinger & Cautley, 1981). It is noted that not all studies have found a significant relationship between LEP and health services utilization (Schur et al., 2005).

There are a number of possible reasons that language interferes with health services utilization. Schur and colleagues used data from the 1987 administration of the NMES and found that monolingual Spanish speakers had significantly lower educational attainment and rates of private insurance, and higher rates of uninsurance and poverty (Schur & Albers, 1996). Higher uninsurance rates also were found among Hispanic individuals who completed their interview in Spanish in the 2000-2003 CTS (Cunningham, Banker, Artiga, & Tolbert, 2006). However, researchers have found that Spanish language use appears to be associated with utilization even after controlling for sociodemographic and access factors. Thus, differences in acculturation also may play a role in the observed disparities (Scheppers et al., 2006). In fact, among a sample of female farmworkers, acculturation was significantly and positively associated with adherence to mammography recommendations among those living in California (Palmer et al., 2005a).

A communication gap between patient and provider likely contributes to the disparities in utilization. In one study, among patients of a medical clinic, Hispanics responding to a questionnaire in Spanish were significantly more dissatisfied with provider communication and their medical care than were whites and Hispanics who completed the questionnaire in English (Morales, Cunningham, Brown, Liu, & Hays, 1999). However, having a Spanish-speaking provider does not appear to be associated with increased utilization (Schur et al., 1995). In sum, just as suggested in the 2002 Timmins review, LEP appears to be a significant barrier to access among Hispanic individuals but may not be the most important one (Timmins, 2002). Thus, it is important to further assess the impact that language and literacy have on health services use among farmworkers.

Immigration status. Data from the 2001-2002 NAWS indicate that the farmworker population is largely made up of Mexican-born immigrants (75%), and approximately half (53%) lack authorization to work in the United States (Carroll et al., 2005). Remaining farmworkers are U.S. citizens (25%), legal permanent residents (21%), and employment-eligible on some other basis (1%). Lack of legal status is thought to be one barrier to healthcare utilization among farmworkers (Leavitt, 2006) and farmworkers have stated that fear of immigration officials is a barrier to healthcare receipt (Perilla et al., 1998). Immigration status is associated with health services utilization (Scheppers et al., 2006). Data from the California Health Interview Survey (CHIS) revealed that undocumented immigrants were the least likely to report having a usual source of care or having made one or more visits to a healthcare facility in the previous year when compared with other Hispanics (both immigrant and U.S.-born) and U.S.-born whites (Ortega et al., 2007). A similar pattern of findings was reported for young adults (Callahan et al., 2006). Immigrants to the United States face a number of barriers to healthcare utilization, including socioeconomic status factors, LEP, and difficulty obtaining health insurance (Derose, Escarce, & Lurie, 2007). Indeed, undocumented immigrants are especially vulnerable to receiving pay below minimum wage (Passel et al., 2004), and many face the language barriers discussed earlier in this section. However, the barriers immigrants face in obtaining health insurance are likely the strongest source of the disparities.

Rates of insurance coverage are low for immigrants and especially those who are undocumented. For example, in CHIS, undocumented Hispanics not from Mexico were found to have the lowest rates of insurance (43.2%), followed by Hispanics with a green card (69.1%), naturalized citizen and U.S.-born Hispanics (both 84.4), and U.S.-born whites (92.8%), with a similar pattern observed for those from Mexico (Ortega et al., 2007). Data from the 2000-2001 Los Angeles Family and Neighborhood Survey revealed similar results (Prentice, Pebley, & Sastry, 2005). Undocumented immigrants had the highest rates of uninsurance and were

significantly less likely to gain insurance after controlling for a number of other factors (e.g., education, income). When followed over time, undocumented immigrants and legal residents also had the longest periods of sustained uninsurance, as well as more difficulty *staying* insured (Prentice et al., 2005). According to the 2001 Survey of Income and Program Participation (SIPP) data, these disparities in health insurance coverage can largely be explained by differential rates of employer-sponsored health insurance offered to citizens and non-citizens (Buchmueller, Lo Sasso, Lurie, & Dolfin, 2007).

Public health insurance can be a good resource for those who do not obtain insurance through their employer. However, immigrants also face significant barriers to obtaining publicly funded insurance (Fremstad & Cox, 2004). One significant barrier to obtaining such coverage stems from the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), which provides that immigrants are not eligible for services such as Medicaid until five years after arrival in the United States (Derose et al., 2007; Fremstad & Cox, 2004). Increases in uninsurance among immigrants have been attributed to the policy (Kaushal & Kaestner, 2005) though some disagree with that assertion (e.g., Borjas, 2003). Barriers to obtaining publicly funded coverage are even greater for immigrants who are undocumented, as many public programs require applicants to have legal status (Fremstad & Cox, 2004).

While barriers to insurance likely account for many of the problems with access to healthcare for immigrants, other factors play a role. For example, labor-related protections for working immigrants may be sub par. Supporting this assertion, in the 2001-2002 NAWS survey, undocumented farmworkers were substantially less likely than authorized workers (i.e., 33% vs. 65%) to report that they were covered by workers compensation (Carroll et al., 2005). Stigma and marginalization are significant issues for immigrants, especially with the recent anti-immigrant sentiment in communities worried about immigrant use of resources (Derose et al., 2007). Data from the CHIS revealed that Mexican-born immigrants had a significantly harder

time understanding their doctors and were more likely to say that they would get better care if they were of a different race/ethnicity when compared to Hispanics and whites born in the U.S. (Ortega et al., 2007). Endorsement of these statements was most common among undocumented immigrants. All of these factors likely contribute to the disproportionately low rates of health services use among immigrants. Little is known about how immigration status influences use of health services among farmworkers. Thus, further examination of the association is warranted.

Migratory lifestyle. Nearly half (42%) of the farmworkers interviewed in the 2001-2002 NAWS were migrant farmworkers (Carroll et al., 2005). Farmworkers' migration patterns (i.e., intra- and inter-state, as well as international) have been cited as barriers to health services receipt in a report by the Secretary of Health and Human Services, perhaps in part due to the difficulties migrant workers face when trying to establish public health coverage or continuity of care (Leavitt, 2006). Only one study has examined this relationship and found that those with a permanent residence outside the U.S. (one form of migrant) used significantly less healthcare (Littlefield & Stout, 1987). Thus, its impact on health services use among farmworkers warrants further attention.

Health status. As noted earlier, the health status of farmworkers is suboptimal in a number of health domains and many farmworkers perceive their health status to be poor. In one 1986 survey conducted among Colorado farmworkers, approximately half reported being in fair or poor health (Littlefield & Stout, 1987). Health status influences utilization of services because people often are motivated to seek care if they have either an acute or chronic condition (Andersen, 1995). For example, when national data on Hispanics, African-Americans, and whites were analyzed, having poor health status was significantly associated with increased utilization of healthcare, hospitalization, and medical expenditures among all three populations (Freiman, 1998). Similar findings were reported in another study using data from the 1987 NMES; Hispanic individuals with at least one chronic condition reported significantly more

utilization of health services (Schur et al., 1995). Findings have also been similar for Hispanics' use of mental health services (Cabassa et al., 2006). The influence of health status on the health services utilization of farmworkers is unknown. Thus, further research is needed.

Additional sociodemographic variables. According to the 2001-2002 NAWS data, the farmworker population is primarily male (79%) and young, with an average age of 33 (Carroll et al., 2005). Over half are married (58%). Age, sex, and marital status all have been found to be associated with healthcare utilization (Scheppers et al., 2006). According to 2005 MEPS data, the percentage of the population having made an ambulatory health care visit is significantly higher among females (80%) than among males (59.6%) (Ezzati-Rice et al., 2008). Data from the 1987 NMES indicated that among Hispanic individuals, being married and being female were associated with increased health services utilization (Schur et al., 1995). Sex, age, and marital status have been found to be associated with use of mental health services among Hispanics as well (Cabassa et al., 2006).

The association of several of these sociodemographic variables with healthcare use has been examined in farmworkers. Younger and female Wisconsin farmworkers were significantly less likely to have ever had a routine physical exam, while males were significantly less likely to have had a dental visit (Slesinger & Cautley, 1981). Adherence to mammography recommendations was significantly associated with age, with women ages 50-69 significantly more likely to adhere to screening recommendations than women 70 years and older (Palmer et al., 2005a). Among Colorado farmworkers, women were more likely than men to have had a medical visit in the previous year (Littlefield & Stout, 1987). However, age and sex were not significantly associated with time since last dental visit. Similarly, age and marital status were not significantly associated with mammography adherence among female farmworkers living in the Lower Rio Grande Valley (Palmer et al., 2005b). While these data provide insights into the

associations of sociodemographic variables with health services utilization for farmworkers,

further assessment of these relationships is needed.

Environmental Level Correlates of Healthcare Utilization

A number of environmental level factors are associated with use of medical care; the

impact of such factors can at times carry more weight than those at the individual level. When a

well-established safety net is in place in a particular community, the impact of factors such as

uninsurance on health services utilization may be reduced (Buchmueller, Grumbach, Kronick, &

Kahn, 2005). Conversely, in communities with few medical resources and/or few physicians,

coverage will not have as positive an impact on utilization. There are a number of ways to

examine the influence of community level factors on health services use. Some factors that are

particularly relevant to farmworkers include rural residence, proximity to the U.S.-Mexico

border, and availability of health services resources. Further detail on these factors is provided in

the following section.

Rurality. Given that agricultural work is performed primarily in rural and near-rural

settings, farmworkers often reside in such regions. However, a number of farmworkers live near

metropolitan statistical areas (MSAs). Differences in proximity to MSAs may influence health

services utilization among farmworkers, because individuals who live in rural areas face unique

barriers with regard to seeking care (Scheppers et al., 2006). The rural healthcare system is often

characterized by physician shortages and excess financial distress for hospitals and other safety

net providers (Ricketts, 2000). Advances in technology (e.g., telemedicine) and strategic policy

are poised to improve the state of rural healthcare (Ricketts, 2000). For example, Medicaid

managed care programs have been implemented in many rural areas (Slifkin, Hoag, Silberman,

Felt-Lisk, & Popkin, 1998). However, some providers are resistant to such programs and

distribution is uneven, with only approximately half of rural counties covered under a Medicaid

managed care program. In addition, rural and near-rural populations have other features leading

to their poor access to healthcare (Ricketts, 2000), including disproportionately lower educational attainment and income (S. L. Larson, Machlin, Nixon, & Zodet, 2004) and higher uninsurance levels (Ricketts, 2000). These barriers appear to have resulted in differential access to care. For example, among those with ambulatory care expenses, rural dwellers made the fewest healthcare visits and had the lowest annual healthcare expenses (S. L. Larson et al., 2004).

Barriers to care related to rural residence also exist for rural minority populations. In a review of the literature, Mueller and colleagues identified a number of factors associated with access to services among rural minorities (Mueller, Ortega, Parker, Patil, & Askenazi, 1999). Financial difficulty, uninsurance, and geographic barriers were significant factors for rural dwelling Hispanics (Mueller et al., 1999). Regarding Hispanics, barriers to care were also identified by staff from 319 rural hospitals. Especially of note were lack of funding for interpretation services, absence of training programs for interpreters, and lack of state agency support (Torres, Parra-Medina, Bellinger, Johnson, & Probst, 2008). Other barriers to care for rural Hispanics mentioned by safety net providers were high levels of uninsurance among the community members, and low levels of funding and trained professionals for providing interpreter services (Casey, Blewett, & Call, 2004). Additionally, preventive services are underutilized in this population, even among the insured community members, often due to financial burden (e.g., high co-pay) (Casey, Blewett et al., 2004). Barriers were identified during focus groups conducted with Hispanic individuals living in the rural Midwest (Cristancho, Garces, Peters, & Mueller, 2008). Lack of health insurance, expensive healthcare services, and poor communication with providers all were commonly reported by the focus group participants. The rural Hispanic participants also mentioned lack of transportation and fear of discrimination, especially as it pertains to immigration status.

As a result of these barriers, access to care is disproportionately low for rural minorities, and especially for Hispanics. Among Hispanics, underutilization of all forms of medical care was

reported in several studies reviewed by Mueller and colleagues, but of particular note was the disproportionately low use of mental health and dental services (Mueller et al., 1999). Analysis of 1999 NHIS data revealed that dental care was disproportionately low for rural adults in an adjusted model and that rates of care were especially poor for rural low-income and minority individuals (Casey, Davidson, Moscovice, & Born, 2004). Also, data from the 2002-2003 MEPS reveal that while the difference in report of usual source of care between Mexican and non-Hispanic whites was significant, that difference was most substantial among those not living in an urban area (Berdahl, Kirby, & Stone, 2007).

Findings regarding associations between rural residence and health services use are not consistent. In one national sample, rural adults had a significantly higher likelihood of having a usual medical care provider (Mainous, King, Garr, & Pearson, 2004). According to data from the 1998-2000 MEPS, rates of uninsurance do not differ between individuals residing in rural counties and those living in other (e.g., metro, near-metro) counties (S. L. Larson et al., 2004). While rural residents were significantly less likely to have visited a physician in the previous 12 months (with Hispanics being one of the least likely groups within rural residents), insurance status showed the greatest association with utilization of services (Mueller, Patil, & Boilesen, 1998). Mixed results have been observed for mental health service utilization among rural Hispanics as well (Cabassa et al., 2006). While there is some inconsistency in the impact that rural residence has on health services utilization, its association with health services use among farmworkers has been studied very little and therefore requires further study.

Proximity to U.S.-Mexico border. Several states along the U.S.-Mexico border have sizable farmworker populations and proximity to Mexico may have some influence on farmworker use of medical services in either or both countries (Wallace, Mendez-Luck, & Castaneda, 2009). Among female farmworkers in California, Texas, and New Mexico, living near the border was significantly associated with decreased adherence to mammography

recommendations (Palmer et al., 2005a). Among Hispanics living in two Texas *colonias*, 50.9% of adults reported that a provider in Mexico is their usual source of medical care (Ortiz, Arizmendi, & Cornelius, 2004). Among farmworkers living in Colorado, 12.6% reported that their most recent medical visit had taken place outside the United States (Littlefield & Stout, 1987) and among California farmworkers reporting that they had made a visit to a doctor, 18% received that care in Mexico (Villarejo et al., 2000). Among North Carolina farmworkers who received dental care in the previous year, nearly the entire sample had received that care in Mexico (Quandt et al., 2007). Around 10% of individuals from farmworker families with an unmet need for dental care attributed it to having postponed care until it could be obtained in Mexico (Quandt et al., 2007).

Residence in such an area is likely associated with a lower level of acculturation, which, as noted earlier, is negatively associated with health services utilization for farmworkers (Palmer et al., 2005a). Colorado farmworkers with a U.S. primary residence were significantly more likely to have had at least one dental visit in their lifetime (81.5% vs. those whose primary residence was outside of the U.S. (65%)) (Littlefield & Stout, 1987), a finding that could in part be attributed to acculturation. On the other hand, place of birth (U.S. vs. Mexico), and length of stay in the U.S. (over/under 20 years) were not significantly associated with adherence to mammography recommendations among female farmworkers (Palmer et al., 2005b). Thus, the relationship between use of health services and proximity to the border likely reflects more than acculturation. The relationship between farmworker proximity to the U.S.-Mexico border and U.S. health services utilization should be explored further. Additionally, it is important to control for whether farmworkers sought medical care outside the U.S. in the previous two years.

Availability of healthcare resources. The availability of health services resources within a community is associated with health services utilization (Scheppers et al., 2006). A variety of healthcare facilities provide care to individuals in need. Hospitals, private clinics, and

community health centers are among the more common sources of care. The type of healthcare facility most relevant to the farmworker population, however, is likely Federally Qualified Health Centers (FQHCs)— healthcare organizations serving low-income populations, including Migrant Health Centers (MHCs), that receive grants under Section 330 of the Public Health Service Act (Health Resources and Services Administration, 2008c). FQHCs provide a substantial portion of medical services for farmworkers (Leavitt, 2006; Rosenbaum & Shin, 2005). For example, these agencies served 807,153 migrant and seasonal farmworkers in 2006 (Health Resources and Services Administration, 2009). Among Colorado farmworkers, 34.2% of the sample reported that an FQHC was their usual source of care (Littlefield & Stout, 1987). Among those whose permanent residence was Texas, nearly half of the sample reported that an FQHC was their usual source of care. Additionally, among Wisconsin farmworkers who had received dental care in Wisconsin, 70% received it at the local FQHC (Slesinger & Cautley, 1981).

FQHCs provide primary care services, as well as additional health services and programs where funding allows (Health Resources and Services Administration, 2008c). These facilities are located in communities with high need for medical resources, based on rates of physicians practicing in the area and community poverty level, among other factors (Health Resources and Services Administration, 2008b, 2008c). In 2006, FQHCs provided care to a disproportionately high number of rural, poor, ethno-racial minorities (especially Hispanic), and either publicly insured or uninsured individuals (Health Resources and Services Administration, 2009; Politzer, Schempf, Starfield, & Shi, 2003; Politzer et al., 2001). For example, 22% of all uninsured ambulatory visits are provided by FQHCs, and FQHCs serve one in five low income uninsured Americans, one in ten rural Americans, and one in four people living in poverty (National Association for Community Health Centers, 2008).

FQHCs deliver important and effective healthcare services to the underserved. For example, data from a national sample revealed that, as opposed to the general U.S. patient

population, being a community health center patient was significantly and positively associated

with improved utilization of services and other access factors (e.g., regular source of care) for

both uninsured individuals and Medicaid recipients (Shi, Stevens, & Politzer, 2007). Although

gaps in care continue, FQHCs have been successful in delivering a variety of preventive and

primary care services to underserved populations. Ethno-racial/insurance/income disparities in

outcomes such as low birth weight (Politzer et al., 2001), receipt of health promotion counseling

(Politzer et al., 2001), and access to screening and preventive services appear to be tempered by

the utilization of FQHC services (Frick & Regan, 2001; O'Malley, Forrest, Politzer, Wulu, & Shi,

2005; Politzer et al., 2003; Politzer et al., 2001). While FQHCs provide an invaluable healthcare

resource to individuals facing substantial barriers to care, the distribution of such resources is not

equal across communities (National Association for Community Health Centers, 2007a;

Rosenbaum & Shin, 2005). States have substantially different numbers of total FQHC grantees

and delivery sites (National Association for Community Health Centers, 2007a). For example,

three states with large farmworker populations had strikingly different numbers of grantees and

delivery sites in 2006, respectively: California (103 and 775), North Carolina (24 and 117), and

Florida (38 and 232). Such differential levels of healthcare sites do not occur at the state level

alone. For example, data analyzed from the 1996-2003 administrations of the CTS indicate that

Hispanic individuals in "new growth" communities were significantly less likely to live near an

FQHC than were those living in major Hispanic centers (43% vs. 71% lived within 5 miles)

(Cunningham et al., 2006). This difference in distribution of healthcare resources likely

contributes significantly to community members' perceived and actual access to services. In one

study, those living in close proximity to an FQHC were significantly more aware of safety net

providers (May, Cunningham, & Hadley, 2004). Unequal distribution of FQHCs has created

barriers to care for farmworkers as well. Farmworkers have stated that inadequate or lack of

services in their community (Perilla et al., 1998), services being too distant (Quandt et al., 2007),

and not knowing where to go for services (Goertz et al., 2007; Perilla et al., 1998; Rose & Quade, 2006) are barriers to seeking care. Thus, while FQHCs provide an invaluable resource to the uninsured, their utility to certain communities is limited due to poor accessibility.

Geographic accessibility of healthcare facilities is an established predictor of healthcare utilization (McLafferty, 2003). For example, using the 1998-1999 CTS, Hadley and Cunningham demonstrated that living closer to a safety net provider (and specifically, an FQHC) significantly increased access to care for the uninsured (Hadley & Cunningham, 2004). A multivariate analysis of data from the 1995-1996 NHIS revealed that adults in a community with a larger supply of community health centers were significantly more likely to have visited a physician in the previous year (Andersen et al., 2002). The impact of proximity to FQHCs has been observed for farmworkers. Among Wisconsin farmworkers, rates of dental and vision care were significantly higher for those living within the catchment area of an FQHC (26% vs. 11% and 64% vs. 53%, respectively) (Slesinger & Cautley, 1981).

There are numerous methods for establishing the relationship between availability of healthcare facilities and utilization of services (McLafferty, 2003). Typically, researchers assess access to care using area-based or distance-based measures. Area-based approaches (e.g., density of healthcare facilities in a county) have limitations. For one, the area chosen for analysis (e.g., county, state) can significantly influence results and such units are often defined by factors not relevant to the question of interest (e.g., politically defined). Distance-based measures largely overcome such limitations, especially in rural areas (Guagliardo, 2004). To assess proximity to healthcare facilities, a common measure is that of the straight-line or Euclidean distance (Guagliardo, 2004; McLafferty, 2003). Employing Geographic Information Systems can enhance the precision of the measures (McLafferty, 2003).

Using distance alone to assess accessibility of facilities also has limitations. When examining distance to healthcare, it is important to also assess availability of transportation for

travel to healthcare facilities (Guagliardo, 2004). Access to a vehicle is especially relevant to

non-urban dwellers, given that their travel to care tends to be significantly longer (Probst,

Laditka, Wang, & Johnson, 2007) and access to public transportation can be minimal (Lovett,

Haynes, Sunnenberg, & Gale, 2002). Transportation problems have been noted as barriers to care

for farmworkers (Goldsmith & Sisneros, 1996; Lantz et al., 1994; Perilla et al., 1998; Rose &

Quade, 2006), and approximately half (49%) of farmworkers interviewed in the 2001-2002

NAWS reported that they own a car in the United States (Carroll et al., 2005). Thus, access to

transportation is an important factor to consider when exploring accessibility of health services

for them. Little is known about the impact of availability of FQHCs and transportation on health

services use among farmworkers. Therefore, further study of the topic is needed.

Other healthcare resources, such as full-time equivalent (FTE) medical professionals

and/or staff, are unequally distributed. A report from the Center for Health System Change found

that, while federal grants contribute greatly to improved access to care among uninsured and low-

income populations, areas with weaker safety nets tend to receive *less* federal funding, thus

widening the gap in healthcare resources between communities (Hoadley & Felland, 2004). New

destinations for immigrants likely have fewer community resources geared towards serving

Hispanic immigrants (Derose et al., 2007). The total FTEs employed at FQHCs varies widely by

state, as do the proportions of state populations who are uninsured (a denominator for those likely

to use such services) (National Association for Community Health Centers, 2007b).

Similar to geographic accessibility, this unequal distribution of healthcare resources has

an impact on health services utilization among community members and should be assessed in

concert with the geographic measures of access (Guagliardo, 2004). For example, the mean

number of general practice physicians (per 1000 residents) differed significantly for non-Hispanic

white and Mexican participants in both metro and non-metro communities, and having a better

physician-to-resident ratio was significantly and positively associated with having a usual source

of care in a multivariate model (Berdahl et al., 2007). Contradictory findings were reported using

1996-1999 MEPS data, with virtually no variation in health services use explained by various

measures of healthcare system capacity (Zuvekas & Taliaferro, 2003).

Availability of resources (e.g., FTE physicians, funding) provided to FQHCs varies

widely and appears to have an impact on health services use. Data from the CTS (1998-2003),

limited to poor non-elderly individuals, were analyzed (Hadley, Cunningham, & Hargraves,

2006). Safety-net capacity was assessed by examining total community health center grant

revenues per poor person within a five-mile radius of respondents. Individuals with insurance

had superior access to care, regardless of race/ethnicity and nearby CHC capacity. When those

with insurance but no nearby CHC were compared to those without insurance but high CHC

resources, access for the insured was still higher. Access was lowest for Spanish-speaking

Hispanic individuals but increased monotonically with increases in CHC capacity. Utilization of

ambulatory care in the last year and having a usual source of care were both higher among those

with insurance and those with high levels of CHC capacity in multivariate analyses. The impact

of variation in FQHC resources on health services utilization among farmworkers is unknown and

therefore warrants further study.

Policy Level Correlates of Healthcare Utilization

Workplace policies such as provision of health insurance, as well as payment structure

(e.g., "piece-rate" pay), likely play a role in farmworker healthcare utilization. Lack of health

insurance and/or knowledge of how to use/obtain insurance have been reported as barriers to

health services utilization by farmworkers (Goertz et al., 2007; Rose & Quade, 2006). The

literature on such correlates follows.

Health insurance. Very few farmworkers report that they have health insurance

(Rosenbaum & Shin, 2005). Fewer than one-quarter (23%) of farmworkers interviewed in the

2001-2002 NAWS reported having health insurance (Carroll et al., 2005) and similar rates of

insurance coverage (approximately 30%) were reported for farmworkers in the CAWHS (Villarejo et al., 2000). Only 7% of the farmworkers reported being covered by public programs (e.g., Medicaid, Medicare) (Villarejo et al., 2000). Rates of insurance coverage were assessed among Texas farmworkers and were slightly lower, with 14% stating that they had some form of health insurance (primarily Medicare and Medicaid) (J. Poss et al., 2005). Among insured farmworkers in the 2001-2002 NAWS survey administration, insurance was provided by their current farm employer (46%), the spouse's employer (12%), the government (19%), individual purchase (spouse or worker) (15%), or other means (e.g., parent's insurance, shared premiums with employer) (7%) (Carroll et al., 2005). Rates of employer-sponsored insurance were low in another study, with only 16.5% of California farmworkers reporting that they had been offered such insurance and only one-third of those workers accepting it, mostly due to inability to pay for added associated costs (Villarejo et al., 2000).

Lack of insurance is a common barrier to receipt of health services (Scheppers et al., 2006). Having health insurance is positively and significantly associated with use of outpatient services, preventive care, acute care in outpatient settings, and inpatient care (Buchmueller et al., 2005). Buchmueller and colleagues postulated that, based on findings from their systematic review, providing universal health coverage to adults would result in an average increase of one to two annual visits for the uninsured. Data from the CTS indicate that 66% of insured Hispanics have a regular care provider and 74.8% had made a visit to the doctor in the previous year, as compared to uninsured Hispanics (34.0% and 38.5%, respectively) (Hargraves, 2004). For low-income individuals, insurance plays a significant role in eliminating barriers to health services. Data from the 1996 SIPP revealed that, among current/previous welfare recipients, the likelihood of having seen a physician in the previous year was significantly lower the longer the person was uninsured (T. Cheng, 2005). Income, on the other hand, was not associated with utilization in the sample.

Receipt of public health coverage appears to have a protective effect for low-income individuals. According to MEPS data collected in 2005, uninsured individuals are significantly less likely to make an ambulatory healthcare visit (42.3%) than those receiving public (77.8%) or private (75.4%) insurance (Ezzati-Rice et al., 2008). Similarly, rates of receiving a general checkup were significantly lower among those without insurance (17.5% vs. 44.4% and 43.4%, respectively) (Ezzati-Rice et al., 2008). Hispanic individuals interviewed in the 1987 NMES with either Medicaid or private insurance coverage had significantly higher use of health services provided that they had a usual source of care (Schur et al., 1995).

Associations between insurance and health services use have been observed for farmworkers. Indeed, the low rate of health insurance was cited as a primary barrier to health services utilization for farmworkers in a report conducted by the Secretary of Health and Human Services (Leavitt, 2006). Having insurance was significantly associated with increased adherence to mammography recommendations among female farmworkers living in California, New Mexico, and Texas (Palmer et al., 2005a) and the Lower Rio Grande Valley (Palmer et al., 2005b).

There are a number of reasons why fewer farmworkers have coverage. It is likely that some of the characteristics of this labor force interfere with access to insurance. For example, farmworkers in the 2001-2002 NAWS reported that they worked for their current employer an average of four and a half years, but 35% had worked for their current employer for one year or less (Carroll et al., 2005). Additionally, seasonal employment was reported by 60% of the farmworkers interviewed and only one-quarter reported year-round employment. Farmworkers who were employed year-round were more likely to report receipt of health insurance (15%) than were seasonal employees (5%), as was the case with workers' compensation (i.e., 62% vs. 47%) (Carroll et al., 2005).

There are additional barriers to health insurance specific to public benefits. As noted above, rates of public healthcare coverage are low among farmworkers, despite having low annual income. This is likely because the requirements for eligibility are usually prohibitive for farmworkers (Leavitt, 2006). Non-elderly and non-disabled childless adults (or those living apart from their children) are categorically ineligible for Medicaid. The PRWORA of 1996, discussed earlier, provides added limitations on farmworker eligibility, as do citizenship requirements (Leavitt, 2006). Additional barriers to Medicaid access include lack of plan portability between states; lengthy application processing time, given migration patterns of the workforce; and fear that application may jeopardize family members who are undocumented immigrants (Leavitt, 2006). Also, since farm work is seasonal, inflation of income estimates may render farmworkers ineligible for Medicaid when current monthly versus annual income is used to estimate poverty status (Leavitt, 2006). Since the average yearly number of workdays for farm laborers is 190 (Carroll et al., 2005), current monthly versus yearly incomes can present a skewed picture. In sum, study of the impact of insurance on health services use among farmworkers is needed.

Other workplace policies. Other workplace policies, such as provision of other benefits (i.e., workers compensation) and payment structure, may be associated with the receipt of health services. Nearly one-half (48%) of farmworkers interviewed in the 2001-2002 NAWS reported that their employer provided workers compensation for work-related injury or illness (Carroll et al., 2005). Over three-quarters of the NAWS sample reported that they were paid by the hour, 16% by the piece, 3% with a combination of hourly and piece rate, and 2% by salary (Carroll et al., 2005). The influence of such policies on farmworker utilization of health services is unknown and therefore examination is needed.

<div align="center">Project Objectives and Hypotheses</div>

This study sought to characterize health services utilization among farmworkers and had the following objectives:

Primary Objective

I.   Apply the Behavioral Model for Vulnerable Populations with a national sample of farmworkers in order to detect individual, environmental, and policy level factors that are independently associated with U.S. healthcare use so that areas for intervention can be identified.

Secondary Objectives

I.   Provide additional descriptive data regarding self-reported barriers to U.S. healthcare and, among healthcare users, site/payment method for most recent U.S. healthcare visit.

II.   Identify individual, environmental, and policy level moderators of the relationships between select environmental level factors and healthcare use.

III.   Assess prevalence of health services utilization among a national sample of farmworkers and statistically compare rates of no healthcare use to U.S. and subpopulation (i.e., those with similar sociodemographic characteristics to farmworkers) rates of no healthcare use.

Study objectives were met by examining findings for a national sample of farmworkers who completed the National Agricultural Workers Survey during fiscal years 2006-2008. The following hypotheses were proposed. Utilization rates in the U.S. were expected to be significantly lower among those who were Hispanic, foreign-born, younger, male, and/or single farmworkers, as well as among those with lower educational attainment and/or income. Having limited English proficiency was expected to be significantly associated with reduced rates of health services utilization in the U.S. Those who were undocumented immigrants were expected to have the lowest rates of health services utilization, while U.S. citizens were expected to have the highest. Migrant farmworkers were expected to have lower health services use. Having been diagnosed with a chronic disease was predicted to be associated with increased health services

utilization. Farmworkers who endorsed at least one barrier to care were expected to have lower rates of healthcare use. Farmworkers reporting that they own a vehicle in the U.S. were expected to have higher rates of healthcare use. It also was expected that farmworkers who used healthcare outside the U.S. in the previous two years would report lower rates of U.S. healthcare use.

Second, environmental level variables were predicted to have an association with health services use among farmworkers. Working in more rural areas, as well as near the U.S.-Mexico border, was expected to be associated with lowered rates of health services use in the U.S. Conversely, individuals working in an area with a higher density of FQHC delivery sites were expected to have higher rates of utilization. Having an employer who is a shorter distance from an FQHC was expected to have the same effect. Finally, working in a county with higher FQHC physician and/or staff quantity and/or higher FQHC funding (relative to size of local farmworker population) was expected to be associated with higher rates of use.

Third, several policy level variables were hypothesized to be associated with health services use among farmworkers. Having U.S. health insurance was expected to be associated with health services utilization, with those receiving employer-sponsored benefits reporting the highest rates of use. Payment structure was expected to be associated with use of healthcare, with those receiving a salary significantly more likely to use health services than those paid an hourly wage. Rates of use were expected to be lowest among those who are paid by the piece. Finally, provision of workers compensation by employers was expected to be significantly and positively associated with health services use.

Rates of no healthcare use were predicted to be higher among farmworkers than for the general U.S. and sociodemographically similar U.S. subpopulations.

RESEARCH DESIGN AND METHODS

Sample

National Agricultural Workers Survey Sampling Procedure

The National Agricultural Workers Survey (NAWS) has been conducted annually since 1988 in 39 U.S. states under a contract with the U.S. Department of Labor (U.S.D.O.L.) (U.S..D.O.L., 2008). NAWS uses multi-stage sampling, due to the regional and seasonal fluctuations in the number of farmworkers. Interview cycles take place during February, June, and October of each year. NAWS researchers estimate the number of farmworkers in a given region and at a given time based on crop labor estimates from the Department of Labor's Bureau of Labor Statistics (B.L.S.) and the United States Department of Agriculture (U.S.D.A.). These estimates are then used to determine the size of the sampling frame so that interviews are conducted with a sample in proportion to the size of the farmworker population. Sampling locations are identified within each of 12 United States regions. Target counties are then selected from each sampling location. Agricultural employers are then identified with simple random sampling using public records (e.g., unemployment insurance files, pesticide registration materials). Once growers agree to have their employees participate in recruitment for the study at the worksite, farmworkers are randomly selected and recruited from the workplace (U.S..D.O.L., 2008).

National Agricultural Workers Survey Sample

Data from the 2006 (n=1,519), 2007 (n=1,511), and 2008 (n=2,182) fiscal year administrations of the NAWS were used, yielding a total of 5,212 farmworker respondents currently employed in agriculture. Between 2006 and 2008, NAWS researchers contacted or attempted to contact 7,720 growers and were able to determine the eligibility of 4,249. Of these growers, 2,217 (52.18%) were eligible for the survey and 2,032 (47.82%) did not have workers at time of contact. Of eligible growers, 71% agreed to cooperate with survey recruitment.

NAWS researchers were not able to conduct interviews at some of these establishments, mainly due to timing issues (e.g., dates the grower was available were not when interviewers were in the county). NAWS researchers completed interviews at 1,152 (51.96%) of the eligible worksites. At participating employers, NAWS researchers contacted 5,758 workers, of whom 5,222 (90.69%) participated in the survey. Valid data were provided by 5,212 interviews. Fiscal, rather than calendar year, administrations were used because NAWS sampling weights are based on fiscal year. Due to deletion of some cases with missing data and outliers (described in the Results section), the final sample size consisted of 4,891 farmworkers.

Eligibility

Eligible farmworkers are those who perform a number of agricultural tasks and hold a variety of job titles, including field workers, field packers, supervisors, and/or those who hold simultaneous non-farm jobs (U.S..D.O.L., 2008). The sample does not include individuals working with poultry, livestock, or fish, or secretaries, mechanics, or H-2A foreign temporary workers.

Comparison Sample: Medical Expenditure Panel Survey

The 2006 Medical Expenditure Panel Survey (MEPS) Self-Administered Questionnaire (SAQ) was used to compare rates of no healthcare use in the previous 12 months among farmworkers to those of a nationally representative U.S. sample and relevant subpopulations. The 2006 full year consolidated data file was downloaded (Agency for Healthcare Research and Quality, 2009). The dataset initially included 34,145 participants but 13,313 (39.0%) did not complete the SAQ questions and were deleted from the dataset. Participants who did not answer (n=579) or did not know the answer (n=4) when asked whether they had used medical care in the previous year were deleted from the dataset, leaving 20,249 MEPS participants for the comparison.

Measures

The NAWS is an approximately 60-minute face-to-face survey. Interviews are typically conducted in the farmworker's home or in another place the farmworker chooses and in the farmworker's preferred language. Numerous versions of the survey have been administered covering a number of topics, including demographics, work history (both in agricultural and non-agricultural work), characteristics of farm employment, and questions regarding health services use.

Outcome Measure

The question, "In the last two years, in the U.S.A., have you used any type of health care services from doctors, nurses, dentists, clinics, or hospitals?" provided the study's dichotomous outcome variable.

Individual Level Correlates of Health Services Utilization

Sociodemographic variables. Sex, marital status (married vs. not), race/ethnicity (Hispanic vs. non-Hispanic), and country of origin (U.S. born vs. not) were dichotomous variables. To create the race/ethnicity variable, those who endorsed being Hispanic/Latino (e.g., Mexican-American, Chicano, Puerto Rican) were deemed Hispanic and those who did not but endorsed being white, Black/African-American, American Indian/Alaskan Native/Indigenous, Asian, Native Hawaiian or Pacific Islander, or Other were deemed non-Hispanic. Age, annual family income, and educational attainment (i.e., highest grade level) were continuous variables.

Additional individual level variables. A variable reflecting current immigration status was created with the following three categories: U.S. citizen; green card or other authorization to work; and unauthorized. A categorical variable reflecting limited English proficiency (LEP) was created using questions about English fluency and literacy. To be English proficient, individuals must have endorsed that they speak *and* read English well, while moderately proficient individuals were those who reported that they speak *and* read English a little/somewhat, at a

minimum. All others were considered LEP. To ascertain health status, questions about whether the farmworkers had ever been diagnosed with a variety of diseases were used. Based on their responses regarding chronic diseases (i.e., heart disease, diabetes, and asthma), a dichotomous variable was created (i.e., diagnosis of chronic disease vs. none). Current acute conditions could not be ascertained due to the lifetime timeframe for diagnosis.

A categorical variable was created to capture whether the farmworker was non-migrant, a follow-the-crop migrant (i.e., reported 2 farm work locations that are more than 75 miles apart), or a shuttle migrant (i.e., international shuttle or has a U.S. home-base that is more than 75 miles away but is not follow-the-crop). Participants were asked whether they had experienced difficulty in obtaining needed healthcare and a categorical variable (i.e., ≥1 barrier endorsed vs. none) was created. To assess access to transportation, a question regarding ownership of a car or truck in the United States (yes vs. no) was used. To control for use of healthcare outside the U.S., a dichotomous variable was used that asked about whether the individual had received care outside of the United States in the past two years.

Environmental Level Correlates of Health Services Utilization

Rural community. A system created by the U.S.D.A.'s Economic Research Service (U.S.D.A., 2004) was used to characterize the rurality of the counties in which farmworker interviews were conducted. Metropolitan Statistical Area populations are used to classify metropolitan areas. Non-metropolitan areas are classified based on the aggregate size of their urban populations and their functional adjacency to metropolitan areas (i.e., whether physically adjacent with at least 2% of its labor force commuting to central metro counties). These U.S.D.A. rurality scores (range = 1-9, with 1 reflecting the largest metropolitan counties and 9 reflecting counties with the smallest population size and not functionally adjacent to a metro county) were merged with each county in which farmworker interviews were conducted.

Proximity to U.S.-Mexico border. A list of border counties provided by the U.S.-Mexico Border Health Commission (USMBHC) (U.S.-Mexico Border Health Commission, 2003) was used to create a categorical variable reflecting border county status. The USMBHC defines a border county as being within 62 miles of the U.S.-Mexico border. According to this definition, there are 48 counties in four states along the U.S.-Mexico border, 7 of which were counties where interviews were conducted for the 2006-2008 administrations of the NAWS.

Denominator for healthcare resource data. When examining the volume of healthcare resources, a denominator must be used to estimate resource demand (Guagliardo, 2004). Thus, county farmworker population estimates were provided by Dr. Susan Gabbard and were used as the denominator for all healthcare resource factors (i.e., resources per 1000 farmworkers). Estimates were based on the 2007 Census of Agriculture and are for farmworkers who engaged in agricultural work in the county in 2007. County estimates were not provided for three NAWS counties. For one such county, from which 11 farmworkers were recruited, the farmworker population was imputed using a neighboring county's estimate. The other two counties had no grantee healthcare resources, meaning that no denominator was needed in calculating their healthcare resource figures. Prior to imputation, the average county farmworker population was 4,876.46 (SD=11,727.01). Following population imputation for the 11 farmworkers' county, the average county farmworker population was M=4,848.53 (SD=11,695.68). The range (160 - 95,026.49) was the same prior to and following imputation.

FQHC healthcare resources. Healthcare resource information (i.e., FQHC grantee/delivery site locations and amount of Section 330 funds, FTE physicians, and total FTEs) was provided in the 2005 and 2006 administrations of the Uniform Data System (Health Resources and Services Administration, 2008a), a mandatory and annual survey administered to all FQHC grantees that assesses a number of domains, including patient demographics, staffing, and revenue (Health Resources and Services Administration, 2008a). Data from the 2005 UDS

were provided for 952 grantees and 5,703 delivery sites. There were slightly more grantees and delivery sites in the 2006 UDS (1,002 and 6,139, respectively). Healthcare resource figures were generated for counties from which participants were recruited in the NAWS. Because of the timeframe for the study outcome (i.e., 2 years), 2006/2007 NAWS counties were merged with 2005 UDS healthcare resource data and 2008 NAWS counties were merged with 2006 UDS data.

Geographic Information Systems (GIS) ArcInfo software (ESRI, 2009b) aided in the generation of study healthcare resource figures. To map the geographic coordinates for grantees, delivery sites, and NAWS growers (i.e., geocoding), their addresses were used. Geocoding was performed using a map containing all U.S. counties, "county_dtl" (ESRI, 2009c). The map's geographic coordinate system was edited into a projected coordinate system: "USA Contiguous Albers Equal Area Conic" and the "composite_US.loc" (ESRI, 2009c) address locator was used. Geocoding statistics are presented in Table 4. Geocoding results with a match score under 70 were considered unmatched (i.e., the match between the address and geographic coordinates was deemed insufficient). For unmatched addresses, further research was performed (using google) in an attempt to identify a more accurate address for the location. Interactive rematching was performed for any unmatched grower addresses and for the majority of any unmatched grantee or delivery site addresses. Grantees and delivery sites in U.S. territories (e.g., American Samoa, Micronesia) were left unmatched because no NAWS data are collected in those locations.

To identify the county location of each grantee so that county grantee resources could be ascertained, a county-grantee spatial join for 2005 and 2006 grantees was performed. To estimate the number of FQHC delivery sites in each county, a county-delivery site spatial join for 2005 and 2006 delivery sites was performed. For 3,219 U.S. counties (includes Puerto Rico) there was at least one grantee located in 634 and 662 counties for 2005 and 2006, respectively. Grantee and delivery site healthcare resource figures were aggregated to the county level and total United States county-level healthcare resource data are presented in Table 5, as are the figures for

counties in the NAWS. County farmworker population estimates were incorporated into these

healthcare resource figures, creating a ratio of resource-to-demand (See table with descriptive

data for environmental level characteristics, Table 8). The latter figures are those that were

included in bivariate and multivariate analyses.

   Proximity of employer to nearest FQHC delivery site. Using GIS data provided from the

aforementioned procedures, the distance from each 2006-2008 NAWS employer to the nearest

FQHC delivery site was calculated (distance from 2006/2007 growers to 2005 delivery sites and

distance from 2008 growers to 2006 delivery sites). Euclidean distances (in meters) were

calculated using ArcInfo's "Near Tool" (ESRI, 2009a). Whether the delivery site nearest the

employer was a community-based primary care clinic, operated part-time (i.e., <35 hours/week),

and/or affiliated with a migrant health center grantee was captured so these variables could be

explored as potential moderators of the relationship between distance to the nearest FQHC

delivery site and healthcare use.

Policy Level Correlates of Health Services Utilization

   Health insurance. Buchmueller and colleagues suggested that influence of insurance

status on access to healthcare be examined by type (Buchmueller et al., 2005). However,

response options in the NAWS were not mutually exclusive (e.g., one farmworker could report

that he or she received both employer- and government- sponsored insurance). A four-level

categorical variable was created reflecting insurance status sponsor (employer; government but

not employer; other (not employer or government); and uninsured) and rates of healthcare use did

not differ substantially by type of insurance in initial bivariate tests of association. Thus,

insurance was recoded to be a dichotomous variable: insured versus uninsured.

   Other workplace policies. Farmworkers were asked whether they are paid by salary, the

hour, the piece, or a combination of piece and hourly. A three-level categorical variable was

created, combining those who reported being paid by piece and those who reported that they were

paid by combination piece/hourly. Responses from a question about whether farmworkers' employers provide workers compensation were combined with a question about whether their employers pay for healthcare if one becomes injured or sick while working to create a workers compensation dichotomous variable.

Variables for Additional Analysis

To further characterize the health services use of farmworkers, site where U.S. medical care was received (e.g., Community Health Center/Hospital/Emergency Room, Migrant Health Clinic) was described by using a question asked only of those who had used medical care in the previous two years. Using another question asked of the same subset of the sample, how medical care was paid for (e.g., insurance, out of pocket) was described. All participants were asked about barriers to medical care. By examining responses to the item, common barriers to healthcare were described.

Comparison with 2006 Medical Expenditure Panel Survey Rates

MEPS participants were asked to report the number of medical visits they had made in the previous year; the proportion of participants reporting none was used for the comparison. Other items were retained to identify subpopulations similar to farmworkers: HISPANIX (a dichotomous variable reflecting Hispanic ethnicity); POVCAT06 (a 5-level variable characterizing family income level based on poverty cutoffs); and HIDEG (a categorical variable reflecting highest degree when first entered MEPS). A dichotomous variable was created to reflect poverty level: low income (poor/negative, near poor, and low income) vs. not low income (middle and high income). In addition, responses to several variables (those who were Hispanic, low income, and had no educational degree) were combined to identify a subpopulation similar to farmworkers.

Statistical Analysis

Data Stratification and Weighting Scheme

Although the NAWS sampling procedures attempt to obtain a sample proportional to regional farmworker population size, it is still necessary to utilize post-sampling weights to account for probability of inclusion in the sample, thereby ensuring that findings are representative of the national farmworker population (U.S. Department of Labor, 2009). For each year of NAWS administration, numerous post-sampling weights are created to account for factors such as regional and seasonal population fluctuations and year of administration (U.S. Department of Labor, 2009). These weights are then combined into two composite weights—one that is to be used when multiple years of data are combined for analysis ("pwtycrd") and one to be used when only one year of data is analyzed ("pwtcrd"). Thus, when descriptive, bivariate, and multivariate analyses were performed using 2006-2008 and 2006/2007 fiscal years, "pwtycrd" was applied. "Pwtcrd" was applied for all analyses performed with only 2008 fiscal year data.

Descriptive and Bivariate Analyses

Stata Release 9 (StataCorp., 2005) was used to calculate individual and policy level descriptive statistics (i.e., means, linearized standard errors, and proportions). Because sampling weights were utilized, counts are not presented with proportions for individual and policy level factors. The Statistical Package for the Social Sciences Version 13.0 (SPSS, 2005) was used to calculate descriptive statistics for environmental level variables. To calculate the average distance from employer to nearest FQHC, duplicate growers were temporarily deleted from 2006/2007 and 2008 datasets. To calculate average FQHC healthcare resources, duplicate counties were temporarily deleted from 2006/2007 and 2008 datasets. Weights were not applied to obtain descriptive data for environmental level variables.

Stata Release 9 (StataCorp., 2005) was used to assess weighted bivariate associations between health services utilization and each of the potential correlates at the individual,

environmental, and policy levels of influence. Design-based Pearson F tests were used to assess

associations with categorical variables and adjusted Wald F tests were used to test associations

with continuous variables. Descriptive and bivariate data are presented for the full sample and

stratified by fiscal years, since 2006/2007 data (n=2884) were merged with 2005 UDS data and

2008 data (n=2007) were merged with 2006 UDS data.

Multivariate Analysis

With the exception of some environmental level variables, those found to be significantly

associated with the outcome in bivariate associations (with an alpha level of .05) were included in

multivariate binary logistic regression (i.e., Bernoulli) analyses. Because of high

multicollinearity among the 4 healthcare resource variables and overlap in construct between

FQHC density and distance to nearest FQHC delivery site, only three variables were entered into

the model at level three (i.e., county): total FTEs, rurality, and border proximity (all were

significant in bivariate analyses for both strata). Multilevel modeling was employed to account

for clustering among farmworkers (at level 1) within workplaces (at level 2), and counties (at

level 3), using Hierarchical Linear Modeling (HLM) Version 6 (Raudenbush, Bryk, & Congdon,

2000)'s penalized quasi-likelihood method. Table 6 contains the level at which each variable was

entered into the model. Because variables at levels 2 and 3 were unique for 2006/2007 and 2008

administrations of the survey, it was necessary to run two separate multivariate models (i.e., one

for 2006/2007 and one for 2008).

All continuous variables were entered into the model grand-mean centered. Dummy-

coding was performed for variables with three categories. In the primary multivariate models, the

reference groups were: those farmworkers unauthorized to work in the U.S., those with limited

English language proficiency, those paid by the piece or a combination of hourly and piece, and

those who were shuttle migrants. To obtain the third comparison, multivariate models were re-

run with new reference groups: green card/other work authorization, moderate English proficiency, paid an hourly wage, and follow-the-crop migrants.

Moderation of Environmental Level Variable Associations with Healthcare Use

Given its larger sample size, data from 2006/2007 fiscal year administrations of the NAWS were used to identify moderators.

Individual and policy level moderators. Data were stratified by individual and policy level characteristics, and two multilevel logistic regression models were executed for each strata using HLM (Raudenbush et al., 2000): impact on healthcare use of distance alone; and a full model containing all level one, two, and three variables that were included in the main 2006/2007 multilevel regression analyses. Models included the primary dummy-coding variables and excluded the variable for which moderation was being tested. Sampling weights were not applied. Continuous variables were trichotomized with cutoffs of 33rd and 66th percentiles. Two payment structure categories' sample sizes were too small to perform HLM estimation and could not be combined (i.e., salary and piece/ combination), so no moderation by payment type was tested. Also due to small sample size, the two migrant categories (i.e., shuttle and follow-the-crop) were combined for these analyses. Differences across strata in the relationship between environmental level variables and healthcare use suggested presence of an interaction.

Environmental level moderators. Three factors at level two were examined as potential moderators of the relationship between distance to nearest FQHC and healthcare use: whether the nearest FQHC to the grower was a community-based primary care clinic, operated part-time, or affiliated with a migrant health center grantee. Multiplying these three dichotomous variables by the mean centered distance variable created three interaction terms to be entered into multilevel models.

Comparison with 2006 Medical Expenditure Panel Survey Rates

Farmworker and other groups' rates of no healthcare use in the previous year were compared using Stata's "prtesti" immediate function (StataCorp., 2005), which statistically compares proportions from two different samples with a z-test. For each analysis, the unweighted proportion of farmworkers who had not used healthcare in the previous two years was compared to the unweighted proportion of the U.S. and other subpopulations (i.e., low income, Hispanic, and members of the abovementioned farmworker comparison group) who had not used healthcare in the previous year.

RESULTS

Missing Data and Outliers

Multiple methods were employed to address missing data and outliers for all primary individual and policy level study variables. For cases with missing data on continuous variables (i.e., age and income), imputation was performed using Expectation Maximization (EM). Listwise deletion was performed for categorical variables (all of which had less than 5% of cases with missing data). Four outliers (all for age) were identified using a z-score cutoff of 3.29 and were deleted from the dataset.

Patterns for missing data were explored for all cases with at least one missing value, as well as for variables with more than 1% of cases with missing data (i.e., insurance (1.3%), income (17.2%), and barriers to care (2.7%)). Cases with missing data on at least one categorical or continuous variable (n=1112; 21.3%) were significantly younger, poorer, less educated, more likely to have reported barriers to care, and less likely to have been diagnosed with a chronic disease and/or to have used healthcare (but more likely to have used healthcare outside the U.S.). Those with missing data also were more likely to lack workers compensation and/or transportation; be unauthorized, Hispanic, foreign born, male, unmarried, or uninsured; and to have limited English language proficiency. Missing data was highest for shuttle migrants (compared with non- and FTC-migrants) and lowest among farmworkers paid by salary (compared to other forms of payment). Fewer significant associations but similar patterns were observed for cases with missing data on income, barriers to care, and/or insurance. Despite these relationships, descriptive results and bivariate associations were comparable before and after imputation/case deletion.

Descriptive Data: Healthcare Use, Individual, Environmental, and Policy Level Factors

Prevalence, site, and payment for healthcare use. Over half of farmworkers reported having used U.S. healthcare in the previous two years (55.26%, 61.77%, and 57.29% for fiscal

years 2006/2007, 2008, and the full sample, respectively). Most participants sought medical care

in a private physician's office or private clinic (47.02%), Community Health Center/hospital/ER

(31.04%), or dentist's office (16.40%). Few farmworkers sought medical treatment from a

migrant health clinic (3.45%), healer (0.17%), chiropractor/naturopath (0.38%), or other (1.54%).

Nearly half (45.22%) paid their bill out of pocket, 15.78% paid with an employer-sponsored

health plan, and 11.02% had expenses covered by Medicaid or Medicare. Remaining healthcare

coverage options were endorsed by fewer than 10% of the sample: public clinic so didn't charge

(6.72%), self/family insurance plan (6.11%), other healthcare plan (6.87%), combination of

coverage (6.84%), billed/did not pay (0.42%), and workers compensation (1.02%).

Perceived barriers to care. The barrier most commonly endorsed was cost (35.31%),

followed by language (9.09%). Remaining barriers were endorsed by fewer than 5% of the

farmworkers: lack of transportation (1.78%); don't know where to go (3.40%); not open when

needed (0.81%); don't provide needed services (2.76%); don't feel welcome (0.75%); don't

understand my problems (0.89%); will lose my job (0.38%); undocumented (2.11%); and other

(3.64%).

Individual level characteristics. Descriptive data for individual level factors are presented

in Table 7. The majority of farmworkers were male, married, Hispanic, foreign-born, and in their

mid- to late-30s, with low educational attainment and annual family income. Approximately half

reported being unauthorized to work in the U.S. and/or that they had limited English language

proficiency. Most of these workers were non-migrant and few reported a lifetime chronic disease

diagnosis. Fewer than half endorsed having experienced at least one barrier to healthcare and/or

not owning a car in the U.S. Finally, less than one-fifth reported having used healthcare outside

the U.S.

Environmental level characteristics. Descriptive data for environmental level factors are

presented in Table 8. Resource data from the 2005 and 2006 UDS are presented with fiscal years

2006/2007 and 2008, respectively. Average county healthcare resources (i.e., county FQHC delivery sites, section 330 funds, FTE physicians, and total FTEs per 1000 farmworkers) were comparable but were slightly higher in 2006 than in 2005. Similarly, distance to the nearest FQHC decreased slightly from 2006/2007 fiscal years to fiscal year 2008. NAWS counties were more urban than rural and few were near the border.

　　　Policy level characteristics. Descriptive data for policy level characteristics are presented in Table 9. The majority of farmworkers reported that they were uninsured, that their employers provided workers compensation, and/or that they were paid an hourly wage.

Bivariate Associations with Healthcare Use

　　　Individual level characteristics. Bivariate associations between categorical individual level characteristics and healthcare use are presented in Table 10. Female, married, non-Hispanic, and U.S.-born farmworkers were significantly more likely to have used healthcare. U.S. citizens were significantly more likely to have used healthcare than those with a Green Card or other authorization, who in turn used significantly more healthcare than unauthorized farmworkers. Rates of use were significantly different between the three English proficiency groups with the highest rates of healthcare use reported by those proficient in English, followed by moderately proficient farmworkers. Non-migrant farmworkers were significantly more likely to have used healthcare than were both groups of migrant farmworkers, with follow-the-crop migrants using more healthcare than shuttle migrants. Farmworkers who had a lifetime diagnosis of a chronic disease were significantly more likely to have used healthcare, as were those who did not endorse barriers to care and/or who owned a car. Finally, those who used healthcare outside of the U.S. were significantly less likely to have used U.S. healthcare in the past two years. Relationships were comparable for most categorical variables. However, in the 2008 fiscal year administration of the survey, shuttle migrants used significantly more healthcare than did follow-the-crop

migrants. In addition, the relationships between healthcare use and barrier endorsement and marital status were not significant for fiscal years 2006/2007 and 2008, respectively.

Regarding continuous variables evaluated for the full sample, farmworkers who had used healthcare were significantly older (M=37.48 (SE=.47) vs. 33.00 (SE=.47), F=45.24), with significantly higher income (M=25,357.70 (SE=470.87) vs. M=19,060.42 (SE=323.08), F=121.60), and educational attainment (M=8.44 (SE=.13) vs. M=6.73 (SE=.14), F=80.75), *p*s <.001. Mean differences between those who did and did not use healthcare (and standardized linear errors) were comparable in fiscal years 2006/2007 (age: 36.47 (.59) vs. 32.40 (.57), F=24.66; income: 23,937.09 (545.67) vs. 18,456.64 (381.66), F=67.74; and educational attainment: 8.58 (.15) vs. 6.82 (.16), F=61.00), as well as for 2008 (age: 39.47 (.71) vs. 34.54 (.84), F=20.02; income: 28,177.61 (834.28) vs. 20,627.39 (591.61), F=54.50; and educational attainment: 8.15 (.24) vs. 6.50 (.24), F=23.65), *p*s <.001.

Environmental level characteristics. Bivariate associations between continuous environmental level characteristics and healthcare use are presented in Table 11. Farmworkers who used healthcare worked in counties with significantly higher mean density of FQHC delivery sites, section 330 funds, FTE physicians, and total FTEs. Bivariate associations were comparable for the 2006/2007 fiscal year administrations of the survey. However, only higher mean county density of FQHCs and total FTEs were significantly associated with healthcare use in 2008. Farmworkers who used healthcare had higher mean distances to the nearest FQHC from their employer and worked in more rural counties for the full sample, 2006/2007, and 2008. The proportion of farmworkers who used healthcare was significantly higher for those working in non-border counties for the full sample (58.10% (95% CI: 55.62, 60.54) vs. 36.29% (95% CI: 27.55, 46.03), F=18.63, *p* <.001), 2006/2007 (55.89% (95% CI: 52.81, 58.93) vs. 33.74% (95% CI: 21.96, 47.95), F=9.27, *p*=.002), and 2008 (63.11% (95% CI: 59.04, 67.01) vs. 39.17% (95% CI: 26.97, 52.89), F=11.60, *p* <.001).

Policy level characteristics. Bivariate associations between policy level characteristics and healthcare use are presented in Table 12. Insured farmworkers and those who reported that their employers provided workers compensation were significantly more likely to have used healthcare. Payment structure was significantly associated with healthcare use, with rates highest among salaried farmworkers and lowest among those paid by the piece or a combination of hourly/piece pay. Bivariate associations were comparable for both fiscal year strata.

Multivariate Analysis Predicting Healthcare Use

Initial logistic regression modeling was performed in SPSS (SPSS, 2005). For 2006/2007, the model fit significantly better than the null (χ^2 (df=24) =804.34, p <.001) and accounted for 33% of the variance in use of U.S. healthcare services (Nagelkerke R^2=.327). Results were similar for the 2008 model (χ^2 (df=24) =503.97, p <.001; Nagelkerke R^2=.299). Multicollinearity was not substantial for the specified models (variance inflation factor (VIF) = 1.49 and 1.43 for 2006/2007 and 2008, respectively). Estimates of clustering at level two and three are presented in Table 13. Median odds ratios (MOR) were used to estimate clustering because they provide a more appropriate measure than the intraclass correlation for logistic regression models (Merlo et al., 2006). MORs for level two and level three clustering were calculated from variance components, as outlined by Merlo and colleagues (2006). Level of clustering was moderate and when the full model was estimated for 2006/2007, level 2 variance approximated a MOR of 1.00. It was just slightly higher for the 2008 full multivariate model. Clustering at level 3 was higher across models. Addition of variables (especially those at level 1) substantially reduced the MOR, indicating that the models were well specified. Results from the multilevel population-average models with robust standard errors are presented in Table 14.

Individual level characteristics. Farmworkers who were female, moderately proficient in English (vs. LEP), and/or non-migrant (vs. shuttle migrant) were significantly more likely to have used healthcare in the previous two years, as were those who had a lifetime diagnosis of a chronic

disease, and/or owned a vehicle in the U.S. In fiscal years 2006/2007, those with a green card or other work authorization (vs. unauthorized) and non-migrant farmworkers (vs. follow-the-crop migrant) were significantly more likely to have used healthcare. Additionally, farmworkers who had not sought healthcare outside the U.S. in the last two years were significantly more likely to have used U.S. healthcare for fiscal years 2006/2007. In fiscal year 2008, U.S. citizens were significantly more likely than those with a green card or other work authorization to have used healthcare. No other individual level variables were significantly associated with the outcome when only level one variables were entered into the model.

Environmental level characteristics. When all three levels were entered into the model simultaneously, only living in a non-border county (fiscal years 2006/2007) and total FTEs (fiscal year 2008) were significantly associated (both positively) with U.S. healthcare use. When only level three variables were entered into the model, total FTEs was positively and significantly associated with the outcome (coefficient = 0.00, OR= 1.00 (95% CI: 1.00, 1.01), *p*=.032) for fiscal years 2006/2007. Working in a non-border county was positively and significantly associated with the outcome for fiscal year 2008 when only level three variables were entered into the model (coefficient = 1.02, OR= 2.77 (95% CI: 1.08, 7.10), *p*=.035), as was distance to the nearest FQHC (coefficient = 0.00, OR= 1.00 (95% CI: 1.00, 1.01), *p*=.04) when only this level two variable was entered into the model.

Policy level characteristics. Insured farmworkers were significantly more likely to have sought healthcare in the preceding two years. In 2006/2007, salaried farmworkers were significantly more likely to have used healthcare than those paid an hourly wage or by the piece/combination. Workers compensation was not significantly associated with the outcome in the full model, nor when only level one variables were modeled.

Moderation of Environmental Level Variable Associations with Healthcare Use

     Individual level moderators. Table 15 contains information on individual level moderators of relationships between the environmental level variables evaluated in multilevel modeling (i.e., distance to nearest FQHC, total FQHC FTEs, rurality, and border proximity) and healthcare use. The table only includes variables that moderated at least one environmental level variable when full model estimation was performed. Although education moderated several relationships during full model estimation, interaction effects could not be estimated for those with less than six years of education because population-average effects were not generated. Four variables moderated the relationship between distance to nearest FQHC and healthcare use after controlling for variables at all levels of analysis: educational attainment, country of origin, immigration status, and access to transportation. The relationship was non-significant for those who had completed at least ninth grade but was significant and negative for those with a sixth through eighth grade education. The relationships were significant for both U.S. and foreign-born farmworkers but they were positively and negatively associated with the outcome, respectively. The relationship was significant and negative for unauthorized immigrants but was non-significant for the other two immigration status categories. Similarly, the relationship was significant and negative for farmworkers who didn't own a car in the U.S. (it was non-significant for car owners). When only distance to nearest FQHC was entered into the model, sex and income moderated the relationship between that variable and healthcare use; relationships for females and those making at least $22,501 were significant and positive (they were non-significant for males and the other income categories).

     Age and income moderated the relationship between total FTEs and healthcare use. The relationship was non-significant for farmworkers who were 41 years of age or younger but was significant and positive for those at least 42 years old. Among farmworkers making $16,250-22,500, the relationship was significant and positive but was non-significant for the other income

categories. Only educational attainment moderated the relationship between rurality and healthcare use; while the relationship was non-significant for those with sixth through eighth grade educational attainment, it was significant and negative among those with at least a ninth grade education.

Numerous variables moderated the relationship between not living in a border county and healthcare use. The relationship was non-significant for farmworkers younger than 28 years old but was significant and positive for those 28-41 years of age, as well as for those at least 42 years old. The relationship was significant and positive among those with at least a ninth grade education but non-significant for those with sixth through eighth grade educational attainment. Similarly, a positive and significant relationship was observed for males, while no significant relationship was observed for females. Immigration status moderated the relationship between border proximity and use of healthcare, with positive and significant relationships observed for citizens and those with green cards or other authorization but no relationship observed for unauthorized farmworkers. The relationship was positive and significant for non-migrant farmworkers; it was non-significant for migrant farmworkers.

There were no significant interactions for barriers to care. Interaction effects (using full model estimation) could not be estimated for the following variables because population-average effects were not generated for one or more strata: marital status, race/ethnicity, English proficiency, health status, and use of healthcare outside the U.S. However, when only distance to nearest FQHC was included in the models for these variable strata, evidence of interaction emerged for three of them. The relationship between distance to nearest FQHC delivery site and healthcare use was significant and positive for non-Hispanic individuals (coeff=.00, OR=1.00, p=.03) and non-significant for Hispanic individuals. Similarly, the relationship was significant and positive for those who had been diagnosed with a chronic disease (coeff=.00, OR=1.00, p=.01) but not for those without a diagnosis. The relationships were significant for proficient

(coeff=.00, OR=1.00, *p*=.04) and LEP (coeff=-.00, OR=1.00, *p*=.01) farmworkers, but the directions of those relationships were opposite. The relationship was non-significant for those with moderate proficiency.

   Policy level moderators. Table 16 contains information on policy level moderators of the relationships between environmental level variables evaluated in multilevel modeling (i.e., distance to nearest FQHC, total FQHC FTEs, rurality, and border proximity) and healthcare use. Only rurality and border were moderated by the evaluated policy level factors. The relationship between rurality and healthcare use was significant and negative for both insured farmworkers and those who receive workers compensation. The relationship was non-significant for the uninsured and for those without workers compensation coverage, it was positive and significant. The relationship between being a non-border county and healthcare use was significant and positive for those with workers compensation but non-significant for those without that coverage.

   Environmental level interactions. For workers in fiscal years 2006/2007, their employers were nearest 263 unique delivery sites (affiliated with 135 grantees). Among those sites, 76.4% were community-based primary care clinics, 12.2% operated part-time, and 40.7% of their affiliated grantees were migrant health center grantees. For workers in fiscal year 2008, their employers were nearest 198 unique delivery sites (affiliated with 105 grantees). Among those sites, 78.3% were community-based primary care clinics, 15.7% operated part-time, and 45.7% of their affiliated grantees were migrant health center grantees. None moderated the relationship between distance and healthcare use.

Comparison with 2006 Medical Expenditure Panel Survey Rates

   Nearly one-third of the MEPS sample had not used medical care in the previous 12 months, a rate significantly lower than that for the farmworker population. Similarly, low income MEPS participants had significantly lower rates than farmworkers of no use. However, rates of

no use were significantly higher for Hispanic participants, as well as for participants in the

farmworker comparison group.

DISCUSSION

This study sought to characterize the use of healthcare in a nationally representative sample of United States farmworkers. Just over half of farmworkers used healthcare during the previous two years, a rate similar to those reported in some previous studies of farmworker healthcare use (Littlefield & Stout, 1987; Rose & Quade, 2006; Slesinger & Cautley, 1981; Villarejo et al., 2000), as well as for the U.S. Hispanic population (Ezzati-Rice et al., 2008), although timeframe and other methodological differences make direct comparison challenging. Farmworker rates of healthcare use appear to be lower than those for the U.S. non-Hispanic white population (Ezzati-Rice et al., 2008). When rates of no healthcare use among farmworkers in the current study were compared to the rates for U.S. and other subpopulations, the data suggested that while farmworkers' rates of healthcare use are disproportionately low, they may be equivalent to (or even higher than) those with similar sociodemographic characteristics. Still, given the disproportionate disease burden facing the farmworker population, the low rate of healthcare use is concerning.

Factors Associated with Healthcare Use among Farmworkers

> *Perceived barriers to care.* Although rates of healthcare use are low for U.S. farmworkers, fewer than half reported that they had experienced difficulty when seeking medical care. Cost was the most frequently endorsed barrier, one that has been cited as a significant barrier to care in several studies conducted with farmworkers (Goertz et al., 2007; Goldsmith & Sisneros, 1996; Lantz et al., 1994; Littlefield & Stout, 1987; Rose & Quade, 2006). Farmworker report of language differences (Goertz et al., 2007; Rose & Quade, 2006), poor transportation (Goldsmith & Sisneros, 1996; Lantz et al., 1994; Perilla et al., 1998; Rose & Quade, 2006), not knowing where to go for healthcare (Goertz et al., 2007; Perilla et al., 1998; Rose & Quade, 2006), lack of services in area (Perilla et al., 1998), fear of job loss (Rose & Quade, 2006),

and fear of immigration officials (Perilla et al., 1998) have been identified as barriers in previous studies. However, related barriers were endorsed by less than 10% of farmworkers in the current study.

Numerous individual, environmental, and policy level factors were associated with healthcare use in bivariate and multivariate analyses. In bivariate tests of association for the full sample, all but two factors were significantly associated with the outcome and in the expected direction (rurality and distance to the nearest FQHC delivery site were associated but not in the expected direction). Many factors remained significant predictors in multivariate models and were consistent with findings from other healthcare utilization studies.

Individual level characteristics associated with healthcare use. When bivariate associations were tested for the full sample, all individual level factors were significantly associated with the outcome in the hypothesized direction. In either or both multilevel multivariate models, sex, immigration status, English language proficiency, migrant status, lifetime diagnosis of a chronic disease, and access to transportation were significantly and independently associated with the outcome. Use of care outside the U.S., a factor controlled for in multivariate analyses, also was significantly, independently, and negatively associated with healthcare use. Consistent with previous studies of farmworkers (Littlefield & Stout, 1987; Slesinger & Cautley, 1981; Villarejo et al., 2000) and Hispanics (Cabassa et al., 2006), female farmworkers used significantly more healthcare than did male farmworkers. Being female was one of the strongest predictors of healthcare use in the current study, with odds ratios of 3.24 and 3.78 in 2006/2007 and 2008 multivariate models, respectively.

Higher rates of healthcare use were reported by those with a green card or other work authorization (vs. unauthorized immigrants) and by U.S. citizens (vs. those with a green card or other work authorization) in the 2006/2007 and 2008 multivariate models, respectively. With an odds ratio of 3.36, the latter finding made immigration status one of the strongest predictors in the

model. While the impact of immigration status on healthcare use has not been studied among

farmworker populations, Hispanics who are U.S. citizens use more healthcare than do non-U.S.

citizens (Callahan et al., 2006; Ortega et al., 2007). Such findings may reflect poorer labor

protections provided to undocumented immigrants (Passel et al., 2004) or fear of immigration

consequences (Berk & Schur, 2001). Fear of immigration officials was cited as a barrier to

seeking medical care by farmworkers in one study (Perilla et al., 1998).

Barriers to insurance faced by both non-citizens may provide additional explanation for

the observed disparities in healthcare use. Rates of health insurance coverage among Hispanics

have been found to be lowest for undocumented individuals, followed by those with a green card

(Ortega et al., 2007). Reducing the many barriers to public (Fremstad & Cox, 2004) and

employer-sponsored (Buchmueller et al., 2007) coverage that immigrants face, and improving

immigration policy, may increase healthcare use for this population. Creating change in

immigration policy is a complicated issue. However, more pathways to citizenship and/or legal

status are needed for unauthorized workers if their access to care in the U.S. and/or Latin

American countries is to be improved. Solutions should be generated via partnerships between

the U.S. and countries providing the immigrant workers. In the meantime, the public healthcare

sector must enhance their outreach for vulnerable immigration groups and inform them that there

won't be immigration consequences for seeking care in their medical settings. Given that U.S.

citizens are a small minority of the farmworker population, making such changes would likely

result in a considerable improvement in access to care for farmworkers.

English language proficiency was a significant and moderate predictor of healthcare use

in both multivariate models; farmworkers who had moderate proficiency reported higher rates of

use than those with limited proficiency. English proficiency was a significant correlate of

healthcare use in one other study of farmworkers (Slesinger & Cautley, 1981) and farmworkers,

including those in the current study, have reported that language is a barrier to receiving medical

care (Goertz et al., 2007; Lantz et al., 1994; Rose & Quade, 2006; Villarejo et al., 2000). While LEP has had a negative impact on Hispanics' use of healthcare in many studies, it may not be the strongest barrier to healthcare (Timmins, 2002); findings from the current study corroborate that sentiment. Poor proficiency may impact *quality* of care more than *access* to care. Additionally, proficiency is likely associated with other factors that impact healthcare access, such as immigration and insurance status, fear of deportation for self or family members, stigma, and/or cultural barriers. Improving healthcare services for those with limited proficiency in English would likely improve farmworker use of healthcare but would also undoubtedly improve the quality of that care. This may be especially true in more rural settings, which often lack such tailored services (Casey, Blewett et al., 2004; Torres et al., 2008).

Follow-the-crop and shuttle migrant farmworkers reported lower rates of healthcare use than non-migrants. These effects were moderate in multivariate analyses (i.e., Odds Ratios ranged from 1.94-2.26). Littlefield and Stout (1987) found similar results when they compared rates of healthcare use for those with and without a permanent U.S. residence. Migrant farmworkers may not know where to go for medical care if they are relatively new to a community. Although few farmworkers in the NAWS endorsed this as a barrier to healthcare, it has been described as a barrier elsewhere (Perilla et al., 1998). Additionally, lack of stability in employment and/or residence may interfere with obtaining employer-sponsored insurance or public benefits, both of which would likely improve healthcare use. Clearly, migrant farmworkers are a subpopulation that could benefit from tailored outreach and services.

As with previous studies of Hispanic individuals (Schur et al., 1995), having a chronic disease diagnosis was associated with healthcare use. In fact, in both multivariate models, it was the strongest predictor of healthcare use, with an odds ratio of 5.25 and 6.68 in 2006/2007 and 2008 multivariate models, respectively. While these findings suggest that need for medical care is a strong predictor of healthcare use, the measure of need asked explicitly about *diagnosis* of

disease. Given that the data are cross-sectional, direction of this relationship (i.e., need causing use) cannot be assumed. However, because the measure of health status was for lifetime diagnosis of chronic disease, it is likely that at least some farmworkers with a chronic disease were diagnosed more than two years prior to survey administration.

Although few farmworkers cited lack of transportation as a barrier to healthcare, having a vehicle was a significant, though moderate, predictor of healthcare use in both multivariate models. Access to transportation can be a critical factor in determining use of medical care, especially in non-urban settings (Probst et al., 2007), and farmworkers have reported that transportation issues interfere with receiving medical care (Goldsmith & Sisneros, 1996; Lantz et al., 1994; Perilla et al., 1998; Rose & Quade, 2006). Providing transportation to medical services (and/or using more mobile health clinics) may improve use of healthcare for the nearly half of farmworkers who do not own a car in the U.S.

Environmental level characteristics associated with healthcare use. Due to multicollinearity, only four environmental level variables were included in the multivariate models, two of which were significantly and independently associated with healthcare use. Total FQHC FTEs was significantly and positively associated with healthcare use in 2008, though this effect was quite modest. The other healthcare resource variables were significantly associated with healthcare use in the bivariate tests of association for the full sample and 2006/2007 fiscal years. Similar findings have been reported for other populations, including a study conducted by Hadley, Cunningham, and Hargraves (2006), which demonstrated that higher community CHC capacity improved access to care for Spanish-speaking Hispanics. The present study was the first to test the association between healthcare resources and healthcare use by farmworkers.

Although the findings for healthcare resource impact are promising, in that they suggest that FQHC resources may improve healthcare use, only total FTEs and FQHC density were associated with healthcare use in 2008 bivariate tests, and the effect of total FTEs on healthcare

use in the 2008 multivariate model was quite modest. In addition, in tests of interactions, the effect of total FTEs was only significant for older and middle-income farmworkers. Moreover, contrary to hypothesis, distance to nearest FQHC delivery site was positively associated with healthcare use in bivariate analyses. These findings are especially surprising given that FQHC healthcare resources were substantially higher for NAWS counties than for U.S. counties overall (see Table 5), the nearest FQHC was an average of just a little over 10 miles from each grower, and approximately half of the nearest FQHC delivery sites were affiliated with migrant health centers.

These disappointing findings may suggest that some unmeasured characteristics of the counties overrode (and/or explained the strong bivariate effect) of resources on healthcare use. After all, FQHCs are disproportionately located in areas of medical need. Perhaps the FQHCs with greatest resources also had the greatest burden on their facilities. The nearly null findings also could reflect differential receipt of other forms of revenue (e.g., Medicaid) for FQHCs— something unmeasured in the current study and that could be associated with other unmeasured community factors. The findings could also reflect differential levels of other forms of healthcare systems (e.g., private medical care) in certain regions. Certain facility types likely play different roles in different regions. Future studies should descriptively examine differential levels of community demographics and need and healthcare resources (including non-public forms of healthcare) across counties.

These findings also may suggest that while FQHC delivery sites and healthcare resources (even those specific to the farmworker population) are highly concentrated in places of great need, FQHCs are not adequately overcoming the other barriers to care that farmworkers face. Indeed, nearly half of farmworkers who sought medical care in the previous two years had their last medical visit in a private physician's office or private clinic. FQHCs are well equipped to serve the farmworker population but it appears that changes in the way that FQHCs provide

outreach and services to farmworkers are needed to help them overcome the aforementioned individual level barriers (e.g., limited proficiency in English, non-U.S. citizenship, lack of transportation).

Farmworkers working near the U.S.-Mexico border reported significantly lower rates of U.S. healthcare use, similar to what was found in a study of mammography adherence among female farmworkers (Palmer et al., 2005a). Such findings may reflect lower acculturation among those working near the U.S.-Mexico border, which was associated with adherence to mammography recommendations for female farmworkers (Palmer et al., 2005a). Farmworkers working and/or living near the border may seek medical care in Mexico (Wallace, Mendez-Luck, & Castaneda, 2009). Numerous studies have found that relatively high numbers of border-dwelling Hispanics (Ortiz et al., 2004) and of U.S. farmworkers (Littlefield & Stout, 1987; Quandt et al., 2007; Villarejo et al., 2000) seek medical care in Mexico. Use of care outside the U.S. was significantly associated with decreased healthcare use in the current study's multivariate models. Use of care outside the U.S. could be capitalized upon to address the issue of poor access to care for immigrant populations and farmworkers. For example, binational health coverage, where burden of coverage and care is shared by entities on both sides of the U.S.-Mexico border (i.e., private insurers in the U.S. and public providers in Mexico), has been discussed as a solution. This is an especially promising solution for documented immigrants living near the U.S.-Mexico border.

Although it was not associated with the outcome in multivariate models, rurality was positively associated with healthcare use in bivariate analyses, contrary to hypothesis. While barriers to care for rural minorities are well documented (Casey, Blewett et al., 2004; Cristancho et al., 2008) and have resulted in lower healthcare access (Berdahl et al., 2007; Casey, Davidson et al., 2004), rural residence is not always associated with poorer access to care (Cabassa et al., 2006; Mainous et al., 2004). This finding may in part reflect the fact that FQHCs are

disproportionately located in rural areas (Health Resources and Services Administration, 2009). Interestingly, in the three interactions for rurality, the relationship between rurality and healthcare use was in the expected direction for farmworker subpopulations at lower risk for having poor access to healthcare (i.e., insured, had workers compensation, and had at least a ninth grade education). The relationship was either non-significant or positive for the other groups. More research is needed to understand how rural residence impacts farmworker healthcare use.

Policy level characteristics associated with healthcare use. Insurance status and payment structure were both significantly and independently associated with healthcare use. Workers compensation was only related to healthcare use in bivariate associations. Health insurance was strongly associated with healthcare use in the current study, consistent with previous studies on mammography adherence among female farmworkers (Palmer et al., 2005b) and other populations (Buchmueller et al., 2005; Hargraves, 2004). In fact, uninsurance has been cited as a barrier to healthcare for farmworkers (Goertz et al., 2007; Rose & Quade, 2006). Unfortunately, only about one-third of the sample reported being insured, consistent with rates reported in a study of California farmworkers (Villarejo et al., 2000). Rates of healthcare use among salaried farmworkers were significantly higher than those paid an hourly or piece/combination wage in the 2006/2007 multivariate analysis.

The bivariate and multivariate associations for policy level variables are likely related to cost of medical care, which was the most frequently reported barrier in the current study. Having health insurance and/or workers compensation insurance reduces medical costs, while payment by salary is more stable and is often associated with higher wages. Payment structure also likely relates to other barriers to care reported by farmworkers in previous studies: fear of job loss (Rose & Quade, 2006), lack of time (Goldsmith & Sisneros, 1996; Lantz et al., 1994; Littlefield & Stout, 1987), and the need to stay at work to make money (Lantz et al., 1994). These factors are also likely associated with other barriers/facilitators to healthcare, such as stability in

employment, job task, migrant status, and immigration status. Because few farmworkers are paid via salary and/or have health insurance, improving treatment of workers not paid via salary and insurance policies, will likely result in substantially improved access to care for farmworkers. There are several possible approaches to improving insurance coverage for farmworkers. Mandating employer-sponsored coverage would likely prove challenging, as would vast expansion of public benefits. Binational health coverage, discussed above, provides a promising alternative, especially for documented immigrants living near the U.S.-Mexico border. It is also critical to augment changes in insurance policy with programs targeting undocumented immigrants, who would likely be left out of changes in coverage plans. The public healthcare sector, and the FQHC system in particular, are well suited for this task, as long as the aforementioned outreach efforts are enhanced.

Limitations

Use of cross-sectional data limits interpretation of findings, since causality cannot be inferred. Due to the sampling scheme, only working farmworkers were recruited. Thus, farmworkers not at work due to illness, injury, or disability were not included in the NAWS, likely yielding a sample with unique characteristics relevant to healthcare utilization. Similarly, employers who agreed to have their workers participate in the study were likely different from those who did not on relevant labor practices, such as hiring/treatment of undocumented immigrants and workplace policies (e.g., insurance, workers compensation, payment structure). Although the sophisticated sampling scheme and application of post-sampling weights greatly enhance the generalizability of findings to the national farmworker population, bias is likely due to these sampling procedures.

Because the NAWS was not designed to measure all aspects of healthcare access and utilization, this study's characterization of farmworker health services use is incomplete. Volume of visits, regular source of healthcare, purpose for the most recent healthcare visit, and unmet or

perceived need were not measured in the NAWS. Also, farmworkers may not remember whether or not they used healthcare in the past two years, where they sought healthcare, and/or how they paid for it, given the two year timeframe used in the NAWS. Still, despite the lack of psychometric data for this healthcare use measure, the study's findings suggest that the item is valid (e.g., lifetime diagnosis of a chronic disease and age were strong predictors of use). The use of a two year timeframe was problematic for comparison of healthcare use between farmworkers and comparison groups from the MEPS, which used a (more common) 12 month timeframe. Because the two were not directly comparable, rates of *no* use were compared. Still, because the items are not directly comparable, findings should be interpreted with caution. A high proportion of cases had missing data for one or more variables and patterns for missing data were observed. However, descriptive/bivariate tests of association were comparable prior to and following imputation and case deletion.

There were several measurement issues at the environmental level. Euclidean (i.e., straight line) distances were used to calculate distance to nearest FQHC delivery site. Other geographic features (e.g., mountains) can be taken into account when estimating proximity (ESRI, 2009a). Future studies should examine the impact of both forms of proximity on healthcare use. In addition, the counter-intuitive findings for distance and use of health care services may be due to the fact that grower addresses, rather than farmworker residences, were used when estimating proximity to nearest FQHC. However, given the relative residential instability in the population, workplace is likely a better proxy for residence than it would be for other groups.

FQHC healthcare resources were aggregated to the county in which the grantee was located. However, affiliated delivery sites (which may or may not be in the same county) receive those funds. The UDS only provides resources for the grantee and not for individual delivery sites. Measure of FQHC resource impact would be greatly enhanced if distribution of resources

to delivery sites were reported as well. Another limitation is that resources from other forms of healthcare (e.g., hospital systems, voucher programs, private physician's offices) were not included in the current study. Perhaps the impact of healthcare resources and proximity would have been stronger had these additional measures been incorporated. Future studies should explore the impact of such factors on healthcare use among farmworkers, especially given that the majority of farmworkers who sought healthcare reported that they received that care in private doctor's offices/clinics, community health centers, hospitals, or emergency rooms.

The fact that area level variance (reflected in the MOR) accounted for more variance than some of the model's specified factors suggests that more research into higher-level factors that influence healthcare use for this population is needed. Moreover, we identified potential moderators of relationships between environmental level factors and healthcare use. Future studies should continue to explore how and why farmworker subpopulations are differentially affected by certain community level factors. The denominator for healthcare resources was imperfect; farmworker population size had to be imputed for one county. In addition, the estimates did not include farmworkers who had not worked in agriculture that year (in that county), nor did they account for farmworkers who live in one county but work in another, thereby underestimating the migrant farmworker population. Additionally, FQHCs provide care to a number of vulnerable groups besides farmworkers. A denominator based on total population living in poverty could have provided a superior estimate of demand. However, given the high mobility of the population, as well as the disproportionate sampling within counties with sizable farmworker populations, the estimates are likely a fair proxy for resource demand. Evidence of the latter lies in the fact that approximately half of the nearest FQHC delivery sites were affiliated with migrant health centers.

There were measurement issues for policy level variables as well. Categories of insurance coverage were not mutually exclusive in the NAWS, due to the fact that insured

farmworkers are often covered by a variety of sources, in part due to employment and residential fluctuations. While this made it a more valid measure of farmworker insurance status, it posed a challenge for looking at the impact of insurance *type* on healthcare use, an approach suggested by Buchmueller and colleagues (2005). In addition, the current study did not account for the endogeneity inherent in the relationship between insurance and healthcare utilization (Buchmueller et al., 2005). To fully understand how insurance status impacts healthcare utilization for this population, future studies should assess impact of insurance type and incorporate statistical methods that account for endogeneity.

Workers compensation was the only policy level factor not associated with the outcome in multivariate analysis. This could, in part, be due to a lack of validity for the survey item. Farmworkers may be hesitant to acknowledge a lack of this labor protection in their workplace. They also may not know whether the insurance is provided. However, we ran a two-level unconditional logistic regression model in HLM (Raudenbush et al., 2000) to assess variance explained in workers compensation by employer and it was quite high (MOR=4.10). This suggests good concordance among workers regarding their employers' workers compensation policies. Perhaps the lack of an effect for workers compensation reflects the fact that one needs to have been injured while working to claim workers compensation, thereby narrowing the relevance of the association to a select few. Moreover, many workers reject such benefits even when the claim is within their rights (Rosenman et al., 2000). Barriers to claiming workers compensation may be particularly high for vulnerable worker groups (Gleeson, 2008). Future studies should examine the issue of workers compensation in more detail by inquiring about workplace injury and whether an attempt to file a workers compensation claim was made, rather than simply whether or not employers provide coverage.

Finally, it was outside the scope of the current study to assess the impact of public policy on healthcare use among farmworkers. Studying the impact of local, state, and national policy

decisions would provide a more comprehensive understanding of farmworker healthcare use and would likely have implications for large-scale changes that could be implemented to improve service delivery to this vulnerable population.

Strengths

This is the first comprehensive study examining correlates of health services use among a national sample of farmworkers. The NAWS sampling strategy and application of post-sampling weights further enhance the generalizability of the study's findings to the national farmworker population. Correlates examined were selected based on a widely used health services model (Andersen, 1968) that has been tailored for use with vulnerable populations (Gelberg et al., 2000). This study also provides the first systematic analysis of association between community healthcare resources and farmworker healthcare use. Use of multilevel modeling to account for clustering adds to the validity of the findings.

Conclusions

Despite high disease burden for the farmworker population, rates of healthcare use are low. Numerous factors were associated with healthcare use in bivariate and multivariate models, highlighting areas for potential intervention. Factors that were independently associated with healthcare use correspond with the BMVP (Gelberg et al., 2000) (i.e., sex, immigration status, English language proficiency, and migrant status are "predisposing characteristics," access to transportation, healthcare FTE resources, proximity to border, insurance, and payment structure are "enabling characteristics," and lifetime diagnosis of a chronic disease reflects "need"). Thus, although the BMVP was not assessed in its entirety, the model's constructs are relevant to the farmworker population. More research on farmworker healthcare use is needed and future studies would benefit from incorporating the model's constructs into study design and analyses. Our understanding of the relevant issues would be further enhanced with study of usual source of care,

purpose, and volume of visits; more comprehensive study of healthcare resource predictors; and local, state, and national policy.

Although more research is needed, numerous areas for intervention were identified by the current study's findings. Farmworker subpopulations at greater risk for poor access to care were identified. To improve their access to care, outreach efforts should target farmworkers who are male, non-U.S. citizens, migrant, and who have limited English language proficiency. In addition to suggestions made throughout this discussion, a plan for affordable healthcare is needed. FQHCs provide low-cost or free medical services, regardless of citizenship status. However, many farmworkers in the current sample reported using private sources of care. Tests of interactions suggested that community factors and FQHC healthcare resources are more important determinants of healthcare use for farmworkers facing fewer barriers to care (e.g., more educated, insured, non-migrant, citizens or those with green cards). For those with more substantial individual level barriers, the impact of community factors appears to be minimal. The exception was for distance to nearest FQHC, where being a shorter distance from an FQHC was associated with increased use of care for the more vulnerable groups (e.g., unauthorized, foreign born, no transportation access). For several groups with fewer barriers (e.g., U.S. born, those in the highest family income category) and in the overall bivariate tests of association, greater distance was associated with more healthcare use. Still, across all analyses, significant relationships between proximity to FQHC delivery site and healthcare use were quite modest.

Taken together, these findings suggest that helping farmworkers overcome their individual level barriers is a critical step if healthcare resources are to be maximized. An increase in resources provided to the public healthcare sector is needed, as are efforts by the public healthcare sector to educate farmworkers about their services. However, based on this study's findings, doing so will not entirely resolve the disparities in healthcare observed. Affordable health insurance is needed and the plan must address persons who are undocumented, income

and/or employment fluctuation, and inconsistent residence. Farmworkers, safety net providers and administrators, researchers, policymakers, farmworker advocacy groups, and agricultural employers on both sides of the U.S.-Mexico border need to work together to move such changes forward. These efforts will likely improve farmworkers' healthcare use and in turn, reduce the observed disparities in disease burden and mortality for this vulnerable population.

TABLES

Table 1. Health risks and conditions of farmworkers: comparison with non-agricultural populations

Health Issue	Farmworker Risk[a]	Farmworkers vs. Others (comparison group type in parentheses)[c]
Cancer	**Morbidity:** (+/-)	Farmworker morbidity OR: leukemia (1.6), stomach (1.7), uterine cervix (1.6), & uterine corpus (1.7); breast (0.8) & colon (0.8); later stage of diagnosis for most sites (vs. U.S. Hispanic)[8]
	Survival: (+/-)	All cancer sites: male crude survival lower for farmworkers (vs. U.S. Hispanic)[5]; Farmworker PMRs[b] = 0.9 (vs. U.S Hispanic) & = 0.8 (U.S.)[9]
Diabetes	**Morbidity:** ($\approx$)	Farmworker prevalence = 2.0%[13] vs. 6.5% (vs. U.S. Hispanic & U.S.)[4]
	Mortality: (+/-)	Farmworker PMR[b] equivalent with U.S. Hispanic; = 1.8 (vs. U.S.)[9]
Heart disease	**Morbidity:** ($\approx$)	Farmworker prevalence = 0.8%[13] vs. 2.2% for ischemic heart disease (blue collar workers)[1]
	Mortality: (-)	Farmworker PMR[b] = 0.8 (vs. U.S. Hispanic) & 0.8 for ischemic heart disease (vs. U.S.)[9]
Hypertension or cholesterol	**Morbidity:** (+)	Hypertension: farmworker males ages 35-44 prevalence = ~32% vs. ~20% (U.S.)[15]
		Cholesterol: Farmworker males ages 35-44 prevalence = ~25% vs. ~20% (U.S.)[15]
Injury	**Incidence:** (+)	9.3/100 FTE farmworkers[7] vs. 5.9/100 FTE workers (for all U.S. private industries)[14]
	Mortality: (+)	Farmworker PMR[b] for unintentional injury = 1.5 (vs. U.S. Hispanic)[9]
		Farmworker PMR[b] for transportation-related =1.8 & other = 1.2 (vs. U.S.) injuries[9]
Overweight	**Prevalence:** (+)	Male farmworker prevalence = 81% vs. ~65% (U.S. Hispanic) & = ~60% (U.S.)[15]
Pesticides	**Exposure:** (+)	Farmworker median 4-Dimethylaminopyridine higher than among U.S. (219.2 vs. 20.8)[12]
Skin disease	**Morbidity:** (+)	Farmworker prevalence = 79.7% skin disease dx[6] vs. 17.2/10,000 (general agricultural workers)[11]
Smoking	**Prevalence:** ($\approx$)	Farmworker prevalence = 24.6%[13] vs. 23.5% (U.S.)[3]
Tuberculosis & respiratory disease	**Morbidity:** (+)	Farmworker TB prevalence = 24%[10] vs. 8/100,000 (U.S.)[2]
		Farmworker respiratory disease prevalence = 13.8-18.7%[13] vs. 5.2% (blue collar workers)[1]
	Mortality: (+/-)	Farmworker TB PMR[b] = 2.6 (vs. U.S. Hispanic) & = 6.0 (vs. U.S.)[9]
		Farmworker respiratory disease PMR[b] equivalent with U.S. Hispanic & 0.9 (vs. U.S.)[9]

[a]Comparison evidence: + (risk greater for farmworkers); - (risk lower for farmworkers); $\approx$ (risk approximately equivalent); and +/- (evidence mixed).
[b]PMR=Proportionate Mortality Rate
[c]Table References: [1]Brackbill, Cameron, & Behrens, 1994; [2]Centers for Disease Control and Prevention, 1997; [3]Centers for Disease Control and Prevention, 2001; [4]Cowie et al., 2006; [5]Dodge et al., 2007; [6]Krejci-Manwaring et al., 2006; [7]McCurdy et al., 2003; [8]Mills & Kwong, 2001; [9]Mills et al., 2006; [10]J. E. Poss & Rangel, 1997; [11]Rautiainen & Reynolds, 2002; [12]Salvatore et al., 2008; [13]Steege, Baron, & Chen, 2009; [14]U.S. Department of Labor & Bureau of Labor Statistics, 2000; [15]Villarejo et al., 2000

Table 2. Health services use among farmworker, U.S. Hispanic, and U.S. non-Hispanic white populations

Healthcare Use	Farmworker	U.S. (Hispanic)	U.S. (non-Hispanic white)
All			
Never	3.6% - 31.8% [3, 8, 12]		
Last 2 years	48.4% - 73.6% [8, 12]		
Last year	~32% - 57.0% [3, 8, 9, 12]	53.2% [1]	75.7% [1]
Preventive			
Never	Physical exam: 30.3% [9] Pap: 28% [2] Mammogram (50 yo+): 61% [2]	Mammogram (40 yo+): 15.4% [10]	Mammogram (40 yo+): 9.1% [10]
Last 2 years	Mammogram: 38% -59.0% [5, 6]	Pap: 84.4% (last 3 yrs) [11] Mammogram (40 yo+): 62.7% [10]	Pap: 86.5% (last 3 yrs) [11] Mammogram (40 yo+): 72.6% [10]
Last year	Physical exam: 28.0% [9]	General checkup: 26.1 [1]	General checkup: 46.2 [1]
Dental			
Never	16% - 57.1% [7, 8, 9, 12]		
Last 2 years	~15% [12]		
Last year	~14% - 47.2% [3, 7, 9, 12]	28.9% [4]	49.4% [4]

[1]Ezzati-Rice & Rohde, 2008; [2]Goldsmith & Sisneros, 1996; [3]Littlefield & Stout, 1987; [4]Manski & Brown, 2007; [5]Palmer et al., 2005b; [6]Palmer et al., 2005a; [7]Quandt et al., 2007; [8]Rose & Quade, 2006; [9]Slesinger & Cautley, 1981; [10]Soni 2007a; [11]Soni 2007b; [12]Villarejo et al., 2000

Table 3. Study variables and their correspondence with theoretical models

Variable Under Investigation	EM Level	BMVP Domain
Sociodemographic (e.g., age, sex, marital status)	Individual	Traditional Predisposing
Educational attainment	Individual	Traditional Predisposing
Race/ethnicity and country of origin	Individual	Traditional & Vulnerable Predisp.
Immigration status	Individual	Vulnerable Predisposing
English language proficiency	Individual	Vulnerable Predisposing
Migratory lifestyle	Individual	Vulnerable Predisposing
Income	Individual	Traditional Enabling
Health status	Individual	Traditional & Vulnerable Need
Transportation	Indiv/ Environmental	Vulnerable Enabling
Availability of Federally Qualified Health Centers	Environmental	Traditional Enabling
Additional healthcare resources	Environmental	Traditional Enabling
Rurality and border proximity	Environmental	Traditional Enabling
Insurance, workers comp, & pay structure	Work/Other Policy	Traditional Enabling

Table 4. Grantee, delivery site, and grower geocoding results

Geocoding Type	Matched	Tied	Unmatched	Rematched[a]	Score range[b]	Mean Score (SD)[b]
2005 grantees *(945 eligible)*	912	33	7	0	72-100	96.74 (6.74)
2006 grantees *(994 eligible)*	967	27	8	0	72-100	96.91 (6.53)
2005 delivery sites *(5680 eligible)*	5487	169	47	24	72-100	97.88 (5.51)
2006 delivery sites *(6113 eligible)*	5908	177	54	28	70-100	97.71 (5.69)
FY 06/07 growers *(644 eligible)*	626	12	6	6	74-100	97.55 (5.90)
FY 08 growers *(449 eligible)*	438	10	1	1	74-100	97.58 (5.90)

[a]Grantees/sites in Guam, Virgin Islands, Micronesia, American Samoa, Marshall Islands, & Palau left unmatched.
[b]Score range and means (SD) exclude sites not rematched in interactive rematch.

Table 5. County FQHC healthcare resources (raw figures)

FQHC Healthcare Resource	Mean 2005	SD	Mean 2006	SD
All U.S. Counties (n=3219)				
Delivery sites[a]	1.76	6.66	1.90	7.05
Section 330 funds[b]	465,293.18	1,782,857.44	491,496.17	1,869,417.07
FTE physicians[b]	2.19	10.14	2.35	10.95
Total FTEs[b]	27.93	128.95	30.17	140.10
NAWS Counties (n=163)[c]				
Delivery sites	4.74	11.08	6.81	15.57
Section 330 funds	1,605,197.60	3,816,464.49	2,191,848.40	5,145,013.53
FTE physicians	7.74	18.58	11.05	26.10
Total FTEs	108.24	307.53	161.54	427.77

[a]All eligible delivery sites (2005, n=5680; 2006, n=6113); [b]All grantees (2005, n=952; 2006, n=1002)
[c]2005 & 2006 FQHC resources aggregated for counties for NAWS interviews in 2006/2007 (n=134) and 2008 (n=80), respectively.

Table 6. Study variables' level of analysis for Hierarchical Linear Modeling

Variable Under Investigation	HLM Level
Sociodemographic (e.g., age, sex, marital status)	Individual: Level 1
Educational attainment	Individual: Level 1
Race/ethnicity and country of origin	Individual: Level 1
Immigration status	Individual: Level 1
English language proficiency	Individual: Level 1
Migratory lifestyle	Individual: Level 1
Income	Individual: Level 1
Health status	Individual: Level 1
Transportation	Individual: Level 1
Barriers to care; use of care outside U.S.	Individual: Level 1
Insurance	Individual: Level 1
Workers compensation & payment structure	Individual: Level 1
Proximity to nearest FQHC delivery site	Workplace: Level 2
County FQHC FTEs	County: Level 3
Rurality and border proximity	County: Level 3

Table 7. Descriptive data for individual level characteristics

Variable	Proportion (%) or Mean (SE) Full Sample	Proportion (%) or Mean (SE) 2006/2007	Proportion (%) or Mean (SE) 2008
Mean age	35.56 (.34)	34.65 (.42)	37.59 (.55)
Mean income	22,667.95 (304.91)	21,484.97 (344.02)	25,291.39 (582.17)
Mean years education	7.71 (.10)	7.79 (.12)	7.52 (.18)
Sex			
Female	21.64	19.76	25.79
Male	78.36	80.24	74.21
Marital status			
Married	59.84	58.38	63.08
Not married	40.16	41.62	36.92
Race/ethnicity			
Non-Hispanic	19.99	20.32	19.24
Hispanic	80.01	79.68	80.76
Country of origin			
Born in U.S.	25.54	26.16	24.18
Foreign born	74.46	73.84	75.82
Immigration status			
Citizen	29.01	28.51	30.13
Green card/other auth.	20.93	20.57	21.71
Unauthorized	50.06	50.92	48.16
English proficiency			
Proficient	25.36	25.57	24.89
Moderately proficient	25.43	24.81	26.81
Limited English proficiency	49.21	49.62	48.30
Migrant status			
Non-migrant	72.63	70.87	76.54
Follow-the-crop	4.11	4.35	3.56
Shuttle migrant	23.26	24.78	19.90
Health status			
Lifetime dx of chronic disease	7.80	8.13	7.07
No dx of chronic disease	92.20	91.87	92.93
Barriers to care			
No barriers endorsed	58.21	55.80	63.54
Endorsed ≥ 1 barriers	41.79	44.20	36.46
Access to transportation			
Owns car in U.S.	56.22	54.73	59.50
Does not own car in U.S.	43.78	45.27	40.50
Healthcare use outside U.S.			
No use outside U.S.	82.44	81.80	83.85
Use of care outside U.S.	17.56	18.20	16.15

Table 8. Descriptive data for environmental level characteristics

Variable	Proportion (%) or Mean (SD) Full Sample	Proportion (%) or Mean (SD) 2006/2007	Proportion (%) or Mean (SD) 2008
County FQHC delivery sites[a]	--	2.72 (7.82)	3.04 (7.84)
County FQHC Section 330 funds[a]	--	773,846.54 (1,922,217.15)	792,899.38 (1,880,875.66)
County FQHC FTE physicians[a]	--	3.40 (8.77)	4.34 (12.93)
County FQHC total FTEs[a]	--	40.77 (106.42)	56.26 (164.45)
Nearest FQHC (meters)[b]	--	16,797.58 (16,483.77)	16,222.45 (15,956.09)
Rurality[c]	3.67 (2.19)	3.58 (2.23)	3.34 (1.99)
Proximity to U.S.-Mexico border[c]			
≥ 62 miles (non-border county)	95.71%	94.78%	93.75%
< 62 miles (border county)	4.29%	5.22%	6.25%

[a]2005 and 2006 FQHC resource (per 1000 farmworkers in county) figures aggregated for counties
from which farmworkers were sampled in fiscal years 2006/2007 (n=134) and 2008 (n=80), respectively.
[b]Distance to nearest FQHC from employer using 2005 and 2006 FQHC figures for employers
from which farmworkers were sampled in fiscal years 2006/2007 (n=640) and 2008 (n=441), respectively.
[c]Rurality/border figures for 2006-2008 (n=163), 2006/2007 (n=134), and 2008 (n=80) fiscal year counties.

Table 9. Descriptive data for policy level characteristics

Variable	Proportion (%) Full Sample	Proportion (%) 2006/2007	Proportion (%) 2008
Insurance status			
Insured	30.93	28.19	36.98
Uninsured	69.07	71.81	63.02
Workers compensation			
Provided by employer	74.11	70.94	81.14
Not Provided by employer	25.89	29.06	18.86
Payment structure			
Salary	5.38	5.31	5.54
Hourly	85.15	83.50	88.80
Piece/combination hourly-piece	9.47	11.19	5.66

Table 10. Bivariate association of categorical individual level characteristics and health services use

Variable	Design-based Pearson F test & % (95% CI) used healthcare Full Sample	Design-based Pearson F test & % (95% CI) used healthcare 2006/2007	Design-based Pearson F test & % (95% CI) used healthcare 2008
Sex	75.64***	43.26***	34.58***
Female	78.90 (73.94, 83.13)	77.87 (70.84, 83.60)	80.63 (74.06, 85.85)
Male	51.32 (48.59, 54.04)	49.69 (46.33, 53.06)	55.22 (50.62, 59.73)
Marital status	5.59*	4.52*	.70
Married	59.73 (56.84, 62.55)	58.10 (54.49, 61.63)	63.06 (58.26, 67.62)
Not married	53.65 (49.45, 57.79)	51.27 (46.06, 56.44)	59.57 (52.69, 66.09)
Race/ethnicity	125.25***	73.55***	109.60***
Non-Hispanic	85.08 (80.70, 88.60)	82.71 (76.60, 87.48)	90.62 (86.61, 93.52)
Hispanic	50.35 (47.70, 52.99)	48.26 (45.04, 51.49)	54.90 (50.33, 59.38)
Country of origin	126.64***	75.97***	96.68***
Born in U.S.	83.08 (78.65, 86.75)	80.55 (74.50, 85.45)	89.15 (84.66, 92.44)
Foreign born	48.44 (45.79, 51.10)	46.30 (43.11, 49.51)	53.04 (48.37, 57.66)
Immigration status	119.34***	77.69***	55.51***
Citizen	82.82 (78.81, 86.20)	79.56 (73.91, 84.25)	89.67 (85.88, 92.53)
Green Card/other auth.	63.65 (58.92, 68.14)	65.49 (59.97, 70.63)	59.77 (50.80, 68.12)
Unauthorized	39.83 (36.71, 43.03)	37.51 (33.87, 41.30)	45.23 (39.51, 51.08)
English proficiency	121.01***	74.46***	59.81***
Proficient	83.32 (78.83, 87.02)	81.20 (74.99, 86.16)	88.15 (83.47, 91.64)
Moderately proficient	66.96 (62.89, 70.79)	64.53 (59.58, 69.19)	71.92 (64.63, 78.22)
Limited English proficiency	38.87 (35.83, 42.00)	37.25 (33.62, 41.02)	42.55 (37.13, 48.15)
Migrant status	111.74***	71.40***	44.06***
Non-migrant	67.92 (65.39, 70.35)	66.39 (63.17, 69.48)	71.05 (66.99, 74.79)
Follow-the-crop	34.07 (25.29, 44.10)	36.82 (25.78, 49.44)	--[a]
Shuttle migrant	28.18 (23.59, 33.28)	26.65 (21.34, 32.73)	32.40 (23.98, 42.15)
Health status	62.71***	40.57***	41.02***
Lifetime dx of chronic dis.	88.27 (82.02, 92.54)	87.54 (78.89, 92.96)	90.12 (83.27, 94.36)
No dx of chronic disease	54.67 (52.14, 57.17)	52.40 (49.25, 55.54)	59.62 (55.46, 63.64)

p <.05; **p < .01; ***p <.001
[a]Frequency not reported because count below limit for Department of Labor protection of confidentiality (i.e., <30 participants per cell)

Table 10. Bivariate association of categorical individual level characteristics and health services use, continued

Variable	Design-based Pearson F test & % (95% CI) used healthcare **Full Sample**	Design-based Pearson F test & % (95% CI) used healthcare **2006/2007**	Design-based Pearson F test & % (95% CI) used healthcare **2008**
Barriers to care	14.46***	3.14	19.02***
No barriers endorsed	61.29 (58.20, 64.30)	57.71 (53.82, 61.51)	68.25 (63.16, 72.94)
Endorsed ≥ 1 barriers	51.71 (47.82, 55.58)	52.16 (47.36, 56.92)	50.48 (44.22, 56.72)
Access to transportation	160.62***	102.50***	58.75***
Owns car in U.S.	70.89 (68.16, 73.49)	69.41 (65.90, 72.71)	73.91 (69.55, 77.85)
Does not own car in U.S.	39.81 (36.06, 43.70)	38.15 (33.54, 42.98)	43.94 (37.74, 50.33)
Healthcare use outside U.S.	77.11***	50.93***	25.85***
No use of care outside U.S.	62.31 (59.73, 64.81)	60.49 (57.24, 63.65)	66.22 (62.08, 70.12)
Use of care outside U.S.	33.73 (28.40, 39.50)	31.72 (25.40, 38.80)	38.70 (29.47, 48.83)

$p < .05$; **$p < .01$; ***$p < .001$

Table 11. Bivariate association of continuous environmental level characteristics and health services use

Variable	Wald F test and Mean (SE) used healthcare vs. did not **Full Sample**	Wald F test and Mean (SE) used healthcare vs. did not **2006/2007**	Wald F test and Mean (SE) used healthcare vs. did not **2008**
County FQHC delivery sites	11.32***	8.08**	6.46*
	3.67 (.50) vs. 1.55 (.38)	4.12 (.70) vs. 1.64 (.52)	2.76 (.52) vs. 1.31 (.24)
County FQHC Section 330 funds	8.73**	7.53**	2.71
	883,651.10 (109,432.70) vs. 459,185.70 (93,121.05)	1,023,556.00 (157,393.10) vs. 469,375.00 (126,586.70)	606,246.60 (84,396.33) vs. 432,635.60 (63289.53)
County FQHC FTE physicians	17.65***	15.41***	3.82
	4.37 (.53) vs. 1.93 (.23)	4.58 (.59) vs. 1.99 (.30)	3.95 (1.08) vs. 1.79 (.23)
County FQHC total FTEs	17.29***	13.61***	4.92*
	51.33 (5.83) vs. 24.27 (2.88)	50.07 (5.87) vs. 24.25 (3.82)	53.83 (12.95) vs. 24.33 (3.04)
Nearest FQHC (meters)	17.59***	5.24*	22.99***
	17,382.86 (668.38) vs. 13,756.14 (548.55)	16,997.03 (843.81) vs. 14,479.53 (705.21)	18,149.09 (1090.40) vs. 11,874.34 (723.46)
Rurality	20.36***	6.19*	26.59***
	3.00 (.06) vs. 2.63 (.06)	2.99 (.08) vs. 2.73 (.07)	3.01 (.08) vs. 2.36 (.10)

*p <.05; **p < .01; ***p <.001

Table 12. Bivariate association of policy level characteristics and health services use

Variable	Design-based Pearson F test & % (95% CI) used healthcare **Full Sample**	Design-based Pearson F test & % (95% CI) used healthcare **2006/2007**	Design-based Pearson F test & % (95% CI) used healthcare **2008**
Insurance status	187.46***	107.21***	84.96***
Insured	81.65 (78.21, 84.66)	80.29 (75.51, 84.33)	83.95 (79.12, 87.84)
Uninsured	46.38 (43.37, 49.41)	45.43 (41.75, 49.16)	48.76 (43.67, 53.87)
Workers compensation	45.10***	34.65***	8.11**
Provided by employer	62.76 (60.18, 65.26)	61.75 (58.50, 64.90)	64.69 (60.43, 68.73)
Not provided by employer	41.63 (36.18, 47.30)	39.40 (33.06, 46.13)	49.21 (39.29, 59.20)
Payment structure	30.89***	20.70***	12.68***
Salary	85.19 (79.12, 89.72)	85.67 (78.11, 90.93)	84.12 (72.31, 91.49)
Hourly	57.19 (54.53, 59.81)	54.86 (51.47, 58.20)	62.05 (57.88, 66.04)
Piece/combination hourly-piece	42.29 (35.40, 49.49)	43.80 (36.04, 51.89)	35.59 (23.27, 50.16)

*p <.05; **p < .01; ***p <.001

Table 13. Variation and clustering in health services use among farmworkers

Multivariate Model	Median Odds Ratio **2006/2007**		Median Odds Ratio **2008**	
	Level 2 Variance	Level 3 Variance	Level 2 Variance	Level 3 Variance
Unconditional Model	1.71	2.26	1.73	2.77
County Level Only	1.69	2.06	1.73	2.30
Grower Level Only	1.70	2.26	1.72	2.50
Individual Level Only	1.01	1.87	1.19	1.79
Full Model	1.01	1.73	1.19	1.68

Table 14. Multivariate logistic regression: Factors associated with healthcare use

Variable	2006/2007		2008	
	Coefficient	Odds Ratio (95% CI)	Coefficient	Odds Ratio (95% CI)
Age	-0.01	0.99 (0.98, 1.01)	0.01	1.01 (1.00, 1.03)
Income	0.00	1.00 (1.00, 1.00)	0.00	1.00 (1.00, 1.00)
Educational attainment	0.01	1.01 (0.96, 1.05)	-0.02	0.98 (0.93, 1.03)
Female sex	1.18***	3.24 (2.23, 4.73)	1.33***	3.78 (2.77, 5.14)
Married	0.22	1.24 (0.92, 1.69)	--	--
Non-Hispanic	0.41	1.51 (0.55, 4.16)	0.53	1.69 (0.72, 3.98)
Born in U.S.	0.09	1.09 (0.39, 3.06)	0.07	1.07 (0.37, 3.10)
Citizen vs. unauthorized	0.15	1.16 (0.55, 2.47)	0.80	2.22 (0.99, 4.95)
Green card/other vs. unauth.	0.48*	1.62 (1.09, 2.42)	-0.42	0.66 (.0.41, 1.07)
Citizen vs. green card/other[a]	-0.33	0.72 (0.39, 1.32)	1.21**	3.36 (1.41, 8.04)
Proficient vs. LEP	0.70	2.01 (0.68, 5.91)	0.46	1.59 (0.73, 3.48)
Moderately proficient vs. LEP	0.54**	1.71 (1.20, 2.44)	0.62**	1.87 (1.25, 2.80)
Proficient vs. mod. Proficient[a]	0.16	1.17 (0.64, 2.14)	-0.16	0.85 (0.42, 1.74)
Non-migrant vs. shuttle	0.81***	2.26 (1.61, 3.16)	0.66**	1.94 (1.17, 3.21)
Follow-the-crop vs. shuttle	0.06	1.06 (0.59, 1.91)	0.02	1.02 (0.36, 2.85)
Non-migrant vs. FTC[a]	0.75**	2.13 (1.33, 3.40)	0.64	1.91 (0.73, 4.99)
Lifetime dx of chronic dis.	1.66***	5.25 (2.35, 11.71)	1.90***	6.68 (3.43, 13.04)
No barriers to care endorsed	--	--	-0.07	0.93 (0.67, 1.30)
Owns Car in U.S.	0.41**	1.50 (1.16, 1.95)	0.56**	1.75 (1.24, 2.47)
No Healthcare use outside U.S.	0.50*	1.64 (1.12, 2.41)	0.46	1.59 (0.97, 2.61)
County FQHC total FTEs	0.00	1.00 (1.00, 1.00)	0.00*	1.00 (1.00, 1.00)
Proximity to nearest FQHC	-0.00	1.00 (1.00, 1.00)	-0.00	1.00 (1.00, 1.00)
Rurality	-0.05	0.96 (0.87, 1.05)	0.04	1.04 (0.92, 1.19)
Non-border county	1.08*	2.93 (1.25, 6.87)	1.20	3.33 (0.95, 11.72)
Insured	0.84***	2.32 (1.65, 3.26)	1.27***	3.55 (2.23, 5.65)
Has workers compensation	0.05	1.05 (0.81, 1.36)	-0.27	0.76 (0.40, 1.44)
Salary vs. combination/piece	0.73*	2.08 (1.07, 4.08)	0.06	1.06 (0.44, 2.56)
Hourly vs. combination/piece	0.05	1.05 (0.69, 1.61)	0.23	1.25 (0.51, 3.06)
Salary vs. Hourly[b]	0.68*	1.98 (1.16, 3.39)	-0.17	0.84 (0.44, 1.62)

[a]Dummy-code comparison run in 2nd multivariate (model estimates for 2006/2007 without robust standard errors)

*p <.05; **p < .01; ***p <.001

Table 15. Individual level moderators of relationships between environmental level factors and healthcare use

Variable	Dist to FQHC Coeff; OR	Total FTEs Coeff; OR	Rurality Coeff; OR	Non-Border Coeff; OR
Age	--	Interaction[a]	--	Interaction[a]
< 28 years old		n.s.		n.s.
28-41 years old		n.s.		1.17*; 3.23
≥ 42 years old		.00*; 1.00		1.01**; 2.75
Income	Interaction[b]	Interaction	--	--
<$16,250	n.s.	n.s.		
$16,250-22,500	n.s.	.00*; 1.00		
≥ $22,501	.00*; 1.00	n.s.		
Education	Interaction[a]	--	Interaction[a]	Interaction[a]
<6th grade	no est.[c]		no est.[c]	no est.[c]
6th-8th grade	-.00*; 1.00		n.s.	n.s.
≥ 9th grade	n.s.		-.09*; .91	1.51**; 4.53
Sex	Interaction[b]	--	--	Interaction[a]
Female	.00*; 1.00			n.s.
Male	n.s.			1.15***; 3.16
Country of origin	Interaction[a]	--	--	--
Born in U.S.	.00*; 1.00			
Foreign born	-.00*; 1.00			
Immigration status	Interaction[a]	--	--	Interaction[a]
Citizen	n.s.			2.20**; 9.05
Green card/other auth.	n.s.			.92**; 2.52
Unauthorized	-.00*; 1.00			n.s.
Migrant status	--	--	--	Interaction[a]
Non-migrant				1.04***; 2.83
Migrant				n.s.
Access to transportation	Interaction	--	--	--
Owns car in U.S.	n.s.			
Does not own car in U.S.	-.00*; 1.00			

[a]Not estimated with robust standard errors; [b]Significant when only distance to nearest FQHC entered into model; [c]Unable to estimate model
*p <.05; **p < .01; ***p <.001

Table 16. Policy level moderators of relationships between environmental level factors and healthcare use

Variable	Dist to FQHC Coeff; OR	Total FTEs Coeff; OR	Rurality Coeff; OR	Non-Border Coeff; OR
Insurance Status	--	--	Interaction[a]	--
Insured			-.13*; 0.88	
Uninsured			n.s.	
Workers Compensation	--	--	Interaction[a]	Interaction[a]
Provided by employer			-.07*; 0.93	1.00***; 2.72
Not provided			.14*; 1.15	n.s.

[a]Not estimated with robust standard errors
*p <.05; **p < .01; ***p <.001

Table 17. Comparison of no healthcare use in past 12 months: farmworkers vs. 2006 MEPS sample and subpopulations

Population	N	Proportion (%)[a] No Healthcare Use[b] (95% CI)	Difference	Z Test Statistic
NAWS Farmworker population[c]	4891	42.20 (40.82, 43.58)	--	[Reference]
2006 MEPS sample	20249	31.80 (31.16, 32.44)	10.40	13.80***
Hispanic	4705	49.40 (47.97, 50.83)	7.20	7.08***
Low income	7916	38.40 (37.33, 39.47)	3.80	4.27***
Farmworker comparison: Hispanic, poor, and no degree	1707	52.30 (49.93, 54.67)	10.10	7.22***

[a]Unweighted proportions
[b]No healthcare use in past year and two years for MEPS and NAWS participants, respectively
[c]NAWS data for 2006-2008 fiscal years
*p <.05; **p < .01; ***p <.001

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