

Perceptions of Environmental and Occupational Health Hazards Among Agricultural Workers in Washington State

Abstract

The purpose of this study is to describe perceptions of environmental and occupational health issues among agricultural workers. Interviews were conducted with 389 agricultural workers in the Yakima Valley in central Washington State in the summers of 2004 and 2005.

Undergraduate students from the community conducted interviews in Spanish or English.

Environmental and occupational health issues were ranked by frequency of concern, and differences by demographic characteristics were evaluated using multivariate analyses. In both 2004 and 2005, agricultural workers expressed high levels of concern about working in hot weather, agricultural injuries, pesticides, and pediatric asthma. Perceptions of environmental and occupational health issues among agricultural workers differed by certain demographic characteristics, particularly age and ethnicity. Consideration should be given to these issues when designing research studies, creating educational materials, and developing interventions related to environmental and occupational hazards among agricultural workers.

KEY WORDS: agricultural workers, Hispanic Americans, health surveys, environmental health, occupational health, perception

Introduction

Multiple environmental and occupational health-related conditions have been documented in agricultural worker populations including: musculoskeletal and traumatic injuries, respiratory conditions such as allergies and asthma, dermatitis, pesticide poisonings, heat-related illnesses, and mental health conditions (Fenske, Hidy, Morris, Harrington, & Keifer, 2002; Larson, 2001; Mines, 2001; Villarejo, 2003). The disparate social position of agricultural workers compounds their occupational risks. According to the National Agricultural Worker Survey, 75% of agricultural workers are Mexican-born, 44% cannot speak English “at all,” and 13% have completed the 12th grade. The average family income ranges from \$15,000-\$17,499 and only 8-12% have health insurance as a benefit of employment (National Agricultural Workers Survey, 2005).

Washington State is one of the top-ten crop producers in the United States. Many labor-intensive crops, such as vegetables and tree fruits, are grown in the Yakima Valley, located in south central Washington. Consequently, there is a large population of migrant and seasonal agricultural workers. Yakima County is a particularly productive agricultural region; it accounts for nearly a quarter of the State’s agricultural jobs (Washington State Employment Security, 2005). An estimated 52,476 migrant and seasonal farmworkers are employed in Yakima County (Larson, 2000).

Literature Review

Recently published literature related to farmworkers’ perceptions of their occupational and environmental health stressors includes studies that report problems and protective practices related to general occupational health (Farquhar, et al., 2008), vision (Quandt, et al., 2008), hearing loss (Rabinowitz, Sircar, Tarabar, Galusha, & Slade, 2005), skin (Cathcart, et al., 2008;

Vallejos, et al., 2008), adolescent pesticide exposure (Salazar, Napolitano, Scherer, & McCauley, 2004), take home pathways of pesticide exposure (Strong, Starks, Meischke, & Thompson, 2009), and injuries among orchard workers (Keifer, Salazar, & Connon, 2009).

Notably, most of these studies focused on a particular issue related to occupational health. Many studies were narrow in scope, which allowed for an in-depth evaluation of the issue being explored, but consequently may have limited other important issues from being identified and discussed. The study by Farquhar et al is a notable exception. This study broadly examined indigenous farmworkers' concerns regarding occupational injury and illness, experiences of discrimination and disrespect, and language and cultural barriers. Most of the articles focused on occupational health topics. Only the study by Strong et al that examined perceptions about take home pesticide exposure among women in farmworker households dealt with the environmental health of farmworker communities.

Innovative research is needed to better understand occupational *and* environmental risks faced by agricultural communities. Locally relevant and culturally appropriate research and interventions are predicated on understanding worker perspectives of their environmental and occupational health hazards (Arcury, Austin, Quandt, & Saavedra, 1999; Arcury, Quandt, & Dearth, 2001; O'Fallon & Dearth, 2002). The purpose of this study is to describe perceptions of certain environmental and occupational health issues among agricultural workers in a community in the state of Washington.

Conceptual framework

Empowerment is a participatory process designed to assist individuals or groups to make decisions that will advance their health and well being. Health promotion theorists define empowerment as a multidimensional construct that attends to individual, small group,

organizational, and community levels of health promotion (Israel, Checkoway, Schulz, & Zimmerman, 1994; Labonte, 1994; Robertson & Minkler, 1994). Early conceptual work around the concept of empowerment fostered the creation of community based participatory research (CBPR) approaches to health promotion research (Israel, et al., 1994; Minkler & Wallerstein, 2003). A critical element in CBPR is the active participation of the community that is affected by the research. CBPR provides a means to obtain new perspectives on occupational and environmental health stressors among agricultural communities. For this study, CBPR provided a means to actively involve members of an agricultural community in the research process.

Methods

El Proyecto Bienestar (The Well Being Project) started as a four-year CBPR project. The goal of the project was to increase local participation in environmental and occupational health-related research. Representatives from a research university, a liberal arts university, a large community/migrant health clinic and a community-based organization came together to create inclusive solutions to the stated occupational and environmental health needs of an agricultural community. A Community Advisory Board helped guide the research process (J. L. Crowe, Keifer, & Salazar, 2008; Ybarra & Postma, 2007).

In 2004, in conjunction with the Yakima Valley Farm Workers Clinic, El Proyecto Bienestar began working with the ConneX (Connecting Students to Health Careers) program to create an undergraduate summer course on environmental and occupational health. ConneX is a local health professions pipeline program for economically or educationally disadvantaged students from the Yakima Valley. As part of the field work component of the course, students conducted interviews with community members about environmental and occupational health issues. Prior to the field research portion of the course, the students received training on

interview techniques and research ethics as well as data entry using Zire TM 31 Palm One® Personal Digital Assistants (PDAs). All study protocols were approved by the Institutional Review Board at the University of Washington and the Research Review Committee/HIPAA Privacy Board at the Yakima Valley Farm Workers Clinic. All study participants provided oral consent prior to the interview. Students were supervised at all times while in the field by university researchers who had completed a university-sponsored human subjects research training course.

Participants were recruited for this study using a site-based sampling approach that has been utilized to achieve a representative sample in previous qualitative and quantitative community research efforts (Arcury & Quandt, 1999; Quandt & Rao, 1999). Interview sites were chosen based on recommendations from the Community Advisory Board and other community members who suggested locations (including grocery stores, soccer games, and flea markets) frequented by Hispanic agricultural workers and their families. Store or site managers gave written permission at each survey location where applicable.

Interviews were conducted during one week periods in August 2004 and 2005 between the hours of 8:00 am and 5:00 pm in the case of restaurants and grocery stores and between 6:00 pm and 8:30 pm at soccer fields and community events. Interviews were only conducted during daylight hours for safety reasons. Students approached potential participants and introduced the project. If the person expressed willingness to participate and was at least 18 years old, the students obtained verbal consent and interviewed the participant in English or Spanish.

Interviews generally took about 15 minutes to complete. Data were entered using the PDAs.

The content of the surveys was developed based on data from key informant interviews from the first phase of El Proyecto Bienestar [(J. Crowe, 2005; Hom, 2006), references available

upon request]. These data sources, in addition to input from investigators involved in the research project and members of the Community Advisory Board, resulted in a list of environmental and occupational health concerns of *a priori* interest that were included in the surveys. This list included a range of topics such as pesticide exposure, heat-related illness, ladder falls, and other issues. Surveys were translated into Spanish by a local translator and reviewed by bilingual research staff and ConneX students to ensure consistency between the Spanish and English versions. Draft versions of the survey were pilot tested and revised prior to data collection. Pilot testing and review of the survey resulted in several important modifications. For example, some Spanish terms were not commonly used in this community and were replaced with local vocabulary (i.e. “hape” rather than “lúpulo” for hops). Both surveys asked about demographic characteristics and agricultural work history. Multiple demographic characteristics were collected: age in years, gender, race/ethnicity, self-reported health status, time since arrival in Yakima Valley, children in the home, household income, education, and English and Spanish literacy. For agricultural work history, the following information was collected: total years working in agriculture, location of agricultural work, type of agricultural operation, work involving specific fruit and vegetable crops, and types of work activities in orchards (2005 only). The response strata were recoded for several ordered categorical variables – such as income and length of employment in agriculture – to be consistent between the 2004 and 2005 surveys.

Because the goal of the study was to characterize agricultural workers’ perceptions of environmental and occupational health hazards, analyses were restricted to participants who had ever worked in agriculture. Participants were further classified as either former or current agricultural workers based on reported work activities and current occupation. Hereafter

participants who ever worked in agriculture (e.g. both formerly and currently working in agriculture) are referred to collectively as “agricultural workers.”

Participants were asked to rate their level of concern about a series of health issues on a four point scale. In 2004, participants were asked to state whether a particular issue (for example, “asthma in children”) was: “not a concern,” “a little bit of a concern,” “likely to be a concern,” or “definitely a concern.” In 2005, response categories were restructured to allow participants to select a neutral response if they did not have a strong opinion about a particular issue. That is, participants in 2005 were asked “To what extent do you think the following issues are a concern in the Yakima Valley?” They were then given a list of issues and the following options: “not a concern,” “possibly a concern,” “definitely a concern” and “no opinion.” For the analysis, levels of concern were dichotomized into “definitely a concern” and all other options, which facilitated comparisons across years. The surveys covered similar content, but varied slightly in structure across the two years. In 2004, the questions asked about environmental and occupational health issues; in 2005, although the majority of the issues were the same, they were subcategorized according to exposures and outcomes of concern (Figure 1).

Survey data were analyzed using the Statistical Program for the Social Sciences (SPSS), version 14.0. The frequency of concern about environmental and occupational health issues was examined in 2004, and the frequency of concern about environmental and occupational exposures and outcomes was examined in 2005. Frequencies are reported for all participants who ever worked in agriculture, and separately for former and current agricultural workers. Multivariate logistic regression analyses were also performed to evaluate the degree of concern about the top three issues in each category based on selected demographic characteristics and agricultural work status. The following covariates were included in the logistic regression

models based on bivariate analyses (results not shown): age category (18-34, 35-54, 55+), gender, ethnicity (Hispanic vs. non-Hispanic), parental status, English literacy, and agricultural work status (former vs. current). Preliminary analyses suggested that some subgroups (e.g. middle-aged participants, women, and parents) were more concerned about a greater number of environmental and occupational health issues. To evaluate this observation, analysis of covariance (ANCOVA) models were used to estimate the average number of issues described as “definitely a concern” according to these three demographic characteristics.

Findings

A total of 442 surveys were completed in this study (203 surveys in 2004 and 239 surveys in 2005). Most study participants (N=389; 88.0%) reported having worked in agriculture (Table 1). The mean age of the agricultural workers was 37.9 years in 2004 (range 18-76 years) and 39.8 years in 2005 (range 18-90). Approximately half were male in each year (48.9% and 53.1% respectively). The vast majority were Hispanic or Latino (93.2% in 2004 and 90.0% in 2005). Most (89.8% and 85.2%) had either always lived in the Yakima Valley or had arrived more than five years ago, and most (83.1% and 80.4%) had children. In both years, well over half (67.5% and 58.2%) reported an annual household income of \$20,000 or less, and over half each year (60.4% and 53.9%) had not completed high school. In 2005, 68.4% of the workers were born in Mexico, but the majority (85.2%) of workers had lived in the Yakima Valley for more than five years (birthplace was not asked in 2004). Most (88.1% and 80.4%) were literate in Spanish (reported being able to read a newspaper in Spanish) and approximately half (40.1% and 53.6%) reported being able to read a newspaper in English. Most (75.7% and 64.5%) chose to complete the survey in Spanish.

Approximately half of the agricultural workers (55.1% and 44.1% respectively) reported currently working in agriculture at the time of the survey (Table 2). Although approximately half reported having worked in agriculture outside of the Yakima Valley, almost all (96.1% and 95.2%) had done agricultural work in the Yakima Valley. The majority (66.1% and 76.9%) had worked five or more years in agriculture. Most workers reported having worked in a variety of workplaces and with a variety of crops; “orchard or field” was the most common workplace and apples, cherries, pears and asparagus were the most commonly reported crops across both years. In 2005, the most frequently reported work activity for orchard and field workers was harvesting or picking, thinning, and pruning. Only 26.8% had worked as a supervisor or foreman. (These data were not collected in 2004).

The most frequently reported environmental health concerns by agricultural workers (according to the number of participants who said the issue was “definitely a concern”) in 2004 were: pediatric asthma, surface water contamination, soil contamination, food borne illness and ground water contamination. The most frequent occupational health concerns reported in 2004 were: working in hot weather, muscular strains/sprains, eye injuries, ladder falls in orchards, and dislocations or broken bones (Table 3). In 2005, the exposures most often ranked “definitely a concern” by agricultural workers were: pesticide exposure, working in hot weather, air contamination and water contamination. The outcomes most often described as “definitely a concern” were: injuries in agricultural work, pediatric asthma, cancer and obesity (Table 4).

The degree of concern about the top three issues in each category was also evaluated based on selected demographic characteristics and agricultural work status. In 2004, middle-aged workers (35-54 years old) and Hispanic/Latino workers were more likely to be concerned about pediatric asthma (OR=2.4, CI=1.02-5.60 for middle-aged workers, and OR=15.13,

CI=2.72-84.18 for Hispanic/Latino workers) (Table 5). The other top environmental health concerns in 2004 (surface water contamination and soil contamination) were also more of a concern to middle-aged workers relative to younger workers (OR=2.10, CI=0.96-4.61 and OR=2.57, CI=1.15-5.71 respectively).

Analyses of responses about occupational health concerns in 2004 showed that working in hot weather was more of a concern to female workers (OR=3.17, CI=1.37-7.30) and to those currently working in agriculture (OR=2.01, CI=0.79-5.11). Pesticide-related illness was more of a concern to middle-aged workers (OR=2.23, CI=1.00-4.99) and to Hispanic/Latino workers (OR=3.98, CI=0.99-16.01).

Among exposures assessed in 2005, “pesticides” was more of a concern to middle-aged workers than younger workers (OR=2.40, CI=1.10-5.24) (Table 6). Among outcomes of concern, middle-aged workers were also more likely to be concerned about injuries in agricultural work than younger workers (OR=2.49, CI = 1.16-5.53). Both middle-aged workers and older workers (>55 years old) were particularly concerned about cancer when compared to younger workers (OR=3.64, CI=1.79-7.43 and OR=4.60, CI=1.71-12.42 respectively). In addition, current agricultural workers were more likely than former agricultural workers to be concerned about cancer (OR=2.07, CI=1.01-4.23). Hispanic/Latino workers tended to be more concerned about pediatric asthma than non-Hispanics (OR=3.76, CI=1.30-10.88).

Some demographic groups expressed higher levels of concern about most or all of the environmental and occupational health issues explored in this study. Women, parents, and middle-aged (35-54 years old) workers tended to express higher levels of concern about most issues. However, after controlling for gender and parental status, statistically significant differences in the number of issues described as “definitely a concern” were only observed for

age category in both years ($P=0.037$ and $P<0.001$ for 2004 and 2005, respectively) (Tables 7 and 8). Compared to those workers aged 18-34 years and those over age 55, 35-54 year-old workers consistently answered “definitely a concern” more frequently across the two years and across all environmental issues, occupational issues, exposures, and outcomes of concern. This difference was statistically significant in all categories except the occupational health issues asked about in 2004 ($p=0.214$). Female workers tended to answer “definitely a concern” more often than male workers, but this trend was only borderline significant for occupational health issues in 2004 and not statistically significant in 2005.

Discussion

Community health surveys conducted in 2004 and 2005 revealed specific issues of concern among agricultural workers in one central Washington community. These surveys were used as one method to involve a large number of community members in the process of identifying high-priority environmental and occupational health issues for future interventions, without requiring an extensive time commitment on the part of the participants (Arcury, et al., 1999). Although barriers to conducting research with agricultural workers have been discussed in the literature (e.g. low rates of participation, fear of employer reprisal or investigation by Immigration and Customs Enforcement), this study was successful at meeting its recruitment goals in terms of the population it reached and the number of respondents, likely due to the use of local, bilingual student interviewers and sampling in public locations (Arcury, Quandt, & McCauley, 2000; Flores, Abreu, & Tomany-Korman, 2006; Rao, Arcury, & Quandt, 2004).

Analyses demonstrated particular concern across both years in terms of pediatric asthma, workplace injuries, working in hot weather, and pesticides. Some of the results may reflect local outreach efforts and provide an opportunity to collaborate with local and state institutions to

develop and test health and safety interventions. For example, the concern about pediatric asthma may be explained in part by the efforts of the Yakima Valley Farm Workers Clinic to address pediatric asthma in the Hispanic agricultural community (Yakima Valley Farm Workers Clinic Planning and Development Department, 2004). Concerns about injuries in agricultural work may be a result of the “Eyes and Falls” initiative sponsored by the Washington State Department of Labor and Industries, or the farmworker death in the summer of 2005 from heat stroke (Safety & Health Assessment & Research for Prevention, 2006; Washington State Department of Labor and Industries, 2001). Events such as these may influence community awareness about important issues and prime people to take action to promote health.

This study is unique in that in addition to describing agricultural worker perceptions of a variety of occupational and environmental issues, differences in the degree of concern about selected issues were examined between subgroups based on demographic characteristics and work history. For example, in both years, Hispanic workers were more likely than non-Hispanic workers to report pediatric asthma as a definite concern. Likewise, middle aged workers were more likely than younger or older workers to report “pesticide-related illness” or “pesticides” as a definite concern. Overall, middle-aged (35-54 years old) participants expressed higher levels of concern about most issues. Findings from this study may indicate the need to target younger workers (who had lower levels of concerns about many issues) who may not perceive themselves as vulnerable. Similar risk perceptions have been found among adolescent farmworkers (Salazar, et al., 2004).

Like other CBPR projects, results will be used to inform locally relevant research and interventions. For example, in other agricultural communities, CBPR practitioners have used exploratory data to inform linguistically and culturally appropriate occupational health

information for indigenous farm workers (Farquhar, et al., 2008), prevent occupational exposures to pesticides (Arcury, et al., 2001), and disseminate information about children's environmental health risks (Israel, et al., 2005). Likewise, these findings will inform El Proyecto Bienestar as they create radio novelas (Spanish language radio soap operas) to educate the farm worker community about occupational and environmental health risks they face.

In addition to its strengths, this study had a number of limitations. Inconsistencies between the two surveys made comparisons across the years and with other studies somewhat difficult. Also, study participants were not selected using a random sampling method. It is possible that some spouses were included in the sample, which may have affected the independence of the data. However, based on field staff observations during data collection it is unlikely that many spouses were included. It should also be noted that the sample captured agricultural workers who were socially similar to national samples of workers, except that a higher percentage in the study sample were born in the United States and were parents (NAWS, 2005). The high proportion of U.S.-born agricultural workers can be explained by the relatively stable nature of the Hispanic population in Yakima County. Overall, similarities between the demographic characteristics of this study population and other national surveys of agricultural workers suggest that bias due to non-random sampling may not be a serious limitation.

Although surveys were pilot tested in both years and subsequently revised with feedback from Proyecto Bienestar investigators and Community Advisory Board members, a more thorough validation of the survey instruments was not feasible given the limited time frame of the ConneX summer program. Also, students' lack of research experience may have resulted in some errors in recording survey responses. For example, in 2005 there was some inconsistency between interviewers regarding whether data on agricultural work history were recorded for

participants who had formerly worked in agriculture. Consequently, work history information was missing for approximately 22-27% of former agricultural workers. (The amount of missing data varied somewhat between variables.)

In addition, there were relatively small numbers of participants in some demographic groups (e.g. non-Hispanic participants). Consequently, results for these analyses should be cautiously interpreted. Finally, because a number of different demographic and work history characteristics were considered in relation to concern about selected environmental and occupational health issues, some of the differences in perceptions of risk observed in this study may have been statistically significant by chance due to multiple comparisons.

Implications for Practice

Results of this study suggest that overall, there was particular concern among respondents in terms of pediatric asthma, workplace injuries, working in hot weather, and pesticides. Agricultural workers' perceptions of some environmental and occupational health issues differed with respect to certain demographic and work history characteristics. In particular, middle-aged workers tended to express higher levels of concern when compared to younger or older workers. Occupational health nurses that work in agricultural practice settings or as clinicians in agricultural communities can benefit from understanding risk perceptions among workers and community members. For example, in the Occupational Health Nurses in Agricultural Communities project, nurses used community organizing strategies in an effort to change community norms around the expectation that injuries and fatalities are a necessary part of agricultural work (Lexau, Kingsbury, Lenz, Nelson, & Voehl, 1993). Occupational health nurses can provide leadership in this area by working across disciplines (e.g anthropology, health sciences) and developing coalitions with community, government and corporate sponsors to raise

the visibility and unique needs of seasonal and migrant agricultural workers (Culp & Umbarger, 2004; Randolph & Migliozi, 1993). At the individual level, clinicians may need to spend more time with adolescent workers to teach them about the unique risks they face at work, approaches they can take to mitigate those risks, and regulations in place to protect them on the job.

Understanding different levels of concern about environmental and occupational health risks that exist within a workforce or community may allow for more effective research studies, educational materials, and occupational and environmental risk reduction interventions to be developed. Occupational health nurses play an important role in responding to the unique needs of individuals and subgroups that make up a diverse workforce by targeting subgroups with health promotional campaigns and advocating for healthy workplaces (Lundvall & Olson, 2001). Occupational health nurses also serve as liaisons between agricultural, health, and farm worker communities (Lundvall & Olson, 2001). Because historically, vulnerable populations have not been influential in the research process, it is especially important to include worker representatives in efforts to promote their health and safety (Postma, 2006). To appropriately address the needs of specific worker subgroups, occupational health professionals must grapple with the complexity that exists within the workforce.

Sidebar

Applying Research to Practice

Based on surveys collected in 2004 and 2005 in one agricultural community, agricultural workers expressed high levels of concern about working in hot weather, agricultural injuries, pesticides, and pediatric asthma. Perceptions of environmental and occupational health issues among agricultural workers differed by certain demographic characteristics, particularly age and

ethnicity. The degree of concern expressed by subpopulations based on demographic characteristics and work history suggest that tailored interventions are needed to meet the needs of subgroups within agricultural worker populations.

References

- Arcury, T. A., Austin, C. K., Quandt, S. A., & Saavedra, R. (1999). Enhancing community participation in intervention research: Farmworkers and agricultural chemicals in North Carolina. *Health Educ Behav*, 26(4), 563-578.
- Arcury, T. A., & Quandt, S. A. (1999). Participant recruitment for qualitative research: A site-based approach to community research in complex societies. *Human Organization*, 58(2), 128-133.
- Arcury, T. A., Quandt, S. A., & Dearry, A. (2001). Farmworker pesticide exposure and community-based participatory research: Rationale and practical applications. *Environ Health Perspect*, 109 Suppl 3, 429-434.
- Arcury, T. A., Quandt, S. A., & McCauley, L. (2000). Farmworkers and pesticides: Community-based research. *Environ Health Perspect*, 108(8), 787-792.
- Cathcart, S., Feldman, S. R., Vallejos, Q. M., Whalley, L. E., Quandt, S. A., Cabral, G., et al. (2008). Self-treatment with bleach by a Latino farmworker. *Dermatitis*, 19(2), 102-104.
- Crowe, J. (2005). *Key informant perceptions of environmental and occupational risks for agricultural workers in Yakima Valley, Washington as a part of El Proyecto Bienestar* University of Washington, Seattle.
- Crowe, J. L., Keifer, M. C., & Salazar, M. K. (2008). Striving to provide opportunities for farm worker community participation in research. *J Agric Saf Health*, 14(2), 205-219.
- Culp, K., & Umbarger, M. (2004). Seasonal and migrant agricultural workers: a neglected work force. *Aaohn J*, 52(9), 383-390.
- Farquhar, S., Samples, J., Ventura, S., Davis, S., Abernathy, M., McCauley, L., et al. (2008). Promoting the occupational health of indigenous farmworkers. *J Immigr Minor Health*, 10(3), 269-280.
- Fenske, R. A., Hidy, A., Morris, S. L., Harrington, M. J., & Keifer, M. C. (2002). Health and safety hazards in Northwest agriculture: Setting an occupational research agenda. *Am J Ind Med*, Suppl 2, 62-67.
- Flores, G., Abreu, M., & Tomany-Korman, S. C. (2006). Why are Latinos the most uninsured racial/ethnic group of US children? A community-based study of risk factors for and consequences of being an uninsured Latino child. *Pediatrics*, 118(3), e730-740.
- Hom, E. (2006). *Analysis of environmental and occupational health concerns in key informant interviews with Community Advisory Board (CAB) members of El Proyecto Bienestar (The Well-Being Project)*. Unpublished Master's project, University of Washington, Seattle.
- Israel, B. A., Checkoway, B., Schulz, A., & Zimmerman, M. (1994). Health education and community empowerment: conceptualizing and measuring perceptions of individual, organizational, and community control. *Health Educ Q*, 21(2), 149-170.

- Israel, B. A., Parker, E. A., Rowe, Z., Salvatore, A., Minkler, M., Lopez, J., et al. (2005). Community-based participatory research: Lessons learned from the Centers for Children's Environmental Health and Disease Prevention Research. *Environ Health Perspect*, *113*(10), 1463-1471.
- Keifer, M., Salazar, M. K., & Connon, C. (2009). An exploration of Hispanic workers' perspectives about risks and hazards associated with orchard work. *Fam Community Health*, *32*(1), 34-47.
- Labonte, R. (1994). Health promotion and empowerment: Reflections on professional practice. *Health Education Quarterly*, *21*(2), 253-268.
- Larson, A. (2000). *Migrant and Seasonal Farmworker Enumeration Profiles Study: Washington: Migrant Health Program, Bureau of Primary Health Care, Health Resources and Services Administration.*
- Larson, A. (2001). *Migrant Health Issues: Environmental/Occupational Safety and Health.* Buda, TX: National Advisory Council on Migrant Health.
- Lexau, C., Kingsbury, L., Lenz, B., Nelson, C., & Voehl, S. (1993). Building coalitions: a community wide approach for promoting farming health and safety. *Aaohn J*, *41*(9), 440-449.
- Lundvall, A. M., & Olson, D. K. (2001). Agricultural health nurses. Job analysis of functions and competencies. *Aaohn J*, *49*(7), 336-346.
- Mines, R., Mullenax, N., Saca, L. (2001). *The binational farmworker health survey: an in-depth study of agricultural worker health in Mexico and the United States.* Davis, CA: California Institute for Rural Studies.
- Minkler, M., & Wallerstein, N. (2003). Introduction to community based research. In M. Minkler & N. Wallerstein (Eds.), *Community-Based Participatory Research for Health* (pp. 3-26). San Francisco: Jossey-Bass.
- National Agricultural Workers Survey (2005). *Findings from the National Agricultural Workers Survey (NAWS) 2001-2002: A Demographic and Employment Profile of United States Farm Workers.* Burlingame, California: U.S. Department of Labor.
- NAWS (2005). *Findings from the National Agricultural Workers Survey (NAWS) 2001-2002; A Demographic and Employment Profile of United States Farm Workers.* Burlingame, California: U.S. Department of Labor.
- O'Fallon, L. R., & Deary, A. (2002). Community-based participatory research as a tool to advance environmental health sciences. *Environ Health Perspect*, *110 Suppl 2*, 155-159.
- Postma, J. (2006). Environmental justice: Implications for occupational health nurses. *AAOHN Journal*, *54*(11), 489-496; quiz 497-488.
- Quandt, S. A., Feldman, S. R., Vallejos, Q. M., Schulz, M. R., Verma, A., Fleischer, A. B., et al. (2008). Vision problems, eye care history, and ocular protection among migrant farmworkers. *Arch Environ Occup Health*, *63*(1), 13-16.
- Quandt, S. A., & Rao, P. (1999). Hunger and food security among older adults in a rural community. *Human Organization*, *58*(1), 28-35.
- Rabinowitz, P. M., Sircar, K. D., Tarabar, S., Galusha, D., & Slade, M. D. (2005). Hearing loss in migrant agricultural workers. *J Agromedicine*, *10*(4), 9-17.
- Randolph, S. A., & Migliozi, A. A. (1993). The role of the agricultural health nurse: bringing together community and occupational health. *Aaohn J*, *41*(9), 429-433.

- Rao, P., Arcury, T. A., & Quandt, S. A. (2004). Student Participation in Community-Based Research to Improve Migrant and Seasonal Farmworker Environmental Health: Issues for Success. *The Journal of Environmental Education*, 35(2), 3-15.
- Robertson, A., & Minkler, M. (1994). New health promotion movement: A critical examination. *Health Education Quarterly*, 21(3), 295-312.
- Safety & Health Assessment & Research for Prevention (2006). Fatality Assessment and Control Evaluation (FACE) Retrieved September 16, 2008, from <http://www.lni.wa.gov/Safety/Research/FACE/files/list05.pdf>.
- Salazar, M. K., Napolitano, M., Scherer, J. A., & McCauley, L. A. (2004). Hispanic adolescent farmworkers' perceptions associated with pesticide exposure. *West J Nurs Res*, 26(2), 146-166; discussion 167-175.
- Strong, L. L., Starks, H. E., Meischke, H., & Thompson, B. (2009). Perspectives of Mothers in Farmworker Households on Reducing the Take-Home Pathway of Pesticide Exposure. *Health Educ Behav*.
- Vallejos, Q. M., Schulz, M. R., Quandt, S. A., Feldman, S. R., Galvan, L., Verma, A., et al. (2008). Self report of skin problems among farmworkers in North Carolina. *Am J Ind Med*, 51(3), 204-212.
- Villarejo, D. (2003). The health of U.S. hired farm workers. *Annu Rev Public Health*, 24, 175-193.
- Washington State Department of Labor and Industries (2001). Safety effort dramatically reduces eye, ladder injuries in Washington's orchards Retrieved November 19, 2007, from <http://www.lni.wa.gov/news/2001/pr011025a.asp>
- Washington State Employment Security (2005). *Agricultural Workforce in Washington State*. Olympia, WA: Washington State Employment Security.
- Yakima Valley Farm Workers Clinic Planning and Development Department (2004). *Childhood Asthma Project Final Report*. Toppenish, WA: Yakima Valley Farm Workers Clinic.
- Ybarra, V., & Postma, J. (2007). El Proyecto Bienestar: An Authentic Community Based Participatory Research Partnership in the Yakima Valley. *Partnership Perspectives*, IV(1), 34-43.

Figure 1: Environmental and occupational health concerns addressed on community surveys, 2004 and 2005

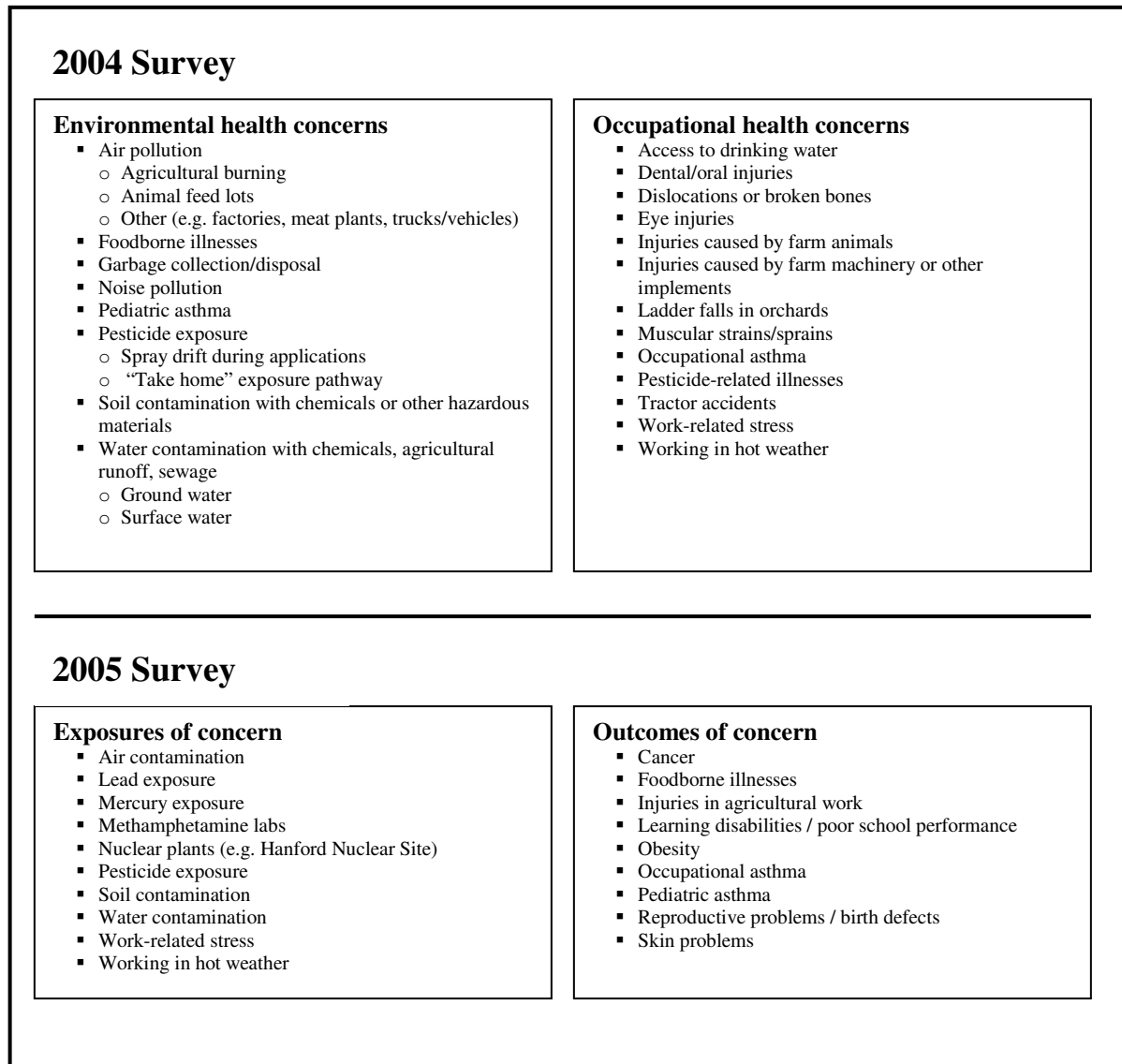


Table 1: Demographic characteristics of agricultural workers

	2004 (N=178)		2005 (N=211)	
	N	%*	N	%*
Age in years				
18-34	84	47.7	85	41.1
35-54	67	38.1	88	42.5
55+	25	14.2	34	16.4
Gender				
Female	91	51.1	99	46.9
Male	87	48.9	112	53.1
Race/ethnicity				
Hispanic	165	93.2	190	90.0
White, non-Hispanic	8	4.5	12	5.7
Other	4	2.3	9	4.3
Birthplace				
Mexico			143	68.4
Yakima Valley			27	12.9
Washington State, outside YV	n/a [†]		7	3.3
United States, outside WA			25	12.0
Other			7	3.3
Arrived in Yakima Valley				
Within the last year	4	2.3	17	8.1
1-5 years ago	14	7.9	14	6.7
More than 5 years ago	117	66.1	146	69.9
Have always lived in YV	42	23.7	32	15.3
Spend >6 months/year in YV				
No	n/a [†]		5	2.9
Yes			167	97.1
Children in home				
No	30	16.9	41	19.6
Yes	148	83.1	168	80.4
Household income				
Under \$10,000	45	27.6	30	15.9
\$10,000-20,000	65	39.9	80	42.3
\$21,000-30,000	28	17.2	45	23.8
More than \$30,000	25	15.3	34	18.0
Education				
Did not attend school	5	2.8	15	7.3
Some elementary school	23	13.0	44	21.4
Completed elementary school	39	22.0	21	10.2
Some high school	40	22.6	31	15.0
High school graduate	58	32.8	75	36.4
College graduate	12	6.8	20	9.7
English literacy				
No	106	59.9	97	46.4
Yes	71	40.1	112	53.6
Spanish literacy				
No	156	11.9	41	19.6
Yes	21	88.1	168	80.4
Language for survey				
English	43	24.3	75	35.5
Spanish	134	75.7	136	64.5
Currently employed				
No	35	19.8	56	26.5
Yes	142	80.2	155	73.5

Self-reported health status				
Poor	10	5.6	17	8.1
Fair	62	34.8	77	36.7
Good	47	26.4	66	31.4
Very good	39	21.9	21	10.0
Excellent	20	11.2	29	13.8

* Missing records were excluded from percentages

† Data available for 2005 only

Table 2: Work activities of agricultural workers

Characteristic	2004 (N=178)		2005 (N=211)	
	N	%*	N	%*
Agricultural work status				
Former	80	44.9	118	55.9
Current	98	55.1	93	44.1
Agricultural operation				
Orchard or field	149	85.6	141	77.9
Warehouse or cannery	96	55.2	105	58.0
Dairy	5	2.9	122	67.4
Other agricultural operation	6	3.4	17	9.4
Selected crop work [†]				
Apples	135	91.8	129	91.5
Cherries	121	82.3	119	84.4
Pears	102	69.4	104	73.8
Asparagus	81	55.1	76	53.9
Peaches	71	48.3	74	52.5
Grapes	61	41.5	53	37.6
Hops	50	34.0	58	41.1
Potatoes	35	23.8	29	20.6
Other crops	22	15.0	42	29.8
Work activity [†]				
Harvesting or picking			129	93.5
Thinning			111	80.4
Pruning			83	60.1
Planting or transplanting		n/a [‡]	63	45.7
Supervisor or foreman			37	26.8
Handling pesticides			23	16.7
Other work activity			8	5.8
Total years working in agriculture				
Less than 1 year	8	4.6	10	5.8
1-2 years	20	11.5	12	6.9
3-4 years	31	17.8	18	10.4
5 or more years	115	66.1	133	76.9
Location of agricultural work				
In the Yakima Valley	171	96.1	200	95.2
Outside the Yakima Valley	90	51.1	90	42.9

* Missing records were excluded from percentages

† Restricted to orchard/field workers only

‡ Data available for 2005 only

Table 3: Percentage of agricultural workers reporting that each issue was “definitely a concern” in 2004*

Category	Ever worked in agriculture (N=178) %	Formerly worked in agriculture (N=98) %	Currently work in agriculture (N=98) %
<i>Environmental health concerns</i>			
Pediatric asthma	70.1% ^a	68.4% ^a	71.4%
Surface water contamination	66.9%	66.3%	67.3%
Soil contamination	64.6%	62.5%	66.3%
Foodborne illnesses	64.0%	60.0%	67.3%
Ground water contamination	62.9%	65.0%	61.2%
Garbage collection/disposal	55.6%	56.3%	55.1%
“Take home” pesticide exposure [†]	55.6%	47.5%	62.2%
Spray drift during pesticide applications	51.7%	52.5%	51.0%
Air pollution from agricultural burning	51.1%	47.5%	54.1%
Air pollution from other sources (e.g. factories, meat plants, trucks/vehicles)	41.6%	37.5%	44.9%
Air pollution from animal feed lots	39.3%	37.5%	40.8%
Noise pollution	20.8%	20.0%	21.4%
<i>Occupational health concerns</i>			
Working in hot weather	76.6% ^c	73.8%	78.9% ^c
Muscular strains/sprains	68.8% ^b	67.5%	69.8% ^b
Pesticide-related illnesses	67.6% ^b	71.3%	64.6% ^b
Eye injuries	66.5% ^b	62.5%	69.8% ^b
Ladder falls in orchards [†]	63.6% ^b	55.0%	70.8% ^b
Dislocations or broken bones	63.4% ^c	58.2% ^a	67.7% ^b
Lack of access to drinking water	59.7% ^b	58.8%	60.4% ^b
Work-related stress	54.3% ^c	54.4% ^a	54.2% ^b
Injuries caused by farm machinery or other implements	52.3% ^b	53.8%	51.0% ^b
Tractor accidents	52.3% ^b	57.5%	47.9% ^b
Occupational asthma	49.4% ^b	48.8%	50.0% ^b
Dental/oral injuries	37.5% ^b	36.3%	38.5% ^b
Injuries caused by farm animals	30.7% ^b	25.0%	35.4% ^b

* Records with missing values were excluded from percentages

† P ≤ 0.05 for Pearson chi-square test comparing former vs. current agricultural workers

Number of missing records excluded from each analysis (none missing unless otherwise noted):

^a One missing record

^b Two missing records

^c Three missing records

Table 4: Percentage of agricultural workers reporting that each issue was “definitely a concern” in 2005*

Category	Ever worked in agriculture (N=211) %	Formerly worked in agriculture (N=118) %	Currently work in agriculture (N=93) %
<i>Exposures of concern</i>			
Pesticide exposure [†]	72.4% ^a	77.8% ^a	65.6%
Working in hot weather	69.0% ^a	70.1% ^a	67.7%
Air contamination	60.7%	60.2%	61.3%
Water contamination	58.8%	60.2%	57.0%
Work-related stress	55.5% ^b	59.8% ^a	50.0% ^a
Soil contamination	52.9% ^a	51.7%	54.3% ^a
Meth labs	47.4%	51.7%	41.9%
Lead exposure	41.2%	41.5%	40.9%
Nuclear plants (e.g. Hanford)	37.4%	42.4%	31.2%
Mercury exposure	27.5%	28.0%	26.9%
<i>Outcomes of concern</i>			
Injuries in agricultural work	73.0%	74.6%	71.0%
Pediatric asthma	65.4%	62.7%	68.8%
Cancer	62.6%	56.8%	69.9%
Obesity	58.3%	55.1%	62.4%
Skin problems	55.0%	53.4%	57.0%
Occupational asthma [†]	52.1%	44.1%	62.4%
Learning disabilities/poor school performance	46.9%	50.8%	41.9%
Foodborne illnesses	43.6%	45.8%	40.9%
Reproductive problems/birth defects	40.5% ^a	40.7%	40.2% ^a

* Records with missing values were excluded from percentages

† P ≤ 0.05 for Pearson chi-square test comparing former vs. current agricultural workers

Number of missing records excluded from each analysis (none missing unless otherwise noted):

^a One missing record

^b Two missing records

Table 5: Adjusted odds ratios for reporting that each issue was “definitely a concern” by selected demographic and work characteristics, 2004

Characteristics	Environmental health concerns						Occupational health concerns					
	Pediatric asthma		Surface water contamination		Soil contamination		Working in hot weather		Muscle strains and sprains		Pesticide-related illness	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age in years												
18-34	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
35-54	2.40	1.02, 5.60	2.10	0.96, 4.61	2.57	1.15, 5.71	1.39	0.56, 3.43	1.12	0.51, 2.47	2.23	1.00, 4.99
55+	1.38	0.45, 4.22	1.09	0.40, 2.98	0.74	0.27, 2.00	1.19	0.39, 3.65	0.88	0.31, 2.49	1.13	0.41, 3.15
Gender												
Male	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Female	0.99	0.46, 2.12	1.45	0.71, 2.95	1.28	0.63, 2.63	3.17	1.37, 7.30	1.62	0.79, 3.33	1.04	0.50, 2.15
Ethnicity												
Non-Hispanic	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Hispanic/Latino	15.13	2.72, 84.18	1.00	0.26, 3.91	1.93	0.48, 7.74	1.90	0.44, 8.25	0.82	0.21, 3.28	3.98	0.99, 16.01
Children												
No	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Yes	1.25	0.48, 3.30	1.07	0.42, 2.71	1.27	0.51, 3.17	1.23	0.45, 3.35	2.04	0.81, 5.11	1.07	0.42, 2.71
English literacy												
No	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Yes	0.64	0.26, 1.59	0.45	0.20, 1.05	0.54	0.23, 1.26	1.46	0.54, 3.94	0.56	0.24, 1.31	0.81	0.34, 1.94
Agricultural work												
Formerly	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Currently	0.70	0.28, 1.70	0.78	0.34, 1.77	0.92	0.41, 2.10	2.01	0.79, 5.11	0.96	0.42, 2.20	0.61	0.26, 1.43

Table 6: Adjusted odds ratios for reporting that each issue was “definitely a concern” by selected demographic and work characteristics, 2005

Characteristics	Exposures of concern						Outcomes of concern					
	Pesticides		Working in hot weather		Air contamination		Injuries in agricultural work		Pediatric asthma		Cancer	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age in years												
18-34	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
35-54	2.40	1.10, 5.24	1.30	0.65, 2.61	1.87	0.96, 3.67	2.49	1.16, 5.35	1.64	0.81, 3.32	3.64	1.79, 7.43
55+	0.81	0.31, 2.10	1.92	0.71, 5.20	0.89	0.37, 2.14	1.46	0.56, 3.81	1.23	0.49, 3.13	4.60	1.71, 12.42
Gender												
Male	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Female	1.40	0.71, 2.79	1.24	0.66, 2.34	1.31	0.72, 2.40	1.18	0.60, 2.31	1.55	0.82, 2.92	1.58	0.83, 2.98
Ethnicity												
Non-Hispanic	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Hispanic/Latino	1.03	0.28, 3.80	1.89	0.65, 5.51	1.01	0.35, 2.89	1.45	0.44, 4.84	3.76	1.30, 10.88	1.92	0.66, 5.58
Children												
No	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Yes	1.26	0.55, 2.92	0.91	0.41, 2.03	0.59	0.27, 1.32	1.02	0.44, 2.35	1.18	0.54, 2.58	0.78	0.35, 1.73
English literacy												
No	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Yes	1.21	0.57, 2.56	0.94	0.46, 1.92	0.85	0.44, 1.67	1.86	0.87, 3.95	0.80	0.40, 1.63	1.40	0.68, 2.89
Agricultural work												
Formerly	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---	Ref	---
Currently	0.51	0.24, 1.07	0.81	0.40, 1.64	0.99	0.51, 1.91	1.01	0.49, 2.12	0.96	0.48, 1.93	2.07	1.01, 4.23

Table 7: Adjusted mean number of issues described as “definitely a concern” by selected demographic characteristics in 2004, based on an ANCOVA model*

Characteristics	All issues combined (N=170)			Environmental health issues (N=175)			Occupational health issues (N=171)		
	Adjusted mean [†]	95% CI	P value [‡]	Adjusted mean [†]	95% CI	P value [‡]	Adjusted mean [†]	95% CI	P value [‡]
Age in years									
18-34	12.2	10.7, 13.8	0.037	5.5	4.7, 6.3	0.016	6.7	5.8, 7.6	0.214
35-54	14.9	12.9, 16.9		7.1	6.1, 8.2		7.8	6.6, 8.9	
55+	12.4	9.6, 15.2		5.7	4.1, 7.2		6.8	5.2, 8.5	
Gender									
Male	12.3	10.8, 13.9	0.112	5.8	5.0, 6.7	0.323	6.5	5.6, 7.4	0.050
Female	14.0	12.0, 16.1		6.4	5.3, 7.5		7.7	6.5, 8.9	
Children									
No	12.3	9.6, 15.0	0.208	5.7	4.3, 7.1	0.311	6.7	5.1, 8.2	0.308
Yes	14.1	12.9, 15.2		6.5	5.9, 7.1		7.5	6.8, 8.2	

* We asked about a total of 25 issues (12 environmental health issues and 13 occupational health issues)

† Estimated marginal means based on ANCOVA analysis including age category, gender, and parental status as covariates

‡ Based on F-tests in ANCOVA analysis

Table 8: Adjusted mean number of issues described as “definitely a concern” by selected demographic characteristics in 2005, based on an ANCOVA model*

Characteristics	All issues combined (N=199)			Exposures of concern (N=200)			Outcomes of concern (N=204)		
	Adjusted mean [†]	95% CI	P value [‡]	Adjusted mean [†]	95% CI	P value [‡]	Adjusted mean [†]	95% CI	P value [‡]
Age in years									
18-34	9.0	8.0, 10.1	< 0.001	4.8	4.2, 5.4	0.003	4.2	3.6, 4.8	0.001
35-54	12.1	10.8, 13.3		6.3	5.6, 6.9		5.8	5.1, 6.5	
55+	11.1	9.3, 13.0		5.6	4.5, 6.6		5.5	4.5, 6.5	
Gender									
Male	10.1	9.0, 11.1	0.061	5.2	4.6, 5.8	0.064	4.8	4.3, 5.4	0.087
Female	11.4	10.1, 12.7		5.9	5.2, 6.6		5.5	4.8, 6.2	
Children									
No	11.1	9.5, 12.8	0.370	5.8	4.9, 6.8	0.242	5.2	4.3, 6.1	0.749
Yes	10.3	9.6, 11.1		5.2	4.8, 5.7		5.1	4.7, 5.5	

* We asked about a total of 19 issues (10 exposures of concern and 9 outcomes of concern)

† Estimated marginal means based on ANCOVA analysis including age category, gender, and parental status as covariates

‡ Based on F-tests in ANCOVA analysis