A Community-Based Participatory Worksite Intervention to Reduce Pesticide Exposures to Farmworkers and Their Families

Alicia L. Salvatore, DrPH, Jonathan Chevrier, PhD, Asa Bradman, PhD, José Camacho, Jesús López, Geri Kavanagh-Baird, BA, Meredith Minkler, DrPH, and Brenda Eskenazi, PhD

We evaluated a community-based participatory research worksite intervention intended to improve farmworkers' behaviors at work and after work to reduce occupational and take-home pesticide exposures. The workers received warm water and soap for hand washing, gloves, coveralls, and education. Self-reported assessments before and after the intervention revealed that glove use, wearing clean work clothes, and hand washing at the midday break and before going home improved significantly. Some behaviors, such as hand washing before eating and many targeted after-work behaviors, did not improve, indicating a need for additional intervention. (*Am J Public Health*. 2009;99:S578–S581. doi:10.2105/AJPH.2008.149146)

Agricultural pesticide exposure among farmworkers is a long-standing occupational health and environmental justice concern.[1–3] The importance of preventing farmworkers' pesticide exposures is underscored by research documenting exposures to farmworkers' children from agricultural pesticide residues brought home by parents[4–11] and potential adverse neurodevelopmental effects.[12–14] Although effectively preventing pesticide exposures at work is paramount for safeguarding the health of farmworkers and their families, few comprehensive worksite programs, including the Environmental Protection Agency's Worker Protection Standard,[15] have been evaluated.[16]

We conducted a cluster-randomized, controlled trial of a community-based participatory research (CBPR) worksite intervention to reduce farmworkers' occupational and take-home pesticide exposures. To our knowledge, this was the first evaluated worksite intervention that integrated behavioral and environmental components and provision of protective clothing. Here we report the intervention's effect on farmworkers' behaviors; impact on exposure was reported previously.[17]

METHODS

The worksite intervention and evaluation were jointly developed and conducted by university and community partners of the Center for Children's Environmental Health Research at the University of California, Berkeley.[18,19] CBPR principles (e.g., that the work involve a participatory, colearning process, build community capacity, and balance research and action) were followed.[20,21] The Center's Community Advisory Board, Farmworker Council, and field staff, many of whom were former farmworkers, participated throughout the project.

Intervention

Farmworkers (n=130) employed at 2 Monterey County CA, strawberry farms participated in the intervention trial from July through October 2003. Spanish-speaking farmworkers who were 18 years or older and planned to work with their employer throughout the study period were eligible. Six crews were randomized to control or intervention groups.

Consistent with social ecologic theory, the worksite intervention included both individual (e.g., worker education) and environmental (e.g., availability of warm water, soap, and protective clothing) components.[22] At the suggestion of community partners, warm water was made available in hand-washing facilities to reduce cultural barriers (i.e., the belief that washing hands with cold water causes arthritis). Propane water heaters and soap were provided, and water tanks were insulated. Workers received lightweight cotton–polyester coveralls, which they left for laundering at the end of the day in collection bins. Disposable nitrile gloves were available in the field. Four weekly field-based educational sessions were conducted to increase awareness of pesticide exposures, promote safe behavior at work and after work, and troubleshoot barriers to carrying out recommended behaviors. After final data collection, the control group received coveralls, gloves, and training about reducing pesticide exposures.

Data Collection and Analysis

Farmworkers' characteristics and behaviors were assessed before and after 2 months of intervention with a standardized interviewer-administered questionnaire similar to instruments used previously.[8,23–25]

We used multilevel mixed-effects linear, logistic, or Poisson regressions, accounting for clustering, to examine baseline-to-exit changes within and between groups. Final models included group (intervention versus control), time point (baseline versus exit), and an interaction term of group and time point. All observations were included, and we adjusted the models for gender. We considered P values lower than .10 for interaction statistically significant.

RESULTS

Sociodemographic characteristics and behaviors were balanced at baseline (Table 1). Study completion (63%) was similar in the intervention and control groups. Few significant sociodemographic differences were found between farmworkers who did and did not complete the study. Most dropouts (71%) moved or changed employers.

Glove use, wearing clean work clothes, and hand washing at the midday break and before going home improved significantly (Table 2). Almost all (92%) intervention participants used coveralls. We observed few improvements in after-work behaviors.

DISCUSSION

Our results indicated that this intervention was effective in promoting several behaviors that may reduce occupational and take-home pesticide exposures. Absence of improvement in some hand-washing behaviors suggested a need for additional intervention. Decreasing

TABLE 1—Baseline Demographic Characteristics of Participants (N = 130): Monterey County, CA, 2003

	All Participants		Participants Who Completed Study	
	Control Group (n = 56), No. (%) or mean ±SD	Intervention Group (n = 74), No. (%) or mean ±SD	Control Group (n = 34), No. (%) or mean ±SD	Intervention Group (n = 48), No. (%) or mean ±SD
Men	47 (83.9)	60 (81.1)	26 (76.5)	38 (79.2)
Age, y	29.6 ±8.7	30.1 ±9.9	29.3 ±8.9	29.6 ±9.7
Married/Living as married	44 (78.6)	55 (74.3)	24 (70.6)	39 (81.3)
Time living in United States, y	5.4 ±4.6	7.15 ±7.0	6.2 ±5.1	6.9 ±6.5
Time working in US agriculture, y	5.1 ±4.5	6.9 ±6.6	5.9 ±5.1	6.8 ±6.6
Highest level of education				
None	7 (12.5)	6 (8.1)	3 (8.8)	2 (4.2)
Grade 1–6	37 (66.1)	54 (73.0)	24 (70.6)	36 (75.0)
Grade 7–9	9 (16.1)	13 (17.6)	4 (11.8)	9 (18.8)
Some high school	3 (5.4)	1 (1.35)	2 (5.9)	1 (2.1)
Monthly household income, $				
≤750	8 (14.3)	9 (12.2)	5 (14.7)	7 (14.6)
751–1500	30 (53.6)	37 (50.0)	19 (55.9)	24 (50.0)
1501–2000	14 (25.0)	21 (28.4)	8 (23.5)	12 (25.0)
≥2001	4 (7.2)	7 (9.5)	2 (5.9)	5 (10.4)
Annual household income[a]				
Under poverty level	40 (72.7)	47 (63.5)	24 (70.6)	32 (66.7)
<200% of poverty level	12 (21.8)	25 (33.8)	7 (20.6)	14 (29.2)
≥200% of poverty level	3 (5.5)	2 (2.7)	3 (8.8)	2 (4.2)
No. of household members	6.6 ±3.9	8.2 ±6.5	5.8 ±2.3	7.4 ±5.7
No. of household members working in agriculture	1.3 ±0.7	1.5 ±1.8	3.4 ±1.8	4.6 ±5.2
Households that included ≥1 child	38 (67.9)	49 (66.2)	26 (76.5)	34 (70.8)
Households that included ≥1 child aged <6 years	26 (46.4)	30 (40.5)	20 (58.8)	19 (39.6)
Time since receiving information about working safely with pesticides, y				
<1	18 (32.1)	36 (48.7)	8 (23.5)	23 (47.9)
1–<2	6 (10.7)	7 (9.5)	5 (14.7)	6 (12.5)
2–5	6 (10.7)	3 (4.1)	6 (17.7)	2 (4.2)
Did not receive	26 (46.4)	28 (37.8)	15 (44.1)	17 (35.4)

Note. We used the Fisher exact (categorical outcomes) and Mann–Whitney tests (continuous outcomes) to test differences in baseline characteristics between intervention and control groups and between those who did and did not complete the study. Those who did not complete the study reported living with more people than did those who completed the study (mean = 8.9 versus 6.7; $P < .05$).

[a]We calculated workers' poverty levels from the US Department of Health and Human Services' thresholds for 2003. A family of 4 with an annual income of $18 400 or less was considered to be at or below the poverty level; the same family earning between $18 400 and $36 800 was within 200% of the poverty level.

the distance to hand-washing facilities (currently within a quarter mile per regulation), increasing break time (currently 2 breaks for 15 minutes and 1 for 30 minutes), and altering worker payment policies (from piece rate to hourly compensation) might increase hand washing. Difficulty in changing after-work behaviors encountered in this and other studies[26] emphasizes the importance of preventing pesticide exposures at work.

The CBPR orientation and participation of growers and farmworkers in the development of the intervention likely strengthened the intervention's relevance.[27] Although our findings are not generalizable to farmworkers in all crops or regions, applicability to real-world settings, an important facet of external validity, may have been enhanced by the inclusive study design.[28] Study limitations included potential overreporting of behaviors, modest sample size, and relatively short study period. Additional research to assess the effects of this intervention is needed and may be improved by including systematic observation, increasing the number of worksites, and examining the sustainability of behavior change.

Preventing agricultural pesticide exposures to farmworkers and their families is imperative. CBPR, with its focus on engaging critical stakeholders and translating research into

TABLE 2—Behavior Changes in Control and Intervention Groups Between Baseline and End of Intervention Study: Monterey County, CA, 2003

Behavior	Control Group: Baseline (n=56), No. (%) or Mean ±SD	Control Group: End of Study (n=34), No. (%) or Mean ±SD	Control Group: Effect[a] (95% CI)	Intervention Group: Baseline (n=74), No. (%) or Mean ±SD	Intervention Group: End of Study (n=48), No. (%) or mean ±SD	Intervention Group: Effect[a] (95% CI)	Between Groups: Effect[a,b] (95% CI)	Between Groups: P
At work								
Used gloves	23 (41.1)	11 (32.4)	0.3 (0.1, 1.2)	38 (51.4)	38 (79.2)	5.0** (1.7, 14.8)	15.5 (2.5, 94.4)	.003
Wore coverall	0 (0.0)	0 (0.0)	. . .	1 (1.4)	44 (91.7)	. . .	. . .	. . .
Wore clean work clothes	18 (32.1)	13 (23.2)	0.5 (0.2, 1.4)	17 (23.0)	28 (37.8)	3.4** (1.2, 9.0)	7.2 (1.6, 33.2)	.01
Washed hands before eating	46 (82.1)	25 (73.5)	0.6 (0.2, 1.7)	58 (79.5)	41 (85.4)	1.5 (0.5, 4.0)	2.5 (0.6, 10.9)	.22
Washed hands before drinking	28 (50.9)	15 (44.1)	0.7 (0.2, 1.8)	35 (47.3)	29 (60.4)	1.9 (0.8, 4.5)	2.8 (0.7, 10.8)	.13
Washed hands before smoking	8 (36.4)	2 (22.2)	0.8 (0.0, 13.2)	13 (28.3)	12 (50.0)	3.3 (0.6, 19.8)	4.4 (0.2, 109.1)	.37
Washed hands before going to the bathroom	37 (67.3)	23 (67.7)	1.0 (0.3, 3.0)	49 (66.2)	35 (72.9)	1.3 (0.5, 3.4)	1.3 (0.3, 5.7)	.68
Washed hands after going to the bathroom	45 (80.4)	28 (84.9)	2.5 (0.7, 8.2)	59 (79.7)	43 (89.6)	2.5 (0.7, 8.2)	1.9 (0.3, 11.5)	.48
Washed hands at morning break	45 (80.4)	21 (61.8)	0.3** (0.1, 1.0)	55 (74.3)	36 (75.0)	1.0 (0.4, 2.5)	3.1 (0.7, 13.4)	.12
Washed hands at noon break	49 (87.5)	25 (73.5)	0.2* (0.1, 1.1)	59 (79.7)	43 (89.6)	2.6 (0.7, 9.7)	10.7 (1.4, 84.3)	.02
Washed hands at afternoon break	37 (66.1)	11 (32.4)	0.2** (0.0, 0.5)	40 (54.8)	28 (58.3)	1.2 (0.5, 3.0)	7.6 (1.7, 34.4)	.008
Washed hands before going home	35 (62.5)	19 (55.9)	0.8 (0.3, 2.5)	40 (54.1)	35 (72.9)	3.5** (1.2, 10.0)	4.3 (0.9, 20.3)	.06
Times washed hands	3.4 ±1.5	3.6 ±1.4	0.0 (-0.2, 0.2)	3.6 ±1.8	4.2 ±2.0	0.1 (-0.1, 0.3)	0.1 (-0.2, 0.4)	.43
Times washed hands with soap	2.8 ±1.7	3.0 ±1.9	0.1 (-0.2, 0.3)	3.0 ±2.1	3.9 ±1.8	0.2** (0.0, 0.4)	0.1 (-0.2, 0.5)	.39
After work at home								
Removed work shoes outside	55 (98.2)	34 (100.0)	. . .	70 (94.6)	47 (97.9)	1.0 (–1.3, 3.2)	. . .	. . .
Stored work shoes outside	55 (98.2)	33 (97.1)	2.2 (0.5, 8.8)	68 (91.9)	45 (93.8)	1.7 (0.5, 5.4)	0.8 (0.1, 4.7)	.78
Changed work clothes outside	8 (14.3)	4 (11.8)	0.8 (0.0, 15.4)	8 (10.8)	4 (8.3)	0.3 (0.0, 6.3)	0.4 (0.0, 27.4)	.67
Changed work clothes within 15 min of arrival	41 (73.2)	13 (38.2)	0.5 (0.1, 1.4)	45 (60.8)	27 (56.3)	1.7 (0.6, 4.4)	3.7 (0.8, 16.4)	.09
Stored work clothes outside	17 (30.4)	14 (41.2)	2.2 (0.5, 8.8)	24 (32.4)	15 (31.2)	1.7 (0.5, 5.4)	0.8 (0.1, 4.7)	.78
Stored work clothes separately	6 (10.7)	5 (14.7)	1.5 (0.3, 9.0)	8 (10.8)	6 (12.5)	1.1 (0.3, 5.0)	0.7 (0.1, 7.6)	.81
Washed work clothes separately	5 (8.9)	5 (14.7)	2.9 (0.4, 24.0)	8 (10.8)	4 (8.3)	0.4 (0.0, 3.1)	0.1 (0.0, 2.8)	.19
Bathed or showered within 15 min of arrival	31 (55.4)	9 (26.5)	0.4 (0.1, 1.4)	30 (40.5)	17 (35.4)	1.9 (0.7, 5.7)	5.0 (0.9, 27.7)	.06

Note. CI = confidence interval.
[a]Measures of intervention effect were odds ratios for dichotomous variables and mean change for continuous variables that were computed by multilevel mixed models with a random intercept, accounting for the fact that participants, crews, and farms were nested within one another. All models controlled for gender.
[b]Represented baseline-to-end odds ratio of behavior change in the intervention group/ baseline-to-end odds ratio of behavior change in the control group for dichotomous variables and baseline-to-end mean change in behavior in the intervention group/baseline-to-end mean change in behavior in the control group for continuous variables. Models included all participants (n = 130).
$^*P<.10$; $^{**}P<.05$, for within-group comparison of change between baseline and end of study.

action, is a promising orientation through which to address this important environmental justice issue. ■

About the Authors

Alicia L. Salvatore, Jonathan Chevrier, Asa Bradman, Meredith Minkler, and Brenda Eskenazi are with the Center for Children's Environmental Health Research, School of Public Health, University of California, Berkeley. José Camacho and Geri Kavanagh-Baird are with Center for the Health Assessment of Mothers and Children of Salinas (CHAMACOS) and Clínica de Salud del Valle de Salinas, Salinas, CA. Jesús López is with California Rural Legal Assistance, Salinas.

Correspondence should be sent to Brenda Eskenazi, Center for Children's Environmental Health Research, UC Berkeley School of Public Health, 2150 Shattuck Ave, Suite 600 MC 7380, Berkeley, CA 94704 (e-mail: eskenazi@berkeley.edu). Reprints can be ordered at http://www.ajph.org by clicking on the "Reprints/Eprints" link.

This brief was accepted June 5, 2009.

Contributors

A.L. Salvatore coordinated the study, conducted the data analysis, and wrote the article. J. Chevrier assisted with analysis. A. Bradman contributed to the design of the study. J. Camacho, J. López, G. Kavanagh-Baird, and M. Minkler assisted with the study. B. Eskenazi designed and supervised all aspects of the study. All authors conceptualized ideas, interpreted findings, and commented on drafts of the manuscript.

Acknowledgments

This research was funded by the National Institute of Environmental Health Sciences (grants RO1 ES11352 and PO1 ES009605) and by the Environmental Protection Agency (grant RD 83171001).

We gratefully acknowledge the contributions of our Community Advisory Board and Farmworker Council and the farmworkers and growers who participated in this study. We thank Diego Vasquez, Nannette Stamm, Ana Vargas, Lupita Perez-Garnica, Elvia Cabrera, Selene Jaramillo, Bill Brockett, Susan Neal, Erin Weltzien, Amy Marks, Jeannette Kamen, Lisa Goldman Rosas, Rosana Hernandez Weldon, Ellie Gladstone, and David Cramer for their assistance.

Note. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of the funding agencies.

Human Participant Protection

This study was approved by the institutional review board of the University of California, Berkeley. Participants gave written informed consent

References

1. Arcury TA, Quandt SA, McCauley LA. Farmworkers and pesticides: community-based research. *Environ Health Perspect.* 2000;108(8):787–792.

2. Das R, Steege A, Baron S, Beckham J, Harrison R. Pesticide illness in migrant farm workers. *Int J Occup Environ Health.* 2001;7(4):303–312.

3. Calvert GM, Plate DK, Das R, et al. Acute occupational pesticide-related illness in the US, 1998–1999: surveillance findings from the SENSOR-pesticides program. *Am J Ind Med.* 2004;45(1):14–23.

4. Bradman MA, Harnly ME, Draper W, et al. Pesticide exposures to children from California's Central Valley: results of a pilot study. *J Expo Anal Environ Epidemiol.* 1997;7(2):217–234.

5. Loewenherz C, Fenske RA, Simcox NJ, Bellamy G, Kalman D. Biological monitoring of organophosphorus pesticide exposure among children of agricultural workers in central Washington State. *Environ Health Perspect.* 1997;105(12):1344–1353.

6. Fenske RA, Kissel JC, Lu C, et al. Biologically based pesticide dose estimates for children in an agricultural community. *Environ Health Perspect.* 2000;108(6):515–520.

7. Fenske RA, Lu C, Barr D, Needham L. Children's exposure to chlorpyrifos and parathion in an agricultural community in central Washington State. *Environ Health Perspect.* 2002;110(5):549–553.

8. Thompson B, Coronado GD, Grossman JE, et al. Pesticide take-home pathway among children of agricultural workers: study design, methods, and baseline findings. *J Occup Environ Med.* 2003;45(1):42–53.

9. Curl CL, Fenske RA, Kissel JC, et al. Evaluation of take-home organophosphorus pesticide exposure among agricultural workers and their children. *Environ Health Perspect.* 2002;110(12):A787–A792.

10. Arcury TA, Quandt SA, Rao P, et al. Organophosphate pesticide exposure in farmworker family members in western North Carolina and Virginia: case comparisons. *Hum Organ.* 2005;64:40–51.

11. Simcox NJ, Fenske RA, Wolz SA, Lee IC, Kalman DA. Pesticides in household dust and soil: exposure pathways for children of agricultural families. *Environ Health Perspect.* 1995;103(12):1126–1134.

12. Eskenazi B, Bradman A, Castorina R. Exposures of children to organophosphate pesticides and their potential adverse health effects. *Environ Health Perspect.* 1999;107(suppl 3):409–419.

13. Eskenazi B, Marks AR, Bradman A, et al. Organophosphate pesticide exposure and neurodevelopment in young Mexican-American children. *Environ Health Perspect.* 2007;115(5):792–798.

14. McCauley LA, Anger WK, Keifer M, Langley R, Robson MG, Rohlman D. Studying health outcomes in farmworker populations exposed to pesticides. *Environ Health Perspect.* 2006;114:953–960.

15. Code of Federal Regulations. Pesticide Worker Protection Standard. 40 CFR Part 170. Available at: http://www.epa.gov/pesticides/safety/workers/PART170.htm. Accessed October 21, 2009.

16. Keifer MC. Effectiveness of interventions in reducing pesticide overexposure and poisonings. *Am J Prev Med.* 2000;18(4 suppl):80–89.

17. Bradman A, Salvatore AL, Boeniger M, et al. Community-based intervention to reduce pesticide exposure to farmworkers and potential take-home exposure to their families. *J Expo Sci Environ Epidemiol.* 2009;19:79–89.

18. Eskenazi B, Bradman A, Gladstone EA, Jaramillo S, Birch K, Holland N. CHAMACOS, a longitudinal birth cohort study: lessons from the fields. *J Child Health.* 2003;1(1):3–27.

19. Israel BA, Parker EA, Rowe Z, et al. Community-based participatory research: lessons learned from the Centers for Children's Environmental Health and Disease Prevention Research. *Environ Health Perspect.* 2005;113(10):1463–1471.

20. Israel BA, Schulz AJ, Parker EA, Becker AB. Review of community-based research: assessing partnership approaches to improve public health. *Annu Rev Public Health.* 1998;19:173–202.

21. Green LW, George MA, Frankish CJ, Herbert CJ, Bowie WR, O'Neil M. *Study of Participatory Research in Health Promotion: Review and Recommendations for the Development of Participatory Research in Health Promotion in Canada.* Ottawa: Royal Society of Canada; 1995.

22. Stokols D, Pelletier K, Fielding J. The ecology of work and health: research and policy directions for the promotion of employee health. *Health Educ Q.* 1996;23(2):137–158.

23. Goldman L, Eskenazi B, Bradman A, Jewell N. Risk behaviors for pesticide exposure among pregnant women living in farmworker households in Salinas, California. *Am J Ind Med.* 2004;45:491–499.

24. Arcury TA, Quandt SA, Russell GB. Pesticide safety among farmworkers: perceived risk and perceived control as factors reflecting environmental justice. *Environ Health Perspect.* 2002;110(suppl 2):233–240.

25. McCauley LA, Lasarev MR, Higgins G, et al. Work characteristics and pesticide exposures among migrant agricultural families: a community-based research approach. *Environ Health Perspect.* 2001;109(5):533–538.

26. Arcury TA, Marín A, Snively BM, Hernández-Pelletier M, Quandt SA. Reducing farmworker residential pesticide exposure: evaluation of a lay health advisor intervention. *Health Promot Pract.* 2009;10:447–455.

27. Green LW, Glascow RE. Evaluating the relevance, generalization, and applicability of research: issues in external validation and translation methodology. *Eval Health Prof.* 2006;29(1):126–153.

28. Green LW. Making research relevant: if it is an evidence-based practice, where's the practice-based evidence? *Fam Pract.* 2008;25(suppl 1):i20–i24.

Pesticide Exposure and Occupational Safety Training of Indigenous Farmworkers in Oregon

Julie Samples, JD, Elizabeth A. Bergstad, MPH, Santiago Ventura, BS, Valentin Sanchez, Stephanie Ann Farquhar, PhD, and Nargess Shadbeh, JD

This follow-up study assessed indigenous and Latino farmworkers' occupational health and safety needs and measured variables related to pesticide exposure and pesticide safety training among this population. Results yielded differences between indigenous workers and Latino workers related to language barriers, experiences of workplace discrimination, preferred modes of information dissemination, pesticide exposures, and sufficiency of pesticide training. Employing more people who speak indigenous languages as interpreters, community and organizational leaders, and health workers may remove some of the linguistic and cultural barriers to occupational safety training. (*Am J Public Health.* 2009;99:S581–S584. doi:10.2105/AJPH.2009.166520)

Pesticide use in the United States exceeds 1.2 billion pounds per year.[1] Consequently, migrant agricultural workers in this country are likely to have high rates of pesticide exposure. The negative health effects associated with pesticide exposures are numerous.[2,3] Many of these effects are exacerbated for farmworkers from ethnic groups indigenous to Mexico and Guatemala that have linguistic and cultural histories different from those of Latino migrant populations. Roughly 40% of the 174 000 farmworkers in Oregon are indigenous persons from Mexico and Guatemala.[4,5] The lack of standardized written forms for many indigenous languages and the lack of knowledge regarding indigenous populations are barriers to providing occupational health and safety training to these workers.

This article follows up on our November 2008 article[6] that presented our study's baseline survey findings. Our project was funded by the National Institute of Environmental Health Sciences and the National Institute for Occupational Safety and Health, and involved community partners from the Oregon Law Center, Salud Medical Center, Pineros y Campesinos Unidos del Noroeste (Northwest Treeplanters and Farmworkers United), the Portland State University School of Community Health, and Farmworker Justice. Here we present the findings of our follow-up survey and comparisons between baseline and follow-up survey results.

METHODS

With input from all project partners,[7] we used previously validated survey tools that had been used with farmworkers[5,8,9] to develop a baseline survey written in Spanish. Between April and October 2006, the indigenous community educator partners administered the baseline survey at labor camps, farmworker homes, and community centers.[6] The indigenous community educator partners administered the follow-up surveys between May and July 2008 at locations similar to those used for the baseline survey, in the Willamette Valley region of Oregon.

Project partners then prerecorded the baseline and follow-up surveys in the Mixteco Alto, Mixteco Bajo, and Triqui (Copala) indigenous languages to ensure that survey questions were linguistically appropriate. Of the 73 indigenous workers surveyed at follow-up, 45 spoke Mixteco or Triqui. Of those, 31 (69%) chose to complete the survey using the prerecorded tapes in their indigenous languages. We used SPSS version 15.0 (SPSS Inc, Chicago, IL) to analyze the follow-up data. Post hoc analyses that used the Bonferroni test were computed for significant ANOVAs to locate the differences between indigenous and time categories.

RESULTS

Of the 150 follow-up surveys administered, 73 were completed by indigenous workers and 77 were completed by Latino workers; 33% of respondents were female (Table 1). All respondents were from Mexico, and respondents reported speaking 12 native languages. The overwhelming majority of indigenous farmworkers did not identify Spanish as their primary language; rather, they named an indigenous language as their primary language. Indigenous workers were younger (35.9 vs 38.4 years), had less formal education in Mexico (4.3 vs 5.8 years), and had been in Oregon and the United States for a shorter period of time (5.5 vs 8.5 and 7.1 vs 11.2 years) than had Latino workers. Indigenous workers reported more individuals living in their households (6.3 persons) than did Latino workers (5.1 persons; $P < .01$).

When comparing job types on the basis of indigenous and nonindigenous status, we found significant differences between groups ($P < .001$). The most common job reported at follow-up was farm work, with 41% of respondents employed in that manner. Farm work employed 53% of indigenous workers and 29% of Latino workers. The next most commonly reported job was plant nursery work, reported by 30% of indigenous workers and 18% of Latino workers. Latinos were more likely to be employed in orchards (26%) and canneries (17%) than were indigenous workers (4% in orchards and 11% in canneries).

We found differences between indigenous and Latino workers with regard to workplace discrimination because of the worker speaking a native language ($P < .001$). Of those who reported experiencing workplace discrimination, 30% of indigenous workers reported discrimination because of speaking a native language, compared with the 8% of Latino workers who reported experiencing workplace discrimination for the same reason.

More indigenous than Latino participants reported that they had been treated by physicians who were unable to speak their native language ($P < .01$). Sixty-three percent of respondents reported having a physician who could not speak their native language (79% of all

TABLE 1—Demographic Characteristics of Follow-up Survey Participants (N = 150): Latino and Indigenous Workers, Willamette Valley, Oregon, May–July 2008

	Total Sample, Mean or No. (%)	Latino, Not Indigenous, Mean or No. (%)	Indigenous, Mean or No. (%)
Age, y	37.24	38.42	35.91
Years of education in Mexico[a]	5.1	5.8	4.28
Years lived in the United States[a]	9.23	11.21	7.13
Years lived in Oregon[a]	7.7	9.1	6.4
Gender			
Men	101 (67%)	52 (67%)	49 (67%)
Women	49 (33%)	25 (33%)	24 (33%)
No. people in home[a]	5.7	5.08	6.33
Type of work[a]			
Orchard	23 (15%)	20 (26%)	3 (4%)
Plant nursery	36 (24%)	14 (18%)	22 (30%)
Cannery	21 (14%)	13 (17%)	8 (11%)
Farm work	61 (41%)	22 (29%)	39 (53%)
Forestry	6 (4%)	6 (8%)	0 (0%)
Other	3 (2%)	1 (1%)	2 (3%)
Reported workplace discrimination as a result of speaking a native language[a]	27 (18%)	6 (8%)	21 (30%)
Had a doctor who did not speak native language[a]	43 (63%)	13 (43%)	30 (79%)
Interpreter was not provided during doctor's visit[a]	12 (20%)	0 (0%)	12 (32%)

Note. Percentages reported were calculated as a proportion of all respondents who answered each individual question. For non-indigenous Latinos, n = 77; for indigenous Latinos, n = 73.
[a]Differences between indigenous and Latino participants are significant at $P < .01$.

indigenous respondents and 43% of all Latino respondents). When asked about whether an interpreter had been provided when a physician did not speak a native language, all of the respondents who noted that no interpreter was provided were indigenous ($P<.01$).

Self-Reported Pesticide Exposure and Training

We identified significant differences between indigenous and Latino worker groups when comparing baseline and follow-up survey responses with regard to current pesticide exposures ($P<.001$), not ever working with pesticides ($P<.05$), and sufficiency of pesticide training (Table 2). At follow-up, more indigenous workers (43%) reported currently being exposed to pesticides than did Latino workers (25%); at baseline, the opposite had been reported, with fewer indigenous workers (31%) reporting current exposure to pesticides than did Latino workers (65%). Among the total subset of 136 farmworkers (80 respondents at follow-up) who reported that they never worked with pesticides, at follow-up more indigenous workers (86%) reported never working with pesticides than did Latino workers (77%).

Indigenous workers reported an increase in sufficiency of training at follow-up ($P<.05$), less written training overall ($P<.01$), and more written training in Spanish ($P<.001$). Latino respondents reported a decrease in written training ($P<.01$)—including written training in Spanish ($P<.001$)—from baseline to follow-up. Additionally, there was a decrease in the percentage of Latino respondents who reported not receiving training via individual presentation ($P<.05$). Table 2 presents data on pesticide training frequency, adequacy, and type as reported by both groups of farmworkers.

DISCUSSION

One of this study's limitations is its repeated-panel design, which does not track the same farmworkers over time. Such a design captures the net change of all of the changes, so changes should be interpreted with caution.[10] Also, the small sample size may reduce the study's statistical power and the generalizability of the study's findings to farmworkers who live outside of Oregon.

Our finding regarding the increased proportion of occupational training in Spanish for indigenous populations is cause for concern. Although indigenous workers reported more training in Spanish at follow-up than at baseline, it is unlikely that training in Spanish is the most effective means for conveying information to indigenous workers regarding pesticide exposures. It is encouraging that when training is provided, it is more likely to be presented orally than in writing, but it may be overly optimistic to assume that indigenous workers feel comfortable engaging with or requesting clarification from a presenter who does not speak their native language. Such reluctance, if it exists, could be caused by the identified discrimination against speakers of indigenous languages. This study did not evaluate the substantive content or adequacy of training.

Indigenous workers were more likely to report that their physician did not speak their language and that they were not provided with an interpreter in such health care settings. To reduce language and cultural barriers to health care access, more *promotores* (community health workers) should be deployed to meet the needs of the Latino and indigenous populations.[11,12] To address this issue, the project supported placement of an indigenous-language-speaking interpreter with the partner clinic.

At both baseline and follow-up survey administration, 69% of workers who spoke an indigenous language elected to complete the survey using prerecorded materials in their own language, rather than completing a survey written in Spanish. Our findings suggest that employing more people who speak indigenous languages as organizational leaders, interpreters, and health workers may help reduce some of the linguistic and cultural barriers to occupational safety training and other health and social services identified in this study. ■

TABLE 2—Comparison of Baseline and Follow-up Survey Results for Pesticide Exposure and Safety Training: Latino and Indigenous Workers, Willamette Valley, Oregon, May–July 2008

	Baseline, No. (%)	Follow-up, No. (%)	P[a]
Currently exposed to pesticides			
Indigenous workers	21 (31)	29 (43)	.002
Latinos	46 (65)	19 (25)	
Never worked in pesticides			
Indigenous workers	36 (75)	37 (86)	.038
Latinos	20 (71)	43 (77)	
Training was sufficient			
Indigenous workers	13 (72)	26 (81)	.039
Latinos	18 (82)	13 (81)	
No individual training presentation			
Indigenous workers	16 (80)	26 (79)	.019
Latinos	21 (78)	11 (65)	
Received written training			
Indigenous workers	8 (40)	10 (30)	.009
Latinos	17 (63)	3 (18)	
Received written training in Spanish			
Indigenous workers	3 (38)	22 (92)	.001
Latinos	13 (81)	5 (56)	

Note. Percentages reported were calculated as a proportion of all respondents who answered each individual question at each data measurement point. The total number of respondents varies for each question. For both baseline and follow-up, N = 150.
[a]P value reported indicates differences between baseline and follow-up results that are significant at $P<.01$.

About the Authors

Julie Samples, Santiago Ventura, Valentin Sanchez, and Nargess Shadbeh are with the Oregon Law Center, Portland. Elizabeth A. Bergstad and Stephanie Ann Farquhar are with the School of Community Health, Portland State University, Portland, OR.

Correspondence can be sent to Stephanie A. Farquhar, PhD, School of Community Health, Portland State University, P.O. Box 751, Portland, OR 97207-0751 (e-mail: farquhar@pdx.edu). Reprints can be ordered at http://www.ajph.org by clicking on the "Reprints/Eprints" link.

This brief was accepted June 9, 2009.

Contributors

J. Samples, S. Ventura, V. Sanchez, and N. Shadbeh provided expertise on farmworker communities in Oregon and helped develop research instruments, interpret data, and write the article. E.A. Bergstad analyzed and interpreted the data and contributed to article writing and editing. S.A. Farquhar facilitated development and implementation of research instruments and protocol, analyzed and interpreted data, and helped write the article. N. Shadbeh conceptualized the study and supervised all aspects of implementation and evaluation.

Acknowledgments

This research was supported by a grant from the National Institute for Occupational Safety and Health and the National Institute of Environmental Health Sciences (grant R25-OH008334-01).

This article's contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Institute for Occupational Safety and Health.

Human Participant Protection

The Portland State University institutional review board approved this study.

References

1. Kiely T, Donaldson D, Grube A. *Pesticides Industry Sales and Usage: 2000 and 2001 Market Estimates.* Washington, DC: Environmental Protection Agency; 2004.

2. Villarejo D, McCurdy SA. The California agricultural workers health survey. *J Agric Saf Health.* 2008;14:135–146.

3. Arcury TA, Quandt SA, Cravey AJ, Elmore RC, Russell GB. Farmworker reports of pesticide safety and sanitation in the work environment. *Am J Ind Med.* 2001;39:487–498.

4. Larson A. *Migrant Farmworker Seasonal Enumeration Profiles Study: Oregon.* Portland, OR: Dept of Human Services Migrant Health Office; 2002.

5. McCauley LA, Lasarev MR, Higgins G, et al. Work characteristics and pesticide exposures among migrant agricultural families: a community-based research approach. *Environ Health Perspect.* 2001;109:533–538.

6. Farquhar S, Shadbeh N, Samples J, Ventura S, Goff N. Occupational conditions and well-being of indigenous farmworkers. *Am J Public Health.* 2008;98:1956–1959.

7. Israel B, Schulz A, Parker E, Becker A. Review of community-based research: assessing partnership approaches to improve public health. *Annu Rev Public Health.* 1998;19:173–202.

8. McCauley LA, Stickler D, Bryan C, Lasarev MR, Scherer JA. Pesticide knowledge and risk perception among adolescent Latino farmworkers. *J Agric Saf Health.* 2002;8:397–409.

9. Farquhar S, Samples J, Ventura S, et al. Promoting the occupational health of indigenous farmworkers. *J Immigr Minor Health.* 2008;10:269–280.

10. Firebaugh G. *Analyzing Repeated Surveys.* Thousand Oaks, CA: Sage Publications; 1997.

11. McGuire S. Agency, initiative, and obstacles to health among indigenous immigrant women from Oaxaca, Mexico. *Home Health Care Manag Pract.* 2006;18(5):370–377.

12. Elder JP, Ayala GX, Parra-Medina D, Talavera GA. Health communication in the Latino community: issues and approaches. *Annu Rev Public Health.* 2009;30:227–251.

Community Collaborations for Farmworker Health in New York and Maine: Process Analysis of Two Successful Interventions

Giulia Earle-Richardson, PhD, Julie Sorensen, PhD, Melissa Brower, MPH, Lynae Hawkes, MA, and John J. May, MD

We conducted a process evaluation of 2 successful farmworker community-based participatory research intervention development projects (in Maine and New York State). Participant surveys measured satisfaction with the program process. We used qualitative methods to analyze free-text responses. Respondents indicated high satisfaction levels overall. The main concern was long-distance project coordination. Community-based participatory research programs in which (1) the work team defines the target health issue, (2) agricultural employers are meaningfully included, and (3) interventions are carried through to completion, warrant further study. (*Am J Public Health.* 2009;99:S584–S587. doi:10.2105/AJPH.2009.166181)

The Community Collaborations for Farmworker Safety and Health Project was established in 2003 as part of the Environmental Justice Initiative. We initiated the project in Washington County, Maine, and in the Hudson Valley of New York, in collaboration with a farmworker service agency and a physician in each location. This initiative was jointly sponsored by the National Institute of Occupational Safety and Health and the National Institute for Environmental Health Sciences; its goal was to establish community-based interventions that assisted populations that had traditionally suffered health disparities as a result of occupational or environmental conditions. The program model was based on hiring a local site coordinator, who then facilitated the recruitment and training of a local work team representing the agricultural community: farmworkers, farm owners, health care providers, and agricultural and community service agency representatives.

In Maine, the coalition developed and successfully piloted an ergonomically enhanced blueberry-harvesting rake. In New York, the program targeted eye irritation caused by high levels of extremely fine dust present in the "black dirt" region, with an intervention consisting of eyewear, eyewash, and training. Both interventions were subsequently evaluated with randomized trials and were found to be effective[1,2] (J.J.M., L.H., unpublished data, 2008). Regardless, understanding why the programs were successful is equally important. To answer this question, we collected process evaluation data throughout the project. Process evaluation breaks down a program into its component parts (e.g., forming a representative work team, making group decisions, and implementing the intervention) and seeks to understand how each unfolded from the point of view of the participants. It tells researchers how implementation was experienced, and if there were any unintended consequences. Process evaluation is a mechanism for systematically listening to participants and, thus, it is difficult to imagine a successful community-based participatory research (CBPR) program that does not include it.

METHODS

To evaluate participants' satisfaction and to solicit program feedback, we conducted structured interviews with work team members at the end of each of 4 program years (2004 through 2007). We aggregated responses and analyzed free-text comments for relevant themes.[3,4]

RESULTS

A total of 60 surveys was completed from 2004 through 2007 (n=20; n=13; n=14; and n=13, each year respectively) by farmworkers (n=9), farm owners (n=11), medical professionals (n=4), farmworker or agricultural service agency representatives (n=6), farm equipment dealers (n=2), and health center staff (n=28; many were former farmworkers). The mean response rate for the 4 years was 42.9%. This reflected the difficulty of reaching farmworkers to interview (16.4% farmworker participation), whereas the participation rate within the other participant categories was much higher (60%).

Work team member satisfaction increased over the course of the project, with 45% (n=8) indicating that they were "satisfied" or "very satisfied" in year 1, and 92% indicating the same (n=12) by year 4. Table 1 shows positive response frequencies for a range of process questions. A majority of participants also rated the dissemination positively (100%; n=9), felt it had affected the community (79%; n=11), and believed that the project could continue into the future (100%; n=12).

As shown in Table 2, the 1 theme identified throughout all 4 years of the program was that coordinating the project from a distance made it very difficult to run the project. As one participant put it: "Yes, [there were problems, missed opportunities] because your facilitators do not live in the community, it's difficult for them to build trust and community relationships, although they try. Spend more time in the community."

DISCUSSION

The process evaluation data for the Community Collaborations for Farmworker Safety and Health Project show high levels of satisfaction, particularly in later years. It is notable that some of the most critical participant respondents in the first year became enthusiastic supporters by the end. Although it is difficult to say definitively why the satisfaction ratings were high, there are some relatively unique aspects to the program model to consider. First, the agricultural health topic was chosen by the work team during the project period. This approach puts it within a relatively small group of agricultural health CBPR programs.[5–7]

TABLE 1—Community Work Team Interview Responses, Farmworker Safety and Health Project, Washington County, Maine, and Hudson Valley of New York: 2004–2006

	No.	%
Any group not adequately represented in the coalition		
No	10	53
Yes, primary health physicians	4	21
Yes, migrant farmworkers	4	21
Yes, White [local] blueberry rakers	1	5
No answer	1	
Not applicable	1	
Total respondents in 2004	19	
Perceived that people or agencies dropped out of coalition		
No	9	69
Yes[a]	4	31
Not applicable	1	
Total respondents in 2006	13	
Participant rating of meeting quality		
Excellent	4	21
Good to excellent	3	16
Good	9	47
Fair to good	2	11
Fair	1	5
Not applicable	1	
Total respondents in 2004	19	
Perceived extent of participation in meetings		
Pretty broad participation by everyone	10	67
Several people talked but many people did not	3	20
Latinos did not speak out as much as I would have liked	1	7
Too much participation by researchers	1	7
No answer	2	
Not applicable	3	
Total respondents in 2004	15	
Perceived any problems or missed opportunities		
Yes[b]	5	50
No	5	50
Not applicable	3	
Total respondents in 2005	10	
Perceived manner in which topic was chosen		
Input from most or all coalition members	8	80
Everyone's opinion was entertained but final choice made by researchers	1	10
Input from a few influential members	1	10
Not applicable	3	
Total respondents in 2005	10	
Satisfaction with final choice of topic		
Very satisfied	6	46
Satisfied	1	8
Somewhat satisfied	6	46
Total respondents in 2005	13	

[a]Scheduling conflicts, transportation, uncomfortable bringing their children.
[b]Stated problems or missed opportunities were: clinic not accessible during peak harvest, power imbalance in the coalition, key project resource people added late, team unfocused or too slow, wide variability in raker skill level, logistics of collaborating over large geographic area, getting farmworker input.

Second, the work team included both farmworkers and agricultural employers together, and there was substantial interaction between them. In fact, the work team in New York ultimately selected a health issue that affected workers and farm owners equally, thus strengthening the coalition. As one work team member put it: "a community impact has been better understanding between all members of the work team." A few other CBPR farmworker programs[5,8,9] have involved agricultural employers in their community work teams, with similarly positive results.

Third, the project progressed all the way from initial issue selection, through intervention development and implementation, to final evaluation. This provided a sense of accomplishment, and may explain increased participant ratings over time. Few CBPR

TABLE 2—Pervasive Qualitative Work Team Themes: Community Collaborations for Farmworker Safety and Health Project, Washington County, Maine, and Hudson Valley of New York, 2004–2007

	2004	2005	2006	2007
Presence				
Running project from a distance (not being located in the community) makes it very difficult	X	X	X	X
More frequent communication			X	X
Power				
Would like more leadership training for community work team members	X	X	X	
More effort needed to equalize power within the coalition	X		X	X
Work pace and time				
Agricultural season busy and unpredictable; need flexibility and to accommodate people's schedules more	X		X	
Participation				
Farmworkers should be leaders and bigger contributors	X	X		
Farmworkers do not have time (already moved on to other jobs)	X	X	X	
Difficult for individuals to make a commitment to a project that requires monthly participation	X			
Physicians do not participate enough (interested but either overcommitted or burned out)	X	X	X	
Participation of growers, farmworkers, and doctors was not as good as hoped			X	X
Intervention themes				
Some issues with the intervention's protective eyewear		X	X	
Demand has grown for the intervention among farmworkers			X	X
Impacts				
Interaction between work teams and farmworkers is positive		X	X	
Increased awareness of problems in community		X	X	
Better understanding between farmworkers and growers	X	X	X	
Affective				
Very committed leadership	X	X		
Things got better over time			X	X

health programs of this type are found in the literature.[10,11] More typically, CBPR occupational health projects have focused in a limited way on such aspects as issue identification[5,7] or intervention development,[8,12–15] although sometimes the predetermined issue comes directly from the community.[6,16,17] These 3 program aspects warrant further exploration and development.

On the qualitative side, respondents were disappointed with farmworker and physician representation on the work team. Although substantial input from farmworkers was obtained through focus groups, individual interviews, and community forums, respondents had apparently hoped to see greater roles played on the work teams. Further research into participant expectations[18] is needed.

Perhaps the issue of greatest concern is the view that the projects were limited by being coordinated from a distance. The perception was that the main driver of the projects was the research project coordinator, rather than the local site coordinator. Placing more control in the hands of local staff leaves open the question of how researchers' accountability to the funding institution can be responsibly fulfilled without this control. The dilemma of accountability and control versus community ownership is a thorny one that has been raised previously.[19] Resolving it will be one of the major challenges for CBPR practitioners in the coming years. ■

About the Authors

The authors are with the New York Center for Agricultural Medicine and Health, Bassett Healthcare, Cooperstown, NY.

Correspondence should be sent to Giulia Earle-Richardson, New York Center for Agricultural Medicine & Health, Bassett Healthcare, One Atwell Rd, Cooperstown, NY 13326 (e-mail: giulia.earle-richardson@bassett.org). Reprints can be ordered at http://www.ajph.org by clicking on the "Reprints/Eprints" link.

This brief was accepted on July 2, 2009.

Contributors

G. Earle-Richardson originated and supervised the evaluation and led the writing. J. Sorensen assisted with the qualitative analysis and with writing the article. M. Brower assisted with the quantitative analysis and with writing the article. L. Hawkes coordinated the program and assisted with the evaluation analysis and with writing the article. J. J. May originated the program, led its implementation, and assisted with the analysis and with writing the article.

Acknowledgments

This work was supported by an Environmental Justice grant from the National Institute for Occupational Safety and Health (R25 OHO8144-02).

The authors would also like to acknowledge the Downeast Maine and the Hudson Valley, New York, Community Collaboration work team members for all of their hard work and dedication.

Human Participant Protection

All research and evaluation procedures were approved by the Mary Imogene Bassett Hospital institutional review board, and all study personnel were institutional review board certified.

References

1. May J, Hawkes L, Jones A, et al. Evaluation of a community-based effort to reduce blueberry harvesting injury. *Am J Ind Med.* 2008;51:307–315.

2. Hawkes L, May J, Paap K, Santiago B, Ginley B. Identifying the occupational health needs of migrant workers. *J Comm Pract.* 2007;15(3):57–76.

3. Aronson J. A pragmatic view of thematic analysis. *Qualitative Rep*, 1994;2(1). Available at: http://www.nova.edu/ssss/QR/BackIssues/QR2-1/aronson.html. Accessed March 24, 2009.

4. Boyatzis R. *Transforming Qualitative Information. Thematic Analysis and Code Development.* Thousand Oaks, CA: Sage Publications; 1998.

5. Crowe JL, Keifer MC, Salazar MK. Striving to provide opportunities for farm worker community participation in research. *J Agric Saf Health.* 2008;14:205–219.

6. Wing S, Horton RA, Muhammad N, Grant GR, Tajik M, Thu K. Integrating epidemiology, education, and organizing for environmental justice: community health effects of industrial hog operations. *Am J Public Health.* 2008;98:1390–1397.

7. Farquhar S, Samples J, Ventura S, et al. Promoting the occupational health of indigenous farmworkers. *J Immigr Minor Health.* 2008;10:269–280.

8. McCauley LA, Beltran M, Phillips J, Lasarev M, Sticker D. The Oregon migrant farmworker community: an evolving model for participatory research. *Environ Health Perspect.* 2001;109(Suppl 3):449–455.

9. Thompson B, Coronado G, Puschel K, Allen E. Identifying constituents to participate in a project to control pesticide exposure in children of farmworkers. *Environ Health Perspect.* 2001;109(Suppl 3):443–448.

10. Helitzer D, Willging C, Hathorn G, Benally J. Building community capacity for agricultural injury prevention in a Navajo community. *J Agric Saf Health.* 2009;15(1):19–35.

11. Andrews JO, Bentley G, Crawford S, Pretlow L, Tingen MS. Using community-based participatory research to develop a culturally sensitive smoking cessation intervention with public housing neighborhoods. *Ethn Dis.* 2007;17:331–337.

12. Pehkonen I, Takala EP, Ketola R, et al. Evaluation of a participatory ergonomic intervention process in kitchen work. *Appl Ergon.* 2009;40(1):115–123.

13. Dick J, Clarke M, van Zyl H, Daniels K. Primary health care nurses implement and evaluate a community outreach approach to health care in the South African agricultural sector. *Int Nurs Rev.* 2007;54:383–390.

14. Flocks J, Clarke L, Albrecht S, Bryant C, Monaghan P, Baker H. Implementing a community-based social marketing project to improve agricultural worker health. *Environ Health Perspect.* 2001;109(Suppl 3):461–468.

15. Arcury TA, Austin CK, Quandt SA, Saavedra R. Enhancing community participation in intervention research: farmworkers and agricultural chemicals in North Carolina. *Health Educ Behav.* 1999;26:563–578.

16. Lipscomb HJ, Argue R, McDonald MA, et al. Exploration of work and health disparities among black women employed in poultry processing in the rural south. *Environ Health Perspect.* 2005;113:1833–1840.

17. Quigley D, Handy D, Goble R, Sanchez V, George P. Participatory research strategies in nuclear risk management for native communities. *J Health Commun.* 2000;5:305–331.

18. Quandt SA, Arcury TA, Pell AI. Something for everyone? A community and academic partnership to address farmworker pesticide exposure in North Carolina. *Environ Health Perspect.* 2001;109(Suppl 3):435–441.

19. Parker EA, Israel BA, Williams M, et al. Community action against asthma: examining the partnership process of a community-based participatory research project. *J Gen Intern Med.* 2003;18:558–567.

Nutrition Content of Food and Beverage Products on Web Sites Popular With Children

Elena O. Lingas, DrPH, Lori Dorfman, DrPH, and Eliana Bukofzer, MPH

We assessed the nutritional quality of branded food and beverage products advertised on 28 Web sites popular with children. Of the 77 advertised products for which nutritional information was available, 49 met Institute of Medicine criteria for foods to avoid, 23 met criteria for foods to neither avoid nor encourage, and 5 met criteria for foods to encourage. There is a need for further research on the nature and extent of food and beverage advertising online to aid policymakers as they assess the impact of this marketing on children. (*Am J Public Health.* 2009;99:S587–S592. doi:10.2105/AJPH.2008.152918)

Children and youths often visit Web sites designed especially for them.[1,2] The top food and beverage advertisers on children's television have branded Web sites designed to appeal to children,[3] and these companies are innovators in the digital marketing ecosystem.[4] The Institute of Medicine (IOM) has established that food and beverage marketing encourages children to request and eat foods that are not good for them; therefore, the IOM has recommended a reduction in children's exposure to such marketing.[5]

Evidence shows that online advertising builds favorable attitudes toward brands, regardless of whether site visitors remember seeing advertisements.[6] Yoo exposed undergraduate students to Web banner advertisements and found that students who had been exposed to an advertisement for a brand were more likely to choose that brand in a later test than were those not exposed to the advertisement for that brand.[6] To date, only a handful of studies in the United States[3,4,7,8] and Australia[9] have documented the evolving online food-marketing environment targeting children and youth. Moore[3] documented the range and extent of marketing techniques designed to engage children with company brands on food and beverage company Web sites. A 2007 report documented additional modes of targeting children and youth with food and beverage product marketing in the digital age—including mobile marketing, branding instant messaging, viral video, and commercializing online communities.[4] A content analysis of 10 children's Web sites found that the foods marketed on the sites were not well suited to a healthful diet.[7] Weber et al. found that the Web sites of 40 top food and beverage brands used "advergames" and cartoon characters to engage children with their brands.[8] The Australian study found similar engagement techniques and references to unhealthful branded foods on popular Australian Web sites targeted toward children.[9]

In an attempt to provide further information on the food and beverage marketing to which children are exposed online, we examined Web sites popular with children to determine whether the sites contained depictions of branded foods and beverages. We also assessed the nutritional value of any marketed products on these Web sites and evaluated their appropriateness for school-age children.

METHODS

We purchased a ranking of the top 30 children's Web sites in the United States for October 2006 (the most recent month available when the study commenced) from Hitwise, an online activity tracking company.[10] The ranking was ordered by number of visits. Because of the complexity and dynamism of Web sites, our study was exploratory. We did not have multiple coders, which precluded assessment of intercoder reliability. Between July 11, 2007, and August 28, 2007, E.B. examined each of the 30 home pages (and every page 1 click away from each home page) for the presence of advertisements for branded foods or beverages.

When we identified a branded product per the methods just described, we assessed the product's nutritional content using the IOM's 2007 standards for "competitive" foods in

TABLE 1—Branded Food and Beverage Products Found on the 30 Most Popular Children's Web Sites (Ranked by US Site Visits) for October 2006: July–August 2007

Web Site	Branded Food or Beverage Product	Present on Home Page	Present 1 Click Away From Home Page
Disney Channel	Teddy Grahams Oatmeal snacks		X
	Splenda artificial sweetener		X
Cartoon Network	Cheez-It Stix crackers	X	X
	Cheese Nips crackers		X
	McDonalds Happy Meal		X
	Red Robin restaurant		X
	Sour Patch Extreme candy	X	X
Neopets	Apple Jacks cereal		X
	Cocoa Krispies cereal		X
	Gushers Fruit Snacks		X
	M&Ms candy		X
	Skittles candy		X
Disney Online	Baked Cheetos snacks		X
	Cheez-It Stix crackers		X
	Horizon Organic Milk		X
	PUR Water		X
	Splenda artificial sweetener		X
Nickelodeon Online	Apple Jacks cereal	X	
	Cheez-It Stix crackers		X
	Cinnamon Toast Crunch cereal		X
	Froot Loops cereal		X
	Froot Loops Cereal Straws snack		X
	Froot Loops Smoothie cereal		X
	Fruity Pebbles cereal		X
	Honey Nut Cheerios cereal		X
	Kid Cuisine frozen dinner		X
	Kraft Macaroni and Cheese		X
	Lunchables Pizza		X
	Reeses Puffs cereal		X
	Splitz Pop-Tarts		X
	Teddy Grahams Oatmeal snacks		X
PBS Kids	Arby's restaurant		X
	Chick-Fil-A restaurant		X
	Chuck E. Cheese's restaurant		X
	McDonald's restaurant		X
	Stonyfield Farm Organic Yo Baby yogurt		X
Millsberry	Cinnamon Toast Crunch cereal		X
	French Toast Crunch cereal		X
	Lucky Charms cereal	X	X
	Reese's Puffs cereal		X
Nick Jr	Eggo Waffles		X
	FruitaBu Organic Fruit snacks		X
	McDonald's Asian Salad		X
	PUR Water		X
	Quaker snack bars		X
	Teddy Grahams Oatmeal snacks		X

Continued

TABLE 1—*Continued*

Barbie	No food or beverage products		
My Scene	No food or beverage products		
Fun Brain	Domino's Pizza restaurant		X
	M&Ms candy		X
	McDonald's Happy Meal		X
	Quaker snack bars		X
Enchanted Learning	No food or beverage products		
Wrigley's Candystand	Altoids candy		X
	Altoids Cinnamon Mints		X
	Big League Chew gum	X	X
	Big League Chew: watermelon gum		X
	Big Red gum	X	X
	Crème Savers candy	X	X
	Doublemint gum	X	X
	Eclipse gum	X	X
	Eclipse Mints		X
	Extra gum	X	X
	Extra Wildberry Frost Plen-T-Pak gum		X
	Freedent gum		X
	Hubba Bubba gum	X	X
	Hubba Bubba Bubble Tape gum	X	X
	Hubba Bubba Max gum	X	X
	Hubba Bubba Ouch! Bubble Gum		X
	Juicy Fruit gum	X	X
	Life Savers candy	X	X
	Life Savers Five Flavor candy		X
	Life Savers Fruit Tarts candy		X
	Life Savers Gummies candy		X
	Life Savers Jelly Beans candy		X
	Life Savers Orange Mints candy		X
	Life Savers PepOMint candy		X
	Life Savers Sours candy		X
	Life Savers Sugar Free Wint-*O*-Green candy		X
	Life Savers Sweet Mints candy		X
	Orbit gum	X	X
	Orbit Citrusmint gum		X
	Orbit White gum	X	X
	Trollis candy		X
	Winterfresh gum	X	X
	Wrigley's Spearmint gum		X
Big Fat Awesome House Party	No food or beverage products		
Disney World	Chef Boyardee canned food		X
	Fruity Pebbles cereal		X
Everything Girl	No food or beverage products		
Funschool	Cheese Nips crackers		X
	Enfamil A.R. LIPIL infant formula		X
	Enfamil Gentlease LIPIL infant formula		X
	Froot Loops Smoothie cereal		X
	Hebrew National Kosher Hot Dogs		X

Continued

TABLE 1—*Continued*

	Horizon Organic Milk Plus DHA Omega-3		X
	Nestle Juicy Juice Harvest Surprise		X
	Nutramigen LIPIL infant formula		X
	PUR flavored water		X
	Slim Jim beef jerky		X
	Special K cereal		X
	Teddy Grahams snacks		X
	Teddy Grahams Oatmeal Snacks	X	X
Bratz	Burger King Kids Meal		X
The N	Sprite soda		X
	Slim Jim beef jerky		X
Disney's Toontown Online	Oscar Mayer Hot Dogs		X
	PUR flavored water		X
LEGO Worlds	No food or beverage products		
Polly Pocket	No food or beverage products		
StarFall	No food or beverage products		
Scholastic	Cheerios cereal		X
	Crunchberries cereal		X
	Eggo Waffles		X
	Froot Loops cereal		X
	Honey Nut Cheerios cereal		X
	Lucky Charms cereal		X
	Trix cereal		X
Playhouse Disney	Site not available		
Fisher Price International	Site not available		
Fisher Price US	Quaker Oats		X
	McDonald's Corporation		X
DLTK's Crafts for Kids	No food or beverage products		
Postopia	Cocoa Pebbles cereal	X	X
	Fruity Pebbles cereal	X	X
	Honeycomb cereal	X	X
	Post cereals		X
American Girl	No food or beverage products		

Note. Web sites are ordered by rank from most visited to least visited.

schools (foods sold outside of school lunch programs).[11] These standards provided an evidence-based proxy for what could be considered healthful or unhealthful foods for children and youths, regardless of where the foods were consumed. The IOM has grouped foods into 3 tiers: tier 1 foods are consistent with what the US Department of Health and Human Services' 2005 Dietary Guidelines for Americans (DGA) call "foods to encourage"[11(p120)] and are recommended for all students, tier 2 foods do not meet tier 1 criteria but do not fall outside DGA recommendations for other nutrients and are recommended only for high school students after school hours, and tier 3 foods are all those that are not recommended for any child at any time in school.

RESULTS

Two of the 30 Web sites were unavailable for viewing during the study period. There were 1709 unique pages directly linked (i.e., 1 click away) to the 28 remaining home pages (n=1737 pages). We found 22 different food and beverage products on 6 of the home pages, and we found 71 additional products one click away from 18 of the home pages, for a total of 93 unique products (Table 1).

We obtained nutrition information on the products either from the product label (25 products) or from the manufacturer's Web site (52 products). We excluded 16 products because of a lack of product specificity or unobtainable nutrition information. Of the remaining 77 products, only 2 (Nestle Juicy Juice Harvest Surprise and Quaker Oats Oatmeal) met the IOM tier 1 criteria[11] (Table 2). Three additional products included at least 1 variety that met tier 1 criteria. Another 20 products met tier 2 criteria, and 3 other products had at least 1 variety that met tier 2 criteria. The remaining 49 products fell into tier 3.

TABLE 2—Branded Food and Beverage Products Found on the 30 Most Popular Children's Web Sites (Ranked by US Site Visits) for October 2006, Categorized by Institute of Medicine Standards for Competitive Foods in Schools: July–August 2007

Tier 1 Products	Tier 2 Products	Tier 3 Products	Products Excluded From Analysis
FruitaBu Organic Fruit snacks[a]	Baked Cheetos snack	Altoids candy	Arby's restaurant[b]
Horizon Organic Milk[a]	Cheerios cereal	Altoids Cinnamon Mints	Big League Chew gum[c]
Horizon Organic Milk Plus DHA Omega-3[a]	Cinnamon Toast Crunch cereal	Apple Jacks cereal	Big League Chew: watermelon gum[c]
Nestle Juicy Juice Harvest Surprise	Eclipse gum	Big Red gum	Chick-Fil-A restaurant[b]
Quaker Oats	Eclipse Mints	Burger King Kids Meal[d]	Chuck E. Cheese's restaurant[b]
	Extra Wildberry Frost Plen-T-Pak gum	Cheese Nips crackers	Domino's Pizza restaurant[b]
	French Toast Crunch cereal	Cheez-It Stix crackers	Enfamil A.R. LIPIL infant formula[e]
	Froot Loops Cereal Straws snack	Chef Boyardee canned food[d]	Enfamil Gentlease LIPIL infant formula[e]
	Honeycomb cereal	Cocoa Krispies cereal	McDonald's Corporation[b]
	Honey Nut Cheerios cereal	Cocoa Pebbles cereal	McDonald's restaurant[b]
	Kid Cuisine frozen dinner[f]	Crème Savers candy	Nutramigen LIPIL infant formula[e]
	Life Savers Fruit Tarts	Crunchberries cereal	Hubba Bubba gum[c]
	Life Savers Sugar Free Wint-O-Green candy	Doublemint gum	Life Savers Sours candy[c]
	Orbit gum	Eggo Waffles	PUR Water[c]
	Orbit Citrusmint gum	Extra gum	Red Robin restaurant[b]
	Orbit White gum	Freedent gum	Stonyfield Farm Organic Yo Baby Yogurt[e]
	Post Cereals[f]	Froot Loops cereal	
	PUR flavored water	Froot Loops Smoothie cereal	
	Quaker snack bars[f]	Fruity Pebbles cereal	
	Special K cereal	Gushers Fruit Snacks	
	Splenda artificial sweetener	Hebrew National Kosher Hot Dogs	
	Teddy Grahams snacks	Hubba Bubba Bubble Tape gum	
	Teddy Grahams Oatmeal snacks	Hubba Bubba Max gum	
		Hubba Bubba Ouch! Bubble Gum	
		Juicy Fruit gum	
		Kraft Macaroni and Cheese	
		Life Savers candy	
		Life Savers Five Flavor candy	
		Life Savers Gummies candy	
		Life Savers Jelly Beans candy	
		Life Savers Orange Mints candy	
		Life Savers PepOMint candy	
		Life Savers Sweet Mints candy	
		Lucky Charms cereal	
		Lunchables Pizza[d]	
		M&Ms candy	
		McDonald's Asian Salad	
		McDonald's Happy Meal[d]	
		Oscar Mayer Hot Dogs	
		Reese's Puffs cereal	
		Skittles candy	
		Slim Jim beef jerky	
		Sour Patch Extreme candy	
		Splitz Pop-Tarts	
		Sprite soda	

Continued

TABLE 2—*Continued*

	Trix cereal
	Trollis candy
	Winterfresh gum
	Wrigley's Spearmint gum

Note. "Competitive" foods are those sold in schools outside of meals provided by the school. Tier 1 foods are consistent with what the US Department of Health and Human Services' 2005 Dietary Guidelines for Americans (DGA) call "foods to encourage"[11(p120)] and are recommended for all students; tier 2 foods do not meet tier 1 criteria but do not fall outside DGA recommendations for other nutrients and are recommended only for high school students after school hours; and tier 3 comprises all other foods.
[a]At least 1 available variety meets tier 1 criteria.
[b]Excluded from analysis because the advertised brand was a restaurant that sold too many products to assess.
[c]Excluded from analysis because nutrition information was unavailable or incomplete.
[d]No available varieties meet criteria for tier 1 or tier 2.
[e]Excluded from analysis because the product is unlikely to be consumed by school-age children.
[f]At least 1 available variety meets tier 2 criteria.

DISCUSSION

The Federal Trade Commission has reported that food and beverage marketing targeting youths in 2006 was dominated by campaigns integrating product promotion across traditional platforms (e.g., television, print) and evolving platforms (e.g., Web, cell phone).[12] On Web sites for children alone, there were 2 billion impressions (ads displayed to a site visitor) for foods and beverages in 2006.[12] The results of our study point to the likelihood that the food and beverage products advertised on the Web were those children should avoid.

Our study had several limitations. Data collection was confined to each Web site's home page and pages that were 1 click away. These criteria yielded more than 1700 Web pages for analysis, but they did not necessarily reflect how a visitor would explore a site nor did they reflect the depth and complexity of the sites—links may be followed far from the initial entry point. The pages also cannot be assumed to be independent of one another. E.B. collected the data, so we could not assess intercoder reliability. Furthermore, the sites most popular in October 2006 (the most recent month for which site rankings were obtainable) may have been less popular when the data were collected from those sites in July and August 2007, and the products advertised on the sites may have changed between site ranking and data collection.

Although we provide only a limited examination of Web sites popular with children, we found the food and beverage products marketed on the sites to be of poor nutritional quality. In 2006, 44 companies spent $1.6 billion marketing foods and beverages to children and youths,[12] and the proportion of marketing dollars spent online is predicted to grow.[13] Therefore, further research on the extent and nature of food and beverage advertising online is needed to aid policymakers as they assess the impact of this marketing on children. ■

About the Authors

At the time of the study, Elena O. Lingas, Lori Dorfman, and Eliana Bukofzer were with the Berkeley Media Studies Group, Berkeley, CA.

Requests for reprints should be sent to Lori Dorfman, Berkeley Media Studies Group, 2140 Shattuck Ave, Suite 804, Berkeley, CA 94704 (e-mail: dorfman@bmsg.org).

This brief was accepted November 11, 2008.

Contributors

E.O. Lingas developed the study protocols and coding guides, oversaw data collection and analyses, and led the writing of the article. L. Dorfman conceptualized the study and supervised all aspects of its implementation. E.O. Lingas and L. Dorfman interpreted findings and wrote article drafts. E. Bukofzer collected and entered data and conducted the nutrition analysis.

Acknowledgments

Support for this research was provided by the Robert Wood Johnson Foundation (grant 052917).

The authors would like to thank Dawud Williams for assistance with data entry and the anonymous reviewers for their helpful comments.

Human Participant Protection

No protocol approval was necessary because data were obtained from secondary sources.

References

1. Phillips LE. *US Online Population.* New York, NY: eMarketer; 2008.

2. Roberts DF, Foehr UG, Rideout V. *Generation M: Media in the Lives of 8–18 Year-Olds.* Menlo Park, CA: Kaiser Family Foundation; 2005.

3. Moore ES. *It's Child's Play: Advergaming and the Online Marketing of Food to Children.* Menlo Park, CA: Kaiser Family Foundation; 2006.

4. Chester J, Montgomery K. *Interactive Food and Beverage Marketing: Targeting Children and Youth in the Digital Age.* Berkeley, CA: Berkeley Media Studies Group; 2007.

5. Institute of Medicine. *Food Marketing to Children and Youth: Threat or Opportunity?* Washington, DC: National Academies Press; 2006.

6. Yoo CY. Unconscious processing of Web advertising: effects on implicit memory, attitude toward the brand, and consideration set. *J Interact Mark.* 2008; 22(2):2–16.

7. Alvy LM, Calvert SL. Food marketing on popular children's web sites: a content analysis. *J Am Diet Assoc.* 2008;108:710–713.

8. Weber K, Story M, Harnack L. Internet food marketing strategies aimed at children and adolescents: a content analysis of food and beverage brand web sites. *J Am Diet Assoc.* 2006;106:1463–1466.

9. Kelly B, Bochynska K, Kornman K, Chapman K. Internet food marketing on popular children's websites and food product websites in Australia. *Public Health Nutr.* 2008;11:1180–1187.

10. *Hitwise Industry Report for Lifestyle—Children's Sites: Based on US Internet Usage for the Month of October, 2006.* New York, NY: Hitwise; 2006.

11. Institute of Medicine. *Nutrition Standards for Foods in Schools: Leading the Way Toward Healthier Youth.* Washington, DC: National Academies Press; 2007.

12. Kovacic WE, Harbour PJ, Leibowitz J, Rosch JT. *Marketing Food to Children and Adolescents: A Review of Industry Expenditures, Activities, and Self-Regulation: A Report to Congress.* Washington, DC: Federal Trade Commission; 2008.

13. Kaplan D. Online ads hit $50 billion by 2011; local reaches $9 billion by 2012; pre-roll, embeds gain in '08. *PaidContent.org.* Published: January 18, 2008. Available at: http://www.paidcontent.org/entry/419-us-online-ad-market-to-reach-50-billion-by-2011-report-24-percent-marke. Accessed March 24, 2008.