

MANAGEMENT, EDUCATION & ADHERENCE

The Feasibility and Acceptability of a Home-Visitation, Asthma Education Program in a Rural, Latino/a Population

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Objectives. The effectiveness of community health worker-delivered interventions to decrease environmental triggers for asthma in the home has been well documented in urban populations, but has had little evaluation in rural, Latino/a families. The purpose of this study was to evaluate the feasibility and acceptability of a home-visitation intervention designed to decrease environmental triggers for pediatric asthma in rural, Latino/a families. **Methods.** Data from a large community health clinic's pediatric asthma program (2002, 2003, 2004, 2005, 2006) were used to retrospectively explore associations between program participation and asthma-related health outcomes. Demographic data were collected on 866 patients. Behavioral outcomes were evaluated in 374 participants. A medical record abstraction was conducted in a subsample of 400 patients to evaluate asthma-related urgent care use. Nonparametric tests were used to compare outcomes before and after the intervention. Demographic attributes associated with program participation were examined using logistic regression. **Results.** Most (91%) participants were Hispanic, and 61% of participants' caregivers were either seasonal or migrant farmworkers. Over half (61%) of the participants did not complete the full intervention. A statistically significant improvement was found in caregivers' abilities to manage asthma medications and adopt behaviors to decrease triggers inside the home. Behaviors related to decreasing outside triggers did not significantly change. Asthma-related urgent care use significantly decreased; however, there was no association between intervention dose and a decrease in urgent care use. Demographic attributes were generally not associated with program completion, having baseline and exit data on intermediate outcomes, and/or inclusion in the chart review. **Conclusions.** Results suggest that the asthma intervention helped caregivers improve the air quality in their homes and reduce urgent care admissions among pediatric participants. The intervention dose may be less important than taking part in an intervention to the extent feasible or desired by the family. Findings suggest that policy-level interventions need to address reimbursement for home visitation and environmental exposures that are beyond caregiver control, such as support for healthy and affordable housing in farmworker communities.

Keywords allergens, asthma, community health aides, Hispanic, patient education, rural

INTRODUCTION

Over 6 million children have asthma in the United States (1). Asthma remains the most common chronic disease in childhood (2). Compared to adults with asthma, children have more frequent asthma attacks and asthma-related health care encounters, including physician office visits, hospital outpatient visits, emergency department visits, and hospitalizations (1). Comprehensive pediatric asthma management includes four components: assessment and monitoring, control of environmental factors, medications, and patient education (3). Although the majority of asthma management occurs in a clinic setting, home visits (HVs) offer a unique opportunity to directly assess and address home environmental triggers and reinforce patient education received in the clinic.

Environmental triggers for asthma are both chemical and biological. Chemical triggers are exposures such as environmental tobacco smoke (ETS), pesticides, and

volatile organic compounds. Biological triggers include exposures to dust mites, molds, rodent and cockroach feces, and animal dander. Evidence suggests that simple environmental interventions designed to avoid exposure to select indoor air contaminants (ETS, dust mites) can prevent the development of asthma in high-risk children (4, 5). Avoiding exposure to indoor triggers (ETS, dust mites, cockroach feces, cat allergen) also prevents asthma exacerbations (6).

Interventions to decrease environmental triggers for asthma are multifaceted and increasingly delivered in homes by community health workers (CHWs) (7–12). In a recent review of randomized clinical trials (RCTs) designed to test the effectiveness of these interventions, authors reported that overall, the studies consistently identified positive outcomes associated with CHW-delivered interventions, including decreased asthma symptoms, fewer daytime activity limitations, and reduced emergency and urgent care use (13). Every RCT review took place in an urban environment and primarily focused on low-income and ethnic minority populations.

Rural families face unique challenges in asthma management including fewer providers, greater distance to clinics, and fewer health care benefits than their urban

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counterparts (14). Low-income Latino families living in rural areas may struggle to implement asthma recommendations due to a lack of resources, competing priorities, and a lack of control over their indoor environment (15).

Farmworker families experience many of the same environmental conditions that scientists attribute to the increased urban prevalence of asthma, such as substandard and crowded housing (16). Nationally, 97% of farmworker families rent their homes and 52% live in crowded conditions and lack one or more laundry machines (i.e., a washer or dryer) (17). In one review of farmworker housing characteristics, between 30% and 70% of families reported that they did not own a vacuum cleaner, an important resource in decreasing environmental triggers for asthma (18). Farmworker families face additional challenges in asthma management, such as language and education barriers, extreme poverty, and a lack of health insurance (19). Immigration status may also influence families' comfort level in seeking care. According to the National Agricultural Worker Study, 75% of agricultural workers are Mexican-born, and 44% cannot speak English. Only 13% of respondents reported completing the 12th grade. The average family income of respondents ranged from \$15,000 to \$17,499 and only 8–12% of respondents reported having health insurance as a benefit of employment (20).

Home-based interventions, delivered by CHWs who come from a similar social background as the participants, hold promise in overcoming several of these barriers to optimal asthma management for rural, Latino/a, and farmworker families (13, 21, 22). The purpose of this study was to evaluate the feasibility and acceptability of a multifaceted, home-visitation intervention on improving the health status of children with asthma in a rural, Latino/a population. Existing data from the Yakima Valley Farm Workers Clinic's (YVFWC) Childhood Asthma Project (CAP) were used to retrospectively explore associations between program participation and asthma-related health outcomes. The specific aims were to

- (1) describe program participation in the CAP;
- (2) describe pre- to post-intervention changes in intermediary outcomes, including medication management, and behaviors to reduce indoor and outdoor environmental triggers;
- (3) describe pre- to -post-intervention changes in primary outcomes, including asthma-related urgent care use, presence of asthma management plan, and flu shot acquisition.

METHODS

The Childhood Asthma Project

The YVFWC is a large, multisite community and migrant health center that serves farmworkers and underserved populations in the northwest United States. The clinic has been offering the CAP in all of its rural Yakima County sites since 2001, and in the county seat of Yakima since 2004. The CAP is a home-visitation program in

which CHWs trained in environmental assessment perform home assessments and make recommendations to families about ways to reduce their children's exposures to environmental triggers that could exacerbate their asthma. They also reinforce the use of asthma care plans and medical management. The intervention curriculum is delivered over eight HVs, spaced approximately 1 month apart. Educational modules are tailored to the home assessment and include medication and general asthma management, the child's bedroom as an important environment, indoor and outdoor asthma triggers, pesticides and chemicals, and housecleaning. Medicine boxes, dust mite-proof pillow and mattress encasings, peak flow meters and spacers, wipe-off mats, and cleaning supplies are provided, depending upon funding availability. Language-appropriate written information is provided. Social services, medical, dental, nutrition, and mental health referrals are made, if deemed necessary.

The interventionists are Clear Corps workers who serve with the clinic for 12 months. A sanitarian oversees the program and is based out of the clinic in Toppenish, WA. These CHWs complete the American Lung Association's (ALA) 2.5-day Asthma Educator Institute and 2.5-day Master Home Environmentalist training before conducting HVs. Through their affiliation with Clear Corps, the CHWs are part of a national network working to reduce environmental hazards in households and neighborhoods where children are at the greatest risk (23). The ALA Asthma Educator Institute provides education on asthma management techniques and teaches participants how to develop and implement effective asthma education programs. The course includes hands-on skill demonstrations and practice as well as evaluation tests to measure increase in knowledge and skills (24). The Master Home Environmentalist (MHE) training teaches participants how to recognize environmental hazards and teach others about health hazards in their home. MHEs recommend low-cost or no-cost methods to reduce risks (25).

Design

A single group pre- and post-design was used to retrospectively explore the relationship between program participation in the CAP and outcomes. Pediatric patients from the YVFWC and their primary caregiver were the participants in this study. Patients were primarily referred to the program through their primary care provider. Inclusion criteria were specified for this secondary analysis. Participants had to be (1) clinic patients, (2) ≤ 18 years of age upon enrollment, (3) have a diagnosis of asthma or asthma-like symptoms, and (4) enroll in the program between January 1, 2002, and December 15, 2006. This period was selected to create a uniform period of time for evaluation of the primary outcomes. All procedures were approved by the university's institutional review board.

Data Collection

Multiple sources of data were used to obtain information on the variables of interest. Participant and caregiver

demographics were collected through the clinic's practice management system. Child characteristics, including clinic identification and guarantor (caregiver) number, date of birth, gender, ethnicity, linguistic preference, clinic site, and payment source, were collected alongside caregiver characteristics, which included household income, housing status, and migrant status. Defined by Section 330(g) of the Public Health Service Act, a migrant agricultural worker is an individual whose principal employment is in agriculture on a seasonal basis (as opposed to year-round employment) and who establishes a temporary home for the purposes of such employment. Seasonal agricultural workers are individuals of the same employment status as migrant workers, but who do not establish a temporary home for purposes of employment (26).

Program participation was ascertained by using dates of HVs, which were collected from the CAP database. Intermediary outcomes, including questions about medication and device management and behaviors to minimize triggers inside and outside the home were asked of caregivers at baseline and upon exiting the program by the CHWs.

Primary outcomes, including asthma-related emergency room visits and hospital admissions, were collected through chart reviews on a subset of 312 participants, pulled from the CAP database, who (a) were patients at one of three clinics in the YVFWC system (Toppenish, Grandview, Yakima), (b) had at least two HVs, and (c) were in the system for at least 3 years. Clinics were selected based on the feasibility of traveling to retrieve charts. Data collected for the chart review were collected during a uniform time period for all participants. A baseline year was constructed from 12 months before enrollment to enrollment, an intervention year was constructed from enrollment to 12 months after enrollment, and a follow-up year was constructed from 12 to 24 months after enrollment.

Data Analysis

Databases containing demographics (date of birth, gender, ethnicity, linguistic preference, clinic site, payment source, federal poverty level, housing status, migrant status), program participation, and intermediary and primary outcome data were reviewed for completeness and errors and then merged into one database. Errors were clarified with the data entry clerk at the clinic and by cross-referencing data (especially dates) by reviewing information available from other databases. After applying the inclusion criteria to the merged database, 866 participants were included in the study. To determine participants' age, the difference between the date of birth and either the date of enrollment or the first HV or the average between the two was computed. Categorical variables were summarized as frequencies (%) and continuous variables were summarized as means (standard deviations). Demographic response categories were collapsed for numerous variables to ensure that the statistical assumptions were met for nonparametric analyses. Responses such as 'unknown' or 'refused to disclose'

(income) were recoded as missing data. With the exception of program participation, all analyses were limited to one child per guarantor to ensure that each observation was independent.

To compare pre- to post-intervention findings, McNemar's test for paired, binary data and the Wilcoxon signed rank test for continuous data, such as subscale scores, were used. Logistic regression was used to compare all demographic and site differences between participants who did and did not complete the intervention, and between participants with and without outcomes data. The latter analyses were conducted to examine whether available data were representative of the underlying population or whether there were biases associated with inclusion in the outcomes analyses. All significance testing were done at the 0.05 level (two-sided). The SPSS software, version 18.0, was used. Statistical methods specific to individual aims included

Sp. Aim 1. Program completion was defined as receiving eight or more HVs. New variables were created to describe the time interval between each HV, and between each HV and the first HV that families receive. The central tendencies of time intervals are reported as medians and modes, rather than as means, as these summary statistics are less affected by outliers. Intervention data were available on all but 48 participants.

Sp. Aim 2. This analysis included 294 participants who had both baseline and exit data. Five subscales were created by summing the variables within each category: medication and device management, child's bedroom, indoor asthma triggers, cleaning throughout the house, and outdoor asthma triggers.

Sp. Aim 3. This analysis included 312 participants. An urgent care use subscale was created by summing scores for the number of emergency room and hospitalization admissions that occurred in the year before and the year after exiting the CAP.

The relationship between level of program participation and urgent care admissions was also explored. The number of HVs received was dichotomized (completed intervention: Y/N) and then categorized (level of intervention completed low, medium, high) into new variables. Likewise, urgent care admissions (emergency room and hospitalization) were dichotomized (positive change in admission: Y/N) and then categorized (no change, positive change, negative change) into new variables. The association between program participation and urgent care admissions was explored using chi-square tests at the 0.05 level of significance.

RESULTS

Sample

The sample included 866 children and their respective caregivers (Table 1). The mean age of the children was 5.7 years and 58% were male. The majority of child participants (91%) were Hispanic, and approximately

TABLE 1.—Baseline demographic characteristics and differences by intervention status.

	Total	Intervention status*	
		Completed 7 or <HV	Completed 8 or >HV
Age: Mean years (SD)	5.7 (4.6)	5.8 (4.8)	5.4 (4.3)
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)
Total	866 (100)	526 (60.7)	292 (33.7)
Gender	866 (100)	526 (64.3)	292 (35.7)
Male	506 (58.4)	308 (37.7)	166 (20.3)
Female	360 (41.6)	218 (26.7)	126 (15.4)
Ethnicity	866 (100)	526 (64.3)	292 (35.7)
Hispanic	785 (90.6)	462 (56.5)	281 (34.4)
Non-Hispanic	81 (9.4)	64 (7.8)	11 (1.3)
Linguistic preference	863 (99.7)	525 (64.4)	290 (35.6)
Spanish	619 (71.5)	361 (44.3)	229 (28.1)
English	244 (28.2)	164 (20.1)	61 (7.5)
Clinic site	864 (99.8)	525 (64.3)	292 (35.7)
Toppenish	404 (46.7)	230 (28.2)	155 (19)
Grandview	173 (20.0)	107 (13.1)	55 (6.7)
Yakima	120 (13.9)	63 (7.7)	49 (6.0)
Walla Walla	137 (15.8)	105 (12.9)	28 (3.4)
Other	30 (3.5)	20 (2.4)	5 (0.6)
Payment source	866 (100)	526 (64.3)	292 (35.7)
Medicaid	707 (81.6)	421 (51.5)	246 (30.1)
State managed care	57 (6.6)	34 (4.2)	23 (2.8)
Private insurance	53 (6.1)	35 (4.3)	15 (1.8)
Uninsured	49 (5.7)	36 (4.4)	8 (1.0)
Federal poverty level (FPL)	778 (89.8)	465 (62.8)	276 (37.2)
100% and < FPL	631 (72.9)	371 (50.1)	231 (31.2)
101–149%	108 (12.5)	65 (8.8)	37 (5.0)
150% and > FPL	39 (4.5)	29 (3.9)	9 (1.0)
Housing status	857 (99)	520 (64.2)	290 (35.8)
Single family dwelling	819 (94.6)	499 (61.6)	273 (33.7)
Other	38 (4.4)	21 (2.6)	17 (2.1)
Migrant status	866 (100)	526 (64.3)	292 (35.7)
Seasonal	437 (50.5)	256 (31.3)	157 (19.2)
Migrant	89 (10.3)	49 (6)	38 (4.6)
Regular (not migrant or seasonal)	340 (39.3)	221 (27)	97 (11.9)

HV, home visit; CI, confidence interval; SD, standard deviation.

*Missing HV frequency on *N* = 48 (5.5)

72% preferred to speak Spanish. Most received Medicaid (82%) and most participants' caregivers (73%) were at or below 100% of the federal poverty level. Almost all (95%) reported living in a single-family dwelling. Approximately half of the caregivers reported being seasonal farmworkers, and 10% reported being migrant workers. Most caregivers (82%) had one child enrolled in the CAP but some had two (15%), three (2.4%), four (0.3%), or five (0.1%).

Participation

The majority of participants completed some portion of the intervention with many (61%) receiving less than the full dose, delivered in eight visits. The average and median number of visits completed was six (range 1–18). The median interval between HVs was 36 days and the

median number of days it took to receive the entire intervention was 307.

Intermediate Outcomes

Of the 866 participants in the study, 374 had both baseline and exit data on the intermediate outcomes. Of those, 294 were included in this analysis (cases filtered to one child/household). Intermediate outcomes were evaluated in the areas of medication management, and behaviors used to minimize environmental triggers inside and outside of the participant's home (Table 2). After the intervention, more caregivers reported that rescue medication was prescribed and properly used, that medications were stored safely and were accessible, that medication instructions were followed, and that devices (either a nebulizer or an inhaler) were used and used effectively.

TABLE 2.—Intermediate program outcomes: baseline and exit values and comparison of baseline-to-exit changes.

Variable	Baseline*	Exit**	Comparison of baseline-to-exit changes	
	N (% Yes)	N (% Yes)	χ (df 1)	p-value
Medication and device management				
Rescue medication prescribed/properly used	171 (59.4)	262 (91.9)	69.23	<.0005
Medications are stored safely and accessible	232 (81.1)	277 (96.2)	32.07	<.0005
Patient/parent follows medication instructions	162 (56.4)	266 (92.4)	86.45	<.0005
Medications refilled before they run out	155 (54.0)	251 (88.4)	71.44	<.0005
Devices used/effectively (nebulizer or inhaler used)	78 (28.4)	114 (40.6)	9.61	.002
Behaviors to minimize triggers				
Child's bedroom				
Bedding washed in hot water	65 (22.3)	247 (84.9)	165.89	<.0005
Pillows/mattresses have dust mite covers	12 (4.20)	218 (76.0)	195.12	<.0005
Floors easy to clean/no rug	143 (49.3)	148 (51.4)	0.28	.598
Pets kept outside of bedroom	111 (38.9)	143 (51.1)	9.88	.002
Minimal furniture/stuffed toys in bedroom	168 (59.2)	239 (83.9)	40.71	<.0005
Indoor asthma triggers				
Family smokes in home	14 (4.8)	12 (4.2)	Binomial	1
Family smokes in car	14 (4.8)	13 (4.5)	Binomial	1
Pets kept off furniture	181 (64.4)	201 (73.1)	6.61	.010
Feet are wiped upon entry into home	164 (56.9)	268 (92.7)	90.09	<.0005
Strong perfumes, hairspray avoided	155 (53.6)	244 (85.0)	65.45	<.0005
Mold problems are prevented, cleaned	145 (50.3)	221 (79.2)	51.11	<.0005
Problems with cockroaches/bugs	33 (11.5)	32 (11.3)	0.00	1
Home pesticide use minimized	244 (84.7)	256 (92.4)	9.59	.002
Indoor chemical use minimized	220 (76.7)	253 (88.8)	16.12	<.0005
Presence of wood burning stove/fireplace	40 (13.9)	30 (10.9)	3.70	.054
Cleaning throughout the house				
Carpets are vacuumed weekly	211 (74.8)	230 (83.3)	5.49	.019
Non-carpeted floors are damp mopped	267 (92.7)	279 (97.2)	Binomial	.027
Furniture covers are washed in hot water	81 (29.7)	171 (64.0)	65.65	<.0005
Outdoor asthma triggers***				
Burn barrel at or near house	37 (12.9)	14 (5.10)	15.75	<.0005
Patient has minimal exposure to agricultural pesticides	151 (53.5)	138 (51.1)	0.96	.326
Patient kept from projects with chemicals	261 (92.2)	261 (94.9)	2.07	.151
Child kept indoors during agricultural sprays	136 (48.4)	137 (50.9)	0.05	.820

Binomial, Binomial test was used and there was almost perfect agreement.

*Missing responses at baseline ranged from 0 to 21 participants;

**Missing responses at exit ranged from 0 to 27 participants;

***Also ran analyses with cases restricted to those that received 8 or >HVs. Did not change results.

Every behavior to reduce triggers in the child's bedroom improved, except ensuring that the floor was easy to clean. After the intervention, more caregivers reported that bedding was washed in hot water, dust covers were applied to pillows and mattresses, pets were kept outside the bedroom, and there was minimal furniture/stuffed toys in the bedroom.

In terms of reducing triggers in the house, most behaviors reportedly improved; however, few participants reported smoking or having problems with bugs at baseline, so there was little room for improvement. After the intervention, more caregivers reported that pets were kept off of furniture, feet were wiped upon entry into the house, strong perfumes and hairspray were avoided, mold problems were prevented and cleaned, home pesticide use was minimized, and indoor chemical use was minimized. There was borderline significance in terms of the difference in the presence of a wood-burning stove/fireplace.

There was one statistically significant improvement in terms of minimizing outdoor triggers for asthma. After the intervention, more caregivers reported not having a burn barrel at or near the house. Changes in minimizing participants' exposure to agricultural pesticides, projects with chemicals, or agricultural sprays did not improve. All of the summary scores were significant except that which measured outdoor triggers (Table 3).

TABLE 3.—Summary scores of intermediate outcomes.

Summary scores*	z	p-value	N
Medication and device management	−9.803	<.0005	253
Child's bedroom	−12.628	<.0005	259
Indoor asthma triggers	−9.162	<.0005	236
Cleaning throughout the house	−7.432	<.0005	239
Outdoor asthma triggers	−0.971	.332	248

*Negatively worded items were reverse-coded for the purposes of the subscale.

TABLE 4.—Primary program outcomes: baseline and exit values and comparison of baseline-to-exit changes ($N = 312$).

	Baseline Mean (range)	Exit Mean (range)	Comparison of baseline-to-exit	
			<i>z</i>	<i>p</i> -value
Emergency room admissions	0.46 (9)	0.22 (5)	-4.76	<.0005
Hospital admissions	0.15 (3)	0.01 (3)	-5.567	<.0005
Summary score: Urgent care use			-6.348	<.0005

Primary Outcomes

Of the 866 participants in the study, 400 were included in the chart review and 312 in this analysis (cases filtered to one child/household). At baseline, 67.9% of participants had no admissions to the emergency room, 23.7% had one, 6.4% had two, and less than 2% had three to nine. Approximately 87% of participants had zero hospitalizations at baseline, 12% had two, and less than 2% had three. After the intervention, there were statistically significant decreases in the number of emergency and hospitalization admissions. The summary score was also significant (Table 4). However, there was no association between level of program participation and a decrease in urgent care admissions (data not shown).

There was a significant improvement in the number of participants with an asthma management plan documented in the participants' charts ($\chi = 33.383$, p -value < .0005, $N = 312$) and a statistically significant increase in receipt of a flu shot ($\chi = 24.008$, p -value < .0005, $N = 287$) among those children 6 months or older at the time of enrollment.

Clinic Site and Housing Status Differences

Clinic site was associated with program completion, having baseline and exit data on intermediate outcomes, and inclusion in the chart review. Compared to the Toppenish site, participants from the Walla Walla site had a lower odds of having received eight HVs (OR 0.45, CI 0.25–0.78, p -value .005), and participants at the Yakima site had a higher odds of having received eight HVs (OR 1.7, CI 1.0–2.8, p -value .051). The odds of a participant having both baseline and exit questionnaire data was also higher (OR 2.6, CI 1.5–4.3, p -value < .0005) for someone who was a participant from the Yakima site than for someone from the Toppenish site, all other factors being equal. Other demographic factors were not found to be associated with program completion or having a full data set. The odds of a participant being included in the chart review was higher (OR 2.8, CI 1.6–4.7, p -value < .005) for a participant from the Yakima site than from the Toppenish site, all other factors being equal. In addition, the odds of a participant being included in the chart review who reported living in something other than a single-family dwelling (includes those that identified as homeless, doubling up, transitional, or living on the street) was approximately

one-third greater than for someone who reported living in a single-family dwelling, all other factors being equal (OR 0.27, CI 0.09–0.78, p -value = .015). Other demographic factors were not found to be associated with inclusion in the chart review.

DISCUSSION

CHW-delivered interventions to decrease environmental triggers for asthma in the home have been tested through RCTs among urban families in the United States, but the feasibility, acceptability, and effectiveness of similar interventions in rural, Latino, and farmworker families have not been well studied. Findings from this study can be used to inform a future efficacy study.

Program participation in the CAP was examined to evaluate the feasibility and acceptability of the intervention in a new population. Most participants completed a portion of the intervention, suggesting that eight visits over 10 months was too great a commitment for these families but that six visits was acceptable. The vast majority of caregivers whose children were enrolled in the study were under-resourced. Working in multiple jobs is a way of life for these families and although committed to their children's health, they simply may not have the time to meet with a CHW eight times. The fact that there was no association between the level of participation and a decrease in urgent care use suggests that a less-intense intervention may yield improved outcomes and be less burdensome to families. Future research should examine the required intensity for an effective home-intervention program and the independent contributions of the different intervention components (13, 27). Behavior change has been hypothesized to lead to better clinical outcomes by decreasing environmental triggers in the home environment. Evidence of behavior change and corresponding antigen levels has been mixed in previous studies, with most behavioral improvements actually tied to resource provision, such as the distribution of mattress and pillow encasements (13). In a recent review of similar interventions, one study demonstrated that trigger reduction behavior correlated with a reduction in antigens (28), and another study illustrated a dose-response relationship between reductions in bedroom antigen levels with improvements in asthma-related health outcomes (10).

In this study, results suggest that caregivers were amenable to behavior changes that will decrease children's exposures to environmental triggers for asthma as well as improved medication management. Although alternative explanations, such as regression toward the mean, cannot be ruled out in a pre- and post-design, results demonstrate that some categories of behaviors changed whereas others did not. In general, self-reported behavior change significantly improved after the intervention. Nonsignificant and borderline findings generally related to non-modifiable *exposures*, versus modifiable *behaviors*, within the socioeconomic context of these families. Resource-poor families who are more likely to rent often

cannot make structural changes, such as removing carpet or changing their heating source. Likewise, although there was a significant improvement in minimizing home pesticide and indoor chemical use, there was no significant improvement in minimizing outdoor pesticide exposure. This likely relates to the fact that housing in agricultural communities is often located in or near fields and orchards where pesticides are sprayed (29–31). Policy-level interventions are needed to address environmental exposures that are beyond caregiver control, such as support for healthy and affordable housing in farmworker communities.

This study detected pre- to post-improvements in asthma-related urgent care use, the presence of an asthma management plan, and flu shot acquisition among those that had their charts reviewed. This study did not detect an association between intervention dose and an improvement in urgent care outcomes, which may be related to the infrequency of emergency room and hospitalization admissions at baseline, or the lack of data on asthma severity. Future work should include underlying asthma severity as a variable, with the understanding that illness severity could modify ongoing control and outcomes. Nonetheless, findings from a recent CDC review suggest that the economic benefits from interventions such as these have the potential to match or even exceed the cost of intervention. Cost-benefit studies show net positive returns on investment with a benefit : cost ratio ranging from 5.3 to 14.0 (32).

Although HVs are beginning to be reimbursed by some health care plans, coverage is inadequate when compared to the need. Policies are needed that support home visitation by CHWs. Krieger suggests funding HVs through public-private partnerships that support certification and training by public health agencies, cross-organizational links to integrate HVs with medical care systems, and continued research to answer questions around intervention intensity and duration as well as the acceptability of HVs in populations not yet studied (33). Current evidence is sufficient, however, for The Task Force on Community Preventive Services to recommend home-based, multicomponent multi-trigger interventions with an environmental focus for children with asthma (27).

Participants who lived in more urban areas (e.g., the County seat) of the rural Yakima region were more likely to have completed the intervention, have a full data set, and be included in the chart review, compared with participants from smaller towns in the region. This finding could relate to the increased proximity those families had to the clinic, which may have, in turn, increased their connection to the program. The CAP program was first offered to rural Yakima County sites, so these differences are not likely due to program refinement. Alternatively, findings may relate to differences in staffing among the clinics involved in the program. The CHW at the Yakima site had a child with asthma so was particularly empathetic with the participants. This empathetic bond may have influenced her clients to complete the entire intervention and participate in the evaluation. Findings may be

more generalizable to similar participants as those seen at the Yakima site, which underscores the need for more research to understand asthma management in the context of exclusively rural families.

Limitations

The single group, pre- and post-design, is the major limitation of this study. Lack of a comparison group precludes the ability to account for confounders. Self-report data collected by interventionists potentially introduces recall and social desirability bias. Some questions about reducing environmental triggers combined two questions in one, making it difficult to know which part of the question the respondent was answering (e.g., rescue medication prescribed/properly used). Finally, some participants did not have data collected at baseline or upon exiting the project, although demographic attributes generally did not differ between those with and without outcomes data.

CONCLUSION

This study supports that trigger reduction interventions, delivered by CHWs in the home, are associated with positive health outcomes among rural, Latino children with asthma. The intervention dose may be less important than taking part in an intervention to the extent feasible or desired by the family. Findings suggest that policy-level interventions need to address reimbursement for HVs and environmental exposures that are beyond the caregiver's control, such as support for healthy and affordable housing in farmworker communities. Future research needs to address the contributions of the individual intervention components and the effectiveness of the intervention in rural, Latino children with asthma.

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DECLARATION OF INTEREST

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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