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Development and Evaluation of an Integrated Pest Management Toolkit for Child Care Providers

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Abstract

Young children and early care and education (ECE) staff are exposed to pesticides used to manage pests in ECE facilities in the United States and elsewhere. The objective of this pilot study was to encourage child care programs to reduce pesticide use and child exposures by developing and evaluating an Integrated Pest Management (IPM) Toolkit for child care providers and staff. A multidisciplinary team developed an English- and Spanish-language IPM Toolkit for child care staff that included an IPM curriculum booklet, IPM Checklist, 11 pest-specific information sheets, and 4 educational posters. The intervention included manager interviews, educational workshops about pests and IPM, a box of ready-to-use IPM tools, an assessment of pest problems using a pilot, 72-item IPM Checklist, and photographs of identified problems. One hundred and seven staff at nine child care centers serving 854 ethnically diverse children were trained. Pre- and post-intervention manager interviews, IPM knowledge forms, and assessments using the IPM Checklists were conducted. Results showed positive changes in IPM policies, awareness, practices, management, and the prevalence of pest problems 4 to 6 months after intervention. The IPM Checklist identified improvements on 34 out of 50 items (68%) and positive changes in reducing pest infestations (100%). Manager interviews revealed positive experiences with IPM and support and satisfaction with the IPM workshop and Toolkit.

Introduction

Young children exposed to pesticides in their environment are at risk for cognitive, neurobehavioral, respiratory, and developmental problems (Eskenazi et al., 2007; Guillette, Meza, Aquilar, Soto, & Garcia, 1998; Makri, Goveia, Balbus, & Parkin, 2004) because of their physiologic immaturity (Bearer, 2000; Moya, Bearer, & Etzel, 2004; Rauh et al., 2006) and their exploratory behaviors such as crawling, touching, and mouthing objects in the environment. Children's potential exposure to environmental pesticides is also increased because they eat, breathe, and drink more per unit of body weight than adults and have relatively large skin surface areas (American Academy of Pediatrics Committee on Environmental Health, 2003; Wigle, 2003).

In 2010, 64% of children in the United States under 5 years of age were spending, on average, 36 hours a week in child care (National Association of Child Care Resource & Referral Agencies, 2010). Many of these infants and young children spend as much as 10 hours per day, 5 days a week, in child care, where they may be exposed to pesticides (Tulve et al., 2006). In addition to children, about 2.3 million child care providers (National Association of Child Care Resource & Referral Agencies, 2010) may also be exposed to pesticides in child care programs; nearly half of them are in their childbearing years, when pesticide exposure may be most harmful (Bureau of Labor Statistics, 2010).

The first U.S. National Environmental Health Survey of Childcare Centers was a probability-based study that assessed children's exposures to lead, allergens, and pesticides in 168 licensed child care centers in 48 states (Tulve et al., 2006). Sixty-three percent of the respondents reported pesticide applications in the centers, ranging from using 1 to 10 pesticide products (mean (*SD*) = 3(1.9)) with a frequency of pesticide applications ranging from 1 to 107 times annually. Pyrethroid and organophosphorus (OP) pesticides were detected in 80% of the centers. Another study of 637 randomly selected child care centers in California (Bradman, Dobson, & Leonard, 2010) found that 90% of the centers reported at least one pest problem, and 55% of the centers reported using pesticides, primarily insecticides; 47% reported using sprays or foggers, leaving residues on surfaces and in the air. In contrast, only 21% reported using lower risk pesticide application methods consistent with principles of Integrated Pest Management (IPM), such as baits and gels. In a pilot study of nine centers in North Carolina, OP and pyrethroid pesticides were found in the air and dust (Wilson, Chuang, & Lyu, 2001), suggesting that exposures in child care environments may constitute a significant portion of total child exposures to OP and pyrethroid pesticides.

The National Health and Safety Performance standards for child care developed by the American Academy of Pediatrics, American Public Health Association, and the National Resource Center for Health and Safety in Child Care and Early Education (2011) stipulate that "facilities should adopt an integrated pest management program to ensure long-term, environmentally sound pest suppression through a range of practices including pest exclusion, sanitation and clutter control, and elimination of conditions that are conducive to pest infestations" (p. 226). The standards include recommendations on pest prevention, pest monitoring, pesticide use, notification, registry, record keeping, and pesticide storage. However, not all states' licensing requirements include these national standards. Early care and education (ECE) policies in 21 states include the use of IPM, with 15 states requiring the use of IPM and 6 states recommending it (Owens, 2009). The State of California Child Care Licensing Regulations (http://www.dss.cahwnet.gov/ord/PG587.htm) require licensees to keep the center free from flies, other insects, and rodents (Regulation 101238)

and to store garbage properly in containers with tight-fitting covers to prevent opportunities for pests to breed and to avoid providing food sources for insects or rodents (Regulation 101239). Although no licensing regulations require the use of IPM to reduce pesticide use in ECE centers, California's Healthy Schools Act (2000) encourages child care centers to implement IPM practices, requires notification for parents and postings on-site about pesticide applications, and requires record keeping and reporting of pesticide use.

In three studies of ECE providers, it was shown that many of the providers were unfamiliar with IPM. In a 2009 survey of child care center directors in California, only 25% were familiar with the concept of IPM, and most providers (63%) obtained pest management information from pest control companies (Bradman et al., 2010). In another survey of 3,364 child care centers in Illinois, 18% had no knowledge of IPM (Mir, Finkelstein, & Tulipano, 2010). In a study of 45 centers in New York City (NYC), 84% of the center administrators had no knowledge of IPM before the intervention project was initiated (Anderson, Glynn, & Enache, 2010).

Two IPM intervention studies in child care programs showed positive effects of IPM education, assessment, and documentation on early care and education IPM practices. In one study conducted by Region 2 of the U.S. Environmental Protection Agency (EPA) in 45 child care centers on Staten Island, NYC, regularly scheduled applications of pesticides were reduced from 80% to 36%, and the number of centers *not* applying pesticides increased from 9% to 20% (Anderson et al., 2010). Another notable accomplishment is that the number of centers adopting and implementing IPM practices increased from 7% initially to 80% after the intervention by implementing their own IPM plan or by adopting/implementing the IPM plan of the pest control company servicing them.

A "Train-the-Trainer" IPM program was conducted in 892 licensed child care programs, including centers and day care homes, in Illinois (Mir et al., 2010). This IPM training program included a slide presentation, question-and-answer session, and IPM handbook and toolkit (i.e., steel wool, caulk gun, traps). After the IPM training, the staff were more confident in their knowledge of IPM, used less pesticide spray, and used more rodent monitoring traps compared with providers who did not participate in the IPM training.

To address gaps in ECE providers' knowledge about IPM and California's Healthy Schools Act, the authors developed and evaluated an IPM Toolkit for Early Care and Education Programs. This paper describes the development of the IPM Toolkit and results of the evaluation study, including whether a comprehensive IPM intervention (i.e., IPM workshops, IPM Toolkit, manager interview, assessment using an IPM Checklist) targeting ECE staff and managers, changed ECE staff knowledge and attitudes about IPM, IPM written policies, IPM prevention practices, pesticide use, and the prevalence of pest problems.

Methods

Development of an IPM Toolkit

Our goal was to develop an evidence-based IPM Toolkit that was practical, useful, and written at the appropriate literacy level for child care providers and managers. We convened an interdisciplinary management team of experts from the fields of epidemiology, entomology, nursing, public health, and ECE to develop the IPM Toolkit outline, key messages, and technical content. We also convened an advisory group of ECE professionals to review the materials for their relevance to the child care community. Additional outside reviewers included child care providers, environmental scientists, ECE educators, and staff with expertise in environmental health working in nonprofit and governmental agencies.

Selection of the content of the Toolkit was based on research and reports on IPM primarily conducted in public elementary and secondary schools and on more limited research with children in child care (California Department of Pesticide Regulation, 2010; Fenske et al., 1990; Makri et al., 2004; University of California Statewide Integrated Pest Management Program, 2010; Wigle, 2003; Woodruff, Axelrad, Kyle, Nweke, & Miller, 2003). The IPM Toolkit was pilot tested in two child care centers to collect feedback from participating staff about the key messages, workshop format, relevance to their work, and ideas for expanding parts of the workshop, such as emphasizing how pesticides are harmful to children's health.

The final IPM Toolkit included an IPM curriculum booklet, pest-specific information sheets written for ECE providers and families, posters, and an IPM Checklist (Tables 1a & 1b). The pest-specific information sheets were chosen based on the top pest problems identified by the survey conducted by Bradman et al. (2010) and consultation with our interdisciplinary management team. The pest-specific information sheets drew heavily from the University of California Pest Note series of publications (University of California Statewide Integrated Pest Management Program, 2010). An action plan was included at the end of each sheet with practical, easy-to-follow information.

Table 1a

IPM Toolkit: Contents and Summary of Materials

Integrated Pest Management: A Curriculum for Early Care and Education Programs

Content	# Pages	Summary of Materials
Introduction	2	• Summary of Toolkit contents • Target audience • Learning objectives • Background: health effects, curriculum overview
What is Integrated Pest Management?	2	• Why use IPM? • Steps to successful IPM • Example of how to use IPM
Healthy Schools Act	2	• What is the Healthy Schools Act (HSA)? • What does the law require? • Who is responsible for helping implement the HSA?
Pests—What you need to know	1	• What are pests? • Hazards of pests for young children
Pesticides—What you need to know	3	• What are pesticides? • Types of pesticides • Where are pesticides used? • What are the health hazards? ◦ Acute and long-term health effects ◦ Why children are at higher risk • Other hazards of using pesticides • Choosing safer pesticide products
Understanding IPM practices	14	• Prevention • Inspection • Identification • Monitoring • Management ◦ Safe storage and disposal of pesticides ◦ How to read a pesticide label
Implementing IPM in your ECE program	3	• Written IPM policy • Designate IPM coordinator • Training about IPM program • Collect information on outside contractors • Hire pest management professional with IPM experience • Inspect buildings and grounds for source of infestations • Establish pest monitoring procedures • Identify pests found

		• Create IPM Action Plan • Establish record keeping • Establish filing system • Establish IPM information area in facility • Evaluation IPM program regularly • IPM programs require attention and consistency
How to hire a pest management professional	1	• Identify pest management professional with IPM experience
Glossary of terms	2	• Define terms used in the IPM Toolkit
Resources	1	• Names and Web sites for IPM materials for child care programs
Appendices	7	• List of Toolkit's complementary materials Forms: ◦ Sample IPM Policy for ECE programs ◦ Sample letters explaining annual written notification registry, notification of planned pesticide use ◦ Parent/staff application to be enrolled in the notification registry ◦ Sample warning sign to be displayed on property ◦ Sample pest monitoring log

Table 1b

IPM Toolkit: Contents and Summary of Materials

Complementary Materials

Content	# Pages	Summary of Materials
Pest Information Sheets: Health and Safety Notes	22	• Ants • Cockroaches • Green cleaning • Head lice • Molds and mildew • Mosquitoes • Rodents • Sanitizing safely and effectively • Slugs and snails • Spiders • Yellow jackets
Fact Sheets for Families	3	• Ants, Head Lice
Posters	4	• Indoor Early Care and Education Environment • Outdoor Early Care and Education Environment • How to Read a Pesticide Label • Exempt and Nonexempt Pesticides
IPM Checklist for Early Care and Education Programs	10	Sections: 1. Instructions on how to complete the Checklist; Helpful tools for an IPM inspection; Notes on evidence of pests or damage they cause 2. 85-Item Checklist with 3 main sections and subsections based on location of observation: • Outdoor areas: garbage storage, building exterior, landscape and play area • Indoor areas: kitchen, bathrooms, common space, and play, eating, storage, and staff areas • Pesticide use and IPM practices 3. Explanation of some items listed in IPM Checklist; more details on why you need to inspect specific areas.

Program Evaluation

Participants. Potential centers were identified from the California Child Care Resource and Referral Network database of licensed centers in California. Inclusion criteria were (1) centers serving primarily low-income, minority children in a range of age groups, (2) centers expected to be in operation for at least 7 subsequent months, (3) centers managing their own garbage removal, and (4) centers located in the San Francisco Bay area or Los Angeles.

A convenience sample of nine licensed child care centers was recruited from 6 out of 58 northern and southern California counties. Seven centers were located in northern California, and two centers were in southern California. The nine participating centers served 854 children under 6 years of age with diverse ethnic backgrounds: 60% Latino/Hispanic, 20% White, 8% Asian, 5% African American, 4% other, and 3% mixed ethnicity/race (Table 2). Seventy-seven percent of the children attending these centers were eligible for government subsidies, including the food program. The nine center managers had a mean of 27 years of ECE experience and a mean of 11 years of working in the participating ECE centers. One hundred and seven ECE staff in eight of the nine centers attended the IPM workshops.

Table 2a

Demographic Characteristics

(*n* = 9 centers, 854 children)

Characteristic	Percent	*N*
Manager Job Title		
Director	56	5
Site supervisor	22	2
Maintenance manager	11	1
Health and safety specialist	11	1
Manager Educational Level		
Bachelor's degree	22	2
Master's degree or more	78	7
Center Type		
Head Start	33	3
Private, nonprofit	33	3
State-funded preschool	33	3
Children's Ethnic Background		
Hispanic, Latino	60	512
European American	20	171
Asian/Pacific Islander	8	68
African American	5	43
Other groups	4	34
Mixed ethnic group/race	3	26
Children receiving government subsidies	77	657

Table 2b

Manager Experience

	Mean (*SD*)	*N*
Years worked in child care field	25 (10)	9
Years worked at this center	15 (11)	9

All study procedures and consent forms were approved by the Committees on Human Research, University of California, San Francisco and Berkeley. Written informed consent was obtained from ECE center managers who participated in the interviews.

Pre- and Post-Intervention Knowledge Forms. Before and after each workshop, ECE center staff completed the same 10-item pre- and post-knowledge forms in either English or Spanish. The multiple choice items included content on the definition of IPM, vulnerability of children to pesticides compared to adults, the California Healthy Schools Act, and which pesticides are approved by the EPA for use in child care (Appendix).

Manager Interviews. Interviews were conducted with nine center managers before the IPM educational workshops and 4 to 6 months after the workshops. These managers were identified by the center directors as having the administrative authority to oversee IPM practices. The managers included ECE directors (n = 5), site supervisors (n = 2), maintenance managers (n = 1), and health and safety specialists (n = 1). Data collected included manager's job title, manager's education level, center type, and the ethnic background of children attending the facility. Open-ended qualitative questions were also included regarding the managers' experience with IPM, impact of the IPM workshops, and utility of the IPM Toolkit. More in-depth qualitative interviews were conducted and are reported in another manuscript. The interviewer asked, "Please tell me how your experience has been when implementing IPM in your child care setting. What has changed at your child care center since you attended the IPM workshop, if anything? Do you think that change is sufficient/truly beneficial/irrelevant? Do you feel your center is better able to handle a pest problem if one were to arise?"

IPM Checklist. We developed a pilot 72-item, observational IPM Checklist to assess ECE programs' pest management practices, evidence of pests or damage caused by pests, and structural integrity of the facility both outdoors and indoors. The pilot Checklist was developed after a review of other evidence-based IPM resources and checklists (including Bearer, 2000; Centers for Disease Control and Prevention, 2011; Fenske et al., 1990; Flint & Gouveia, 2001; Frumkin, Geller, Rubin, & Nodvin, 2006; University of California Statewide Integrated Pest Management Program, 2010) and the requirements of California's Healthy Schools Act. The pilot IPM Checklist was used in this evaluation study and later revised based on our experiences during this project. The final IPM Checklist included in the IPM Toolkit has 85 items and includes items from the pilot interview on written policies about pesticide use, parent notification, tracking systems, and sanitation (available at http://ucsfchildcarehealth.org/pdfs/Curricula/ipm/ipm_checklist.pdf).

Staff members involved in this study used the Checklist as part of an inspection to assess the centers' IPM practices, pest management, and the presence of pests (Table 3). Photographs were taken to document the problems identified and to compare pre- and post-intervention conditions. Subjects of the photographs included, but were not limited to, cluttered storage areas, leaky faucets, holes in screen windows, and gaps between pipes and walls. The pre-intervention Checklist results and photographs were shared with center managers after the IPM workshops were completed.

Table 3

Frequency of IPM Checklist Items Pre- and Post-Workshop (n = 9 centers)

Item	Pre-Workshop		Post-Workshop	
	% yes	#yes/#centers	% yes	#yes/#centers
Outdoor Areas				
Garbage Storage: Cans and Dumpsters				
1. Are sealed properly	67%	6/9	78%	7/9

2. Are located 50 feet away from doors	89%	8/9	89%	8/9
3. Are located on hard, cleanable surfaces such as concrete	89%	8/9	100%	9/9
4. Area around garbage cans and dumpsters are free from spilled liquids or garbage.	67%	6/9	100%	9/9
5. All recyclables are rinsed or cleaned.	71%	5/7	100%	8/8
6. Pests (ants)	11%	1/9	0%	0/9
Building Exterior				
1. Walls, roof, and foundation are free of holes or cracks.	44%	4/9	78%	7/9
2. Window trim is free of cracks.	78%	7/9	89%	8/9
3. Windows close properly.	88%	7/8	100%	9/9
4. Window screens are free of damage (e.g., holes).	50%	3/6	89%	8/9
5. Vents and other large openings are screened with $\leq$ ¼–inch hardware cloth.	33%	3/9	22%	2/9
6. Exterior doors have sweeps, weather stripping or similar barriers.	38%	3/8	78%	7/9
7. Pests (other–possible termites)	0%	0/9	0%	0/9
Landscape and Play Area				
1. Plants are at least 12 inches away from building.	56%	5/9	67%	6/9
2. Branches are at least 6 feet away from building.	89%	8/9	67%	6/9
3. Free of ivy and other vines	67%	6/9	89%	8/9
4. Wood, debris, and thick mulch are at least 6 inches away from building.	89%	8/9	89%	8/9
5. Water sources (faucets or sprinklers) do not cause standing water.	100%	9/9	100%	9/9
6. Water sources are free of drips or leaks.	100%	9/9	100%	9/9
7. Equipment and toys are free of standing water.	78%	7/9	78%	7/9
8. Garbage containers outdoors have dome lids.	11%	1/9	11%	1/9
9. Garbage containers have plastic linings.	78%	7/9	100%	9/9
10. If present, rodent bait stations are out of children's reach.	0%	0/1	100%	1/1
11. If present, wasp traps are away from play and eating areas.	0%	0/1	100%	1/1
12. Pests (snails and slugs)	11%	1/9	0%	0/9
Indoor Areas				
Kitchen				
1. Area around and underneath dishwasher are clean and dry.	100%	7/7	89%	8/9
2. Area around and underneath refrigerator are clean and dry.	89%	8/9	100%	9/9
3. Countertops are clean and dry.	100%	9/9	100%	9/9
4. Shelves, cabinets, and drawers are clean and dry.	100%	9/9	100%	9/9
5. Food is stored in tightly sealed containers.	71%	5/7	100%	9/9

6. Stoves are free of food scraps, grease, and sugary substances.	100%	8/8	100%	8/8
7. Floors and molding are free of food scraps, grease, and sugary substances	100%	9/9	100%	9/9
8. Faucets and pipes do not drip or leak.	89%	8/9	100%	9/9
9. Gaps between pipes, vents, and walls are sealed or screened.	89%	8/9	100%	9/9
10. Cracks, crevices around cabinets are sealed or plugged.	78%	7/9	89%	8/9
11. Garbage containers have plastic linings.	100%	9/9	100%	9/9
12. Garbage containers have lids.	89%	8/9	78%	7/9
13. If present, insect bait stations are out of children's reach.	100%	2/2	100%	2/2
14. If present, monitoring traps are out of children's reach.	100%	2/2	100%	1/1
15. Pests (flies, cockroaches)	22%	2/9	0%	0/9
Bathrooms				
1. Free from mold	100%	9/9	100%	9/9
2. Walls, floor, and tiles are in good condition without cracks.	78%	7/9	78%	7/9
3. Faucets and pipes do not drip or leak.	89%	8/9	89%	8/9
4. Gaps between pipes, vents, and walls are sealed or screened.	33%	3/9	56%	5/9
5. Cracks and crevices around cabinets and mirrors are sealed or plugged.	44%	4/9	67%	6/9
6. Pests (ants)	11%	1/9	0%	0/9
Common Space, Play Area, Eating Area				
1. Furniture moves easily for vacuuming.	100%	9/9	100%	9/9
2. Free of clutter (e.g., cardboard boxes, paper products, playthings, toys, dress-up clothes)	89%	8/9	89%	8/9
3. Free of cobwebs	89%	8/9	89%	8/9
4. Free of dust	100%	9/9	100%	9/9
5. Walls or baseboards are free of holes.	78%	7/9	78%	7/9
6. Food items used for arts or crafts are in sealed containers.	100%	9/9	100%	9/9
7. Garbage containers have linings.	100%	9/9	100%	9/9
8. Garbage containers have lids.	89%	8/9	100%	9/9
9. If present, insect bait stations are out of children's reach.	100%	1/1	100%	0/0
10. If present, pest monitoring traps are out of children's reach.	Not applicable		Not applicable	
11. Pests (flies x2, moths–other)	33%	3/9	0%	0/9
Storage Area(s)				
1. Clean, organized, and free of clutter	89%	8/9	78%	7/9
2. Buckets are rinsed, and mops are hung up to dry.	50%	3/6	57%	4/7
3. Dry and free of standing water or moisture	100%	9/9	100%	9/9
4. Cracks and crevices around cabinets are sealed or plugged.	86%	6/7	100%	9/9

5. Items are stored in plastic bins that have sealed lids whenever possible.	67%	6/9	78%	7/9
6. Pests	0%	0	0%	0
Staff Area				
1. Free of clutter (e.g., cardboard boxes or paper)	88%	7/8	89%	8/9
2. Free of cobwebs	100%	9/9	100%	9/9
3. Free of dust	100%	9/9	100%	9/9
4. Free of beverage containers, crumbs, or debris	89%	8/9	100%	9/9
5. Cracks, crevices around cabinets are sealed or plugged.	88%	7/8	100%	9/9
6. Garbage containers have linings.	89%	8/9	100%	9/9
7. If present, insect bait stations are out of children's reach.	100%	0/0	100%	2/2
8. If present, pest monitoring traps are out of children's reach.	100%	2/2	100%	2/2
9. Pests (mouse, cockroaches)	22%	2/9	0%	0/9

IPM Workshops. Seven workshops were conducted in English and two in Spanish and English. The workshops averaged 1.5 hours in length and were attended by child care staff and managers; one workshop included primarily custodial or maintenance staff. The workshops started with an IPM game followed by a presentation with slides and hands-on experience involving several IPM tools. Each center was given an IPM toolbox with yellow jacket traps, bait stations, cooper mesh to block holes in walls and gaps around pipes, etc., a caulk gun to seal cracks, and a cobweb duster to remove webs and dust in hard-to-reach places.

Analysis

We computed descriptive statistics to summarize center characteristics, manager experience, frequency of IPM Checklist items observed, frequency of IPM policies and tracking systems, and pre- and post-workshop knowledge forms. *T*-tests were used to analyze mean change in responses on the pre- and post-workshop knowledge forms.

Results

Pre- and Post-workshop Knowledge

The pre- and post-workshop knowledge forms (Appendix) were completed by the ECE staff in eight of the nine centers (n = 107 participants). Knowledge significantly increased in 2 of the 10 content areas assessed: IPM and the use of pesticides (#6) and California Healthy Schools Act (#7). There was a significant increase, from 70% to 84%, of participants who said that IPM can include the use of pesticides (t statistic (df), p-value = -2.48 (196), $p < .05$). There was a significant increase, from 21% to 44%, of participants who knew that the Healthy Schools Act applies to California's licensed child care centers (t statistic (df), p-value = 3.55 (194), $p < .05$). Overall, there was no statistically significant increase or decrease in knowledge on the total scores.

IPM Checklist

In contrast to results of the pre- and post-knowledge forms, the IPM Checklist showed many improvements in IPM practices and building conditions and fewer pests on the post- versus pre-workshop inspection (Table 3). There were positive changes in 34 items; 5 items became worse, 32 items had no change (21 remained at 100%), and 1 item was not assessed. To summarize, there was a 68% increase in IPM practices (34 items improved out of 50 items, which had shown less than 100% compliance at baseline). No pests were observed during the post-workshop inspection at any of the centers compared to the pre-workshop inspection (n = 10 pests); during the baseline inspection, ants, snails and slugs, flies, cockroaches, moths, and mice were present.

The photographs taken pre- and post-intervention documented that previously noted problems listed on the IPM Checklist had been addressed. Storage areas were clean and well organized. Gaps between the pipes, vents, and walls were sealed. Garbage bins outside buildings were relocated to hard, cleanable concrete surfaces, and window trim was free of cracks.

IPM Policies

The number of written policies on the use of pesticides and IPM practices increased among participating centers after the training. Forty-four percent (n = 4) of the centers had policies at the post-workshop inspection compared to 11.1% (n = 1) at enrollment (Table 4). In addition, the centers had improved tracking systems for building maintenance, cleaning, and sanitizing. At the post-workshop inspection, we found that the managers knew what IPM was, and the programs had designated IPM coordinators.

Table 4
Frequency of IPM Policies and Prevention Practices: Manager Interviews (n = 9)

Item	Pre-Workshop # Yes	Post-Workshop # Yes
Policies		
Written policy for use of pesticides	1 (11.1%)	4 (44.4%)
Written policies include IPM	0 (0%)	4 (44.4%)
Tracking system		
Tracking system for building maintenance	5 (55.6%)	8 (88.9%)
Tracking system for cleaning and sanitizing	4 (44.4%)	6 (75%)
Know what IPM is	2 (22.2%)	9 (100%)
Designated IPM coordinator	1 (12.5%)	5 (55.6%)
Tried to use IPM	4 (44.4%)	8 (88.9%)
Did it work?	4 (44.4%)	8 (100%)
Pesticides sprayed outside in the last 6 months	4 (44.4%)	1 (11.1%)
Pesticides applied by "other"	8 (100%)	0 (0%)

Manager Interviews

Based on the open-ended questions, the managers were universally positive about their experience with IPM, impact of the IPM workshops, and utility of the IPM Toolkit. The managers indicated that IPM was used more frequently, and they reported using fewer pesticides during the

4 to 6 months after the IPM workshop. Feedback included favorable comments from two managers: "I thought your workshop was very effective. I think people that went really appreciated it. … You did some games that engaged people. … It was interactive and informative." "I think it's [IPM] a really good idea because you're really focusing on cleanliness and using things besides chemical or pesticides to solve the issue, so you're looking at the structural integrity of your buildings and how they [pests] might be getting in and I think … it seems much safer and much more effective way when you focus that way rather than just calling our pest man to come out and solve this."

Discussion

This comprehensive IPM intervention increased use of IPM practices among participating ECE centers and reduced observed pest infestations. The programs made concrete improvements in physical environments that reduced the potential for future pest entry and refuge. This finding suggests the importance of having programs use the IPM Checklist and underscores the value of thorough assessments or inspections in enhancing the use of IPM practices. The IPM Checklist was combined with photographic documentation of the pest problems and specific suggestions on how to address the deficiencies. Thus, center managers were given the information needed to direct their staff, including maintenance and custodial employees, to address the highlighted problems.

Similar IPM checklists have been used in other schools and in some child care programs (California Department of Pesticide Regulation, 2010; IPM Institute of North America, 2004, 2006; Maine Board of Pesticide Control, n.d.). One point-based evaluation of the IPM programs, the IPM STAR Certification for School Systems, was developed by the IPM Institute (Green, Gouge, Braband, Foss, & Graham, 2007); it showed an increased adoption of IPM policies, record keeping and notification practices, and safe pesticide use protocol in 17 school districts that were initially found to be deficient in these areas. However, the program described in this paper is the first to document the effectiveness of using a checklist as an assessment tool to identify pest prevention policies and practices and the first to evaluate use of an IPM training program for child care staff.

Although analysis of the pre- and post-knowledge forms did not show overall positive change in the areas specified on the form, findings from the interviews and post-training inspections indicate that the staff training provided a foundation of knowledge that helped the managers who instructed their staff to mitigate the problems identified. Although there is a high rate of child care provider staff turnover, child care center managers tend to have a higher rate of job stability (National Association of Child Care Resource & Referral Agencies, 2011; Whitebook et al., 2006). This suggests that the child care managers, who have the authority to implement IPM pest management practices, are optimal targets for outreach and dissemination of the IPM Toolkit.

Our findings compare favorably to two similar IPM intervention studies in ECE programs: the IPM intervention conducted in 892 licensed child care programs in Illinois (Mir et al., 2010) and 45 centers in New York (Anderson et al., 2010). Both IPM intervention programs included education, surveys, and IPM tools. After the IPM training, ECE staff members in both studies were more knowledgeable about IPM and used more IPM practices compared with pesticide sprays.

Although our pilot project had several important results, this study had several limitations. We recruited a convenience sample of licensed centers, which included motivated managers interested in IPM. Thus, the results of this study may not be generalized to all ECE centers. We also speculate that the literacy level of the items on the workshop knowledge forms may have been too high given that the forms showed nominal short-term changes in knowledge, while substantial changes in IPM practices and policies were assessed several months later.

One important contribution of this novel study was the use of a standardized, observational, objective checklist completed by research staff. This detailed inspection included center-specific photographs given to the site managers to document the pest-related problems and facilitated their follow-up on the identified problems. Future research is needed to determine whether inspections conducted by trained local health departments or ECE providers would have similar results.

In summary, we found that this comprehensive, multifaceted IPM intervention for ECE managers, providers, and custodial staff changed IPM attitudes, prevention policies and practices, and pest management, and thereby likely reduced pesticide use and exposure to children and staff in the participating ECE centers. It seems reasonable to conclude that future dissemination of the IPM Toolkit to center managers and ECE staff would increase knowledge and acceptance of IPM principles in the broader ECE community. Dissemination through ECE professional groups, health and education departments, and individual pest control companies would also increase the use of IPM practices in child care programs.

Finally, further research is needed to refine and improve upon this comprehensive IPM intervention. A randomized control trial with a more representative sample of ECE centers may be able to show that the IPM Toolkit, educational workshop, and IPM Checklist inspection can change pest management practices. We also recommend that state child care licensing regulations should include the U.S. national standards for child care programs (American Academy of Pediatrics et al., 2011), which support the use of IPM practices, thereby reducing pesticide exposure to young children and staff and supporting healthy child care environments.

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Appendix
Pre-Post IPM Workshop Form

1. Integrated Pest Management (IPM) is a process that
    a. Gets rid of pests quickly
    b. Focuses on long-term prevention or suppression of pest problems through prevention, monitoring, and the use of least toxic methods
    c. Can only be carried out by a pest management company
    d. Doesn't work as well as regular application of pesticides by a pest control company

2. Pesticides may have effects on children's health, including
    1. Cancer
    2. Learning disabilities
    3. Asthma
    4. All of the above

3. Monitoring is one component of IPM and involves
    1. Watching children to make sure that they don't get near areas where pesticides have been applied
    2. Observing children to make sure that they don't leave food in outdoor areas
    3. Observing the program's buildings and grounds for pest problems early on when it is easier to manage them
    4. Designating an IPM coordinator who looks for pests in the environment

4. Young children are more vulnerable to the effects of pesticides than adults because
    1. They have immune systems that are not well developed and do not protect them completely from toxic chemicals
    2. They put their hands and other objects into their mouths frequently
    3. They are closer to the ground where pesticides collect in the dust

4. *All of the above*

5. All child care centers in California are required by the Healthy Schools Act to
    1. Provide a way for parents and staff to sign up to be notified each time a pesticide is used in the program
    2. Post warning signs around each area where pesticides will be applied
    3. Keep records of what pesticides have been used at the facility site for the past four years
    4. *All of the above*

6. Integrated Pest Management is an approach that never uses any pesticides at all.
    1. True
    2. *False*

7. The Healthy Schools Act applies to California's K through 12 schools and
    1. *Licensed child care centers only*
    2. Licensed family day care homes only
    3. Child care center, family day care homes, and informal care

8. Once pesticides are approved by the Environmental Protection Agency, they are not dangerous to our health.
    1. True
    2. *False*

9. How do we know if a pesticide is legal to use?
    1. If it doesn't smell too toxic when I spray it, then it's legal and safe.
    2. All pesticides that I can buy at in the market are legal and safe.
    3. *I will see the EPA registration number on the container.*
    4. All of the above

10. The following are IPM strategies on how to prevent pests in the child care center:
    1. *Pest proofing the building and having good sanitation*
    2. Use pesticides regularly
    3. Use baits regularly
    4. All of the above