

# Pesticides and Your Children: A Randomized Controlled Evaluation of a Pamphlet

Daniel J. Sklansky, BA; Marlon P. Mundt, MS; Murray L. Katcher, MD, PhD

## ABSTRACT

*Background:* Maternal and pediatric residential pesticide exposure has been identified as a risk factor for birth defects, pediatric cancers, and neurological damage, and it may play a role in other disease processes.

*Objective:* To examine whether the use of a pamphlet with a brief educational message in a clinic setting would increase the knowledge and/or change the attitudes of pregnant women and mothers about pesticide use and alternatives, as well as promote pesticide safety.

*Methods:* A group of 103 women currently pregnant and/or with children less than 6 years of age were recruited at 2 Special Supplemental Nutrition Program for Women, Infants and Children (WIC) clinics for the study. Participants were given a 16-question true/false oral survey testing their baseline knowledge about pesticide safety and safer alternatives to pesticide use. Participants were then randomly assigned to a control group or to the intervention group, which received the pamphlet and a 2-minute scripted overview of its contents. Approximately 2 to 3 weeks later, all participants received a follow-up telephone call by a researcher blinded to the original group assignment, and the original survey questions were repeated.

*Results:* Follow-up assessments were completed for 73 (71%) of the participants. The mean improvement in correct responses on the follow-up survey was +0.39

for the control group and +3.1 for the intervention group ( $P < .001$ ). Item analysis revealed that the intervention produced a significantly higher number of correct answers to 9 of the 16 survey questions.

*Conclusions:* Providing mothers and pregnant women with a pamphlet and a brief message about pesticide safety and safer alternatives to pesticides in a clinic setting may be effective in improving knowledge and beliefs about pesticides.

## INTRODUCTION

Pesticides are ubiquitous in American residences. Residential pesticides are contained in insect-killing sprays, insect repellent, insect and rodent poisons, fumigants, head lice treatments, flea treatments for pets, lawn and garden treatments, and other products. The frequent use of pesticides has contributed to the large increase of environmental chemicals in the bloodstream of the US population in recent decades. In a recent report from the Centers for Disease Control and Prevention (CDC), numerous insecticides and herbicides were found at detectable blood levels in pediatric age groups.<sup>1</sup> The Minnesota Children's Pesticide Exposure Study also found pesticide metabolites in urine samples of 98% of the enrolled pediatric participants.<sup>2</sup>

Children are particularly susceptible to pesticides because of their play patterns, proximity to the ground, and age-related variation in toxicity; all of these increase the potential for harmful effects of many chemicals in pediatric patients.<sup>3,4</sup> An often overlooked area of concern in pesticide exposure studies is the prevalence of acute pesticide exposure and its consequences. In 2001, 90,010 acute pesticide exposures were reported to US poison control centers, 46,929 of which involved children. Of the 90,010 exposures, approximately 2500 were considered moderate, 250 severe, and 17 resulted in death.<sup>5</sup> Acute exposure can result in subsequent neurological effects, including headaches and problems with memory and concentration.<sup>6</sup>

Mr Sklansky is a second-year medical student, University of Wisconsin Medical School and recipient of the Summer Fellowship in Government and Community Service from the Wisconsin Medical Society Foundation. Mr Mundt is a Programmer Analyst in the Department of Family Medicine, University of Wisconsin Medical School. Doctor Katcher is Chief Medical Officer, Family and Community Health, Wisconsin Division of Public Health, Department of Health and Family Services, and Clinical Professor of Pediatrics, University of Wisconsin Medical School. Please address correspondence to Murray L. Katcher, MD, PhD, Wisconsin Division of Public Health, 1 West Wilson St, Room 243, Madison, WI 53701-2659; phone 608.266.5818; fax 608.266.3125; e-mail katchml@dhfs.state.wi.us.

**Table 1.** Pamphlet Contents: Pesticides and Your Children: Questions and Answers

<p><b>What are pesticides?</b> Pesticides are chemicals that keep out or kill plants or animals.</p> <p><i>What products contain pesticides?</i> Pesticides are commonly found in weed killers, insect killers, rat and mouse killers, head lice treatments, flea treatments for pets, and insect repellents.</p> <p><b>Pesticide Risks</b></p> <p><i>Can pesticides harm people?</i> Yes! Pesticides are poisons. They are meant to kill pests, but they can hurt people too.</p> <p><i>Can pesticides harm children?</i> Yes! Pesticides are especially dangerous to developing children because young children often put their hands in their mouths.</p> <p><i>How can I protect my children from pesticides?</i> Use other methods of pest control; use fewer pesticides; use pesticides as a last resort; keep children away from areas where pesticides have been used.</p> <p><b>Pesticides and Your Lawn</b></p> <p><i>Are pesticides in lawn sprays?</i> Yes. Most lawn treatments have many pesticides.</p> <p><i>How can I get rid of weeds without pesticides?</i> A healthy lawn is the best natural weapon against weeds: cut grass higher; use a mulching mower; water deeper, but less often.</p>	<p><i>Are there safer ways to kill weeds?</i> Yes, there are natural methods and natural lawn services: spread corn gluten meal in spring; remove weeds and their roots by hand.</p> <p><b>Pesticides in Your Home</b></p> <p><i>What is the best way to reduce pesticide use at home?</i> Make your home unfriendly to pests: eliminate wet areas; put food in sealed containers and keep your kitchen clean and tidy.</p> <p><b>How can I stop pests from entering?</b> Keep doors closed; repair screens; seal holes; caulk cracks.</p> <p><i>Should I spray to keep insects out?</i> No. The best and safest way to keep insects out is to make your home unfriendly to them.</p> <p><b>Cockroaches (and insects)</b></p> <p><i>Can cockroaches be unhealthy?</i> Yes, they can carry disease and can trigger asthma.</p> <p><i>How can I control cockroaches?</i> Make your home unfriendly to pests; use treatments with slow poisons so roaches live to carry it back to the nest.</p> <p><i>What treatments should I use?</i> Use bait stations or gel baiting; use non-dust boric acid; hire a service that uses baiting.</p> <p><i>Should I use insect spray?</i> No. Sprays are harmful to breathe and they NEVER solve the insect problem; soapy water mist kills most bugs.</p>	<p><b>Mice and Rats</b></p> <p><i>How can I safely eliminate rodents?</i> Make your home unfriendly to pests: seal holes and remove food and water sources; use traps before using poisons.</p> <p><i>How should I use traps?</i> Wear gloves to set new or old traps; old used traps work best; put traps along walls.</p> <p><i>What if traps don't work?</i> Use poison bait stations; call a service and ask for Integrated Pest Management of your problem.</p> <p><b>Fleas on Pets</b></p> <p><i>What is a safer flea treatment?</i> Frequent pet bathing and combing.</p> <p><i>What is the safest flea pesticide?</i> Use products for pets with "Insect Growth Regulator."</p> <p><b>Insect Repellent</b></p> <p><i>How can I prevent insect bites?</i> Cover skin with clothing; use products with 10% DEET or less.</p> <p><i>What is the safest way to use DEET?</i> Apply to clothing rather than skin. Do not apply on hands or mouth. Products with DEET are not for kids under 2 months of age.</p> <p><i>How often can I use DEET?</i> Apply no more than once per day.</p>
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The long-term consequences of human pesticide exposure are not fully appreciated, but recent studies have begun to show evidence of deleterious effects in several physiological systems. Residential pesticide exposure may impair children's neurobehavioral development and may contribute to the development of learning disabilities, behavioral disorders, and attention deficit hyperactivity disorder.<sup>6-8</sup> Also, early pesticide exposure may make children more susceptible to subsequent exposures to neurotoxins later in life.<sup>9</sup> Pesticide-induced neurotoxicity has been implicated as a factor leading to an increased likelihood of developing Parkinson's disease.<sup>10</sup> Maternal pesticide exposure may also contribute to spontaneous abortion, fetal death, and some birth defects.<sup>11,12</sup> Numerous studies have linked residential pesticide exposure to an increased likelihood of developing pediatric cancers, including acute lymphoblastic leukemia, neuroblastoma, and non-Hodgkin's lymphoma.<sup>13-17</sup>

In response to the serious public health risk posed by pediatric pesticide exposure, we designed a pamphlet that could be presented to parents by health professionals, containing information about pesticide safety and safer alternatives to pesticide use. In this study, we tested the hypothesis that such a pamphlet, coupled with a brief message in a clinic setting, could improve knowledge and attitudes about pesticide safety and alternatives to their use in mothers and pregnant women.

## METHODS

### *Pamphlet*

A pamphlet was designed with the goal of incorporating the principles of residential integrated pest management (RIPM), a technique of using the least toxic approach to pest control. The pamphlet was written at the fourth-grade level by the Flesch-Kincaid standard. It included basic information about the most common

sources of residential pesticides, ways to prevent pest infestations, and alternative pest elimination strategies, in addition to Internet links for more details and phone numbers to call in case of safety concerns. The contents of the pamphlet can be found in Table 1, and the actual pamphlet can be downloaded as a PDF file from the Internet at <http://www.wisconsinmedicalsociety.org>.

### Participants

Eligible participants were women who attended WIC clinics in Janesville or Beloit, Wis, during the study period. Janesville and Beloit were chosen because they share staff members and they draw from both urban and rural populations. Women using WIC services are in families earning <185% of the federal poverty level, and the women must either be pregnant or have at least 1 child under the age of 6 years. Women who were not fluent in English or who were unable to receive telephone calls were not eligible for the study. This study was approved by the University of Wisconsin Health Sciences Human Subjects Committee.

Potential participants were approached by a medical student researcher (DJS) in the waiting room at the WIC clinic and asked to participate in a brief research study that would require being called back in about 2 weeks. Upon agreement, a 16-question true/false survey, designed to test knowledge and attitudes about pesticide safety and safer alternatives to pesticides, was administered. The researcher began every interview by reading the list of questions to the participant, stopping after each question to record the participant's response. Participants were instructed to answer each question, even if they were not completely certain about the answer; they could also decline to answer if they had no idea of the correct response. Participants were then asked basic demographic questions: age, education level, ethnicity, number of children, and type of housing. Separate numerically linked forms were used for survey information and contact information to protect participant confidentiality. Participants who wanted to know the correct answers to the questions were told that they would receive them in a follow-up call.

Upon completion of the baseline survey, a random number generator was used to assign participants to either control or intervention groups with equal odds. Subjects in the control group were given no further information. The researcher presented intervention group subjects with the pamphlet and gave a 2-minute scripted overview of its content.

All participants were called 11 to 25 days after the baseline survey completion, and an identical survey was

**Table 2.** Characteristics of the Sample

	Control Group (n=36)	Intervention Group (n=37)
<b>Age (yr)</b>		
Mean	25.6*	28.5*
Standard Deviation	5.5	6.8
Range	19-42	19-44
<b>Education (yr)</b>		
Mean	12.8	12.3
Standard Deviation	3.5	1.9
Range	8-17	9-16
<b>Number of Children‡</b>		
Mean	2.18	1.93
Standard Deviation	1.41	1.18
Range	0.5-6	0.5-6
<b>Ethnicity</b>		
African American	2 (5.6%)	4 (10.8%)
Hispanic	1 (2.8%)	1 (2.7%)
White	31 (86.1%)	31 (83.7%)
Other	2 (5.6%)	1 (2.7%)
<b>Interview Location</b>		
Janesville	28 (77.8%)	23 (62.2%)
Beloit	8 (22.2%)	14 (37.8%)
<b>Home Type</b>		
House	25 (69.4%)	27 (73.0%)
Apartment	11 (30.6%)	10 (27.0%)

\*p=.05; distribution of demographic attributes between control and intervention groups was not significantly different for any attribute except age.

administered. Not all of the original women could be contacted due to changed phone numbers, wrong numbers, or inability to find the participant at home. Each working number was called at least 5 times unless instructed by an occupant of the home to stop calling. The researcher administering the follow-up surveys was blinded to the group assignment (control or intervention) of the participant.

Surveys were scored according to the number of correct responses. Means were computed for the changes in scores between baseline and follow-up surveys for the control and intervention groups. The 2-sample t-test was used to compare the control and intervention group mean score changes statistically. Demographic data were analyzed by multivariate regression analysis to examine potential confounders in randomization of control and intervention groups and in the distribution of participants who did and did not complete the follow-up survey.

Item analysis was performed on each survey question to assess the specific effects of the intervention. We

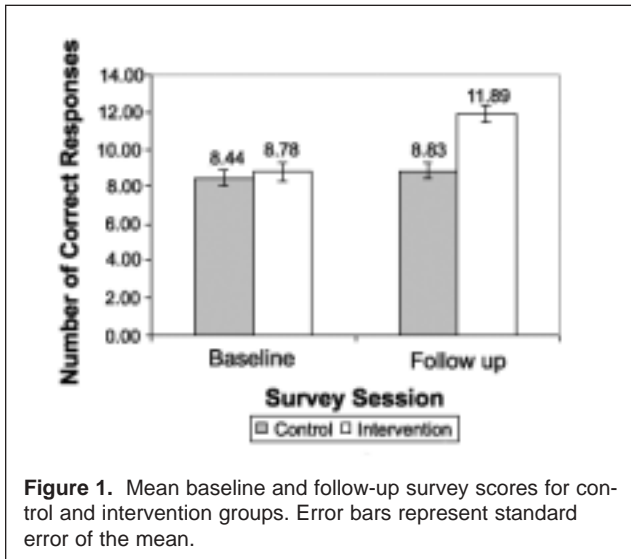


Figure 1. Mean baseline and follow-up survey scores for control and intervention groups. Error bars represent standard error of the mean.

computed the percent of correct responses for each question in the baseline and follow-up surveys for intervention participants and compared them using the chi-squared test.

RESULTS

Of the 113 eligible women approached, 103 (91%) agreed to participate in the study and completed the baseline survey; 73 (71%) of them were later reached by telephone and completed the follow-up survey. Table 2 shows the demographic characteristics of the control and intervention groups. Distribution of demographic attributes between control and intervention groups was not significantly different for any attribute except age. Analysis of age showed no significant correlation with the outcome variable, and age had no effect on the significance of the comparison of score change between control and intervention groups. The only demographic factor which was significantly different between participants who could and could not be reached for follow-up surveys was average years of education (unreached=11.8, reached=12.5,  $P<.05$ ). Multivariate analysis of the impact of education on score change indicated that the intervention effect was not significantly altered by adjustment for education level.

The mean baseline survey score defined by number of correct answers for participants who completed both surveys was 8.62 of a possible 16. The mean baseline scores of the control and intervention groups, 8.44 and 8.78 respectively, did not differ significantly (Figure 1). The mean follow-up survey scores for control and intervention groups were 8.83 and 11.89 respectively, showing score improvements between baseline and fol-

low-up surveys of +0.39 in the control group and +3.11 in the intervention group ( $t=4.48$ ,  $df=70$ ,  $P<.001$ ).

Abbreviated forms of the 16 questions asked in the survey are found in Table 3, along with the correct answers, according to the pamphlet. We analyzed the impact of the pamphlet/message intervention on the responses to each question by comparing the number answered correctly in the baseline survey to that in the follow-up survey. The chi-squared test indicated statistically significant improvement ( $P<.05$ ) for 9 of the 16 questions.

DISCUSSION

Pamphlets are often used in medical practices to inform patients about issues that a physician may not have time to talk about at length or so that the patient may use them as a reference at a later time. Written materials may be effective for educating patients about health risks, but some disagreement exists about the benefits of written materials alone.<sup>18-20</sup> Since a verbal supplement may enhance the educational effect of written materials,<sup>21,22</sup> we designed the intervention to include both, which can be readily used by a clinician in the office.

The results indicate that the intervention of a pamphlet and a brief message significantly improved participants' knowledge and attitudes about pesticide safety and safer alternatives to pesticides. The slight increase in mean correct responses in the control group was not significant and may be attributable to having heard the questions before. The age difference between participants who were reachable for follow-up questions and those who were not reachable could have been a random trend or may have been due to different work patterns, depending on education.

The item analysis of the survey indicates what messages from the pamphlet came through most clearly. There was a significant improvement in the number of correct responses for all questions dealing with the spraying of pesticides (questions 4, 11, and 16). It is important to avoid spraying because children can inhale the spray and because sprayed poisons only kill the pests they contact directly, and they are not a good long-term solution to pests. There was also a significant improvement in questions that ascertained whether participants knew that pesticides were contained in household products including flea treatments for pets, head lice treatments, and mosquito repellents (questions 6, 8, and 9). Intervention participants showed a significantly altered attitude that cockroaches may be harmful and that pesticides should not be the first

**Table 3.** Survey Item Results for Intervention Group (n=37)

Survey Question*	Correct Answer†	Baseline (% correct)	Follow-Up (% correct)	p-Value‡
Pesticides are not harmful if you follow directions.	F	59	59	NS
Pesticides are often the only way to get rid of pests.	F	89	89	NS
Pesticides should be the first method of pest control.	F	62	84	<.05
You should use pesticide spray cans for some pests.	F	14	43	<.005
Pesticides are found in ant killers.	T	86	92	NS
Pesticides are found in flea treatments for pets.	T	59	89	<.005
Pesticides are found in mousetraps.	F	65	62	NS
Pesticides are found in head lice treatments.	T	46	78	<.005
Pesticides are found in mosquito repellent.	T	54	86	<.005
Cutting grass shorter eliminates lawn pests.	F	27	32	NS
Spraying your house keeps insects from entering.	F	41	65	<.05
You should wear gloves when setting new mousetraps.	T	86	89	NS
Cockroaches are ugly, but harmless to humans.	F	68	92	<.01
The Internet has no information on pesticide alternatives yet.	F	43	65	NS
Use insect repellent on children at most once per day.	T	46	100	<.001
For a roach problem, spraying is better than poison baiting.	F	19	62	<.001

\* Items slightly abbreviated from original questions.

† F=false

‡ T=true

method of pest control (questions 3 and 12). A significant improvement was also seen in question 15, reflecting the impact of the pamphlet in teaching that insect repellent should not be applied to children more than once per day.<sup>23</sup> In fact, every participant in the intervention group answered it correctly on the follow-up survey.

This study did not investigate long-term retention of information included in the intervention or the effects of this information on participant behavior. The study could have been influenced because the author of the pamphlet was directly involved in the survey administration. However, we attempted to eliminate bias from our results at the time of the follow-up survey by blinding the researcher to the baseline random group-assignment status of the participant.

## CONCLUSION

We do not fully understand the mechanisms by which pesticides may cause harm to humans, and we do not know the exact chemicals that are most likely to be at fault. As more studies are conducted, we will learn more about the long-term effects of individual agents, and we hope it will be possible to use only products and treatments that will be safe over long periods of time. Even with safer chemicals, the principles of RIPM could prevent pest problems from occurring in the first place and could spare homeowners the cost of purchasing pesticides. The safest current approach to pest

problems is to prevent pests from becoming a problem and to use alternative least-toxic measures against them when necessary. Patient education materials, such as the pamphlet we tested, in combination with a brief message from a health care provider, may be an effective way of changing the behavior of individuals to provide a safer home environment for children.

## ACKNOWLEDGMENTS

The authors thank Wisconsin Division of Public Health Chief Medical Officer, Henry Anderson, MD, and Chief Toxicologist, Lynda Knobeloch, PhD, for their assistance in designing the pamphlet. The authors also acknowledge Wisconsin WIC Program Director Patti Herrick and the Janesville and Beloit WIC staff, especially Nutrition Manager Jennifer Johnson, for helping the study run smoothly. This study was made possible by grants from the Wisconsin Medical Society Foundation and the University of Wisconsin Medical School Department of Family Medicine's LOCUS (Leadership Opportunities with Communities, the Underserved, and Special Populations) program.

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## Appendix 1. Pesticide Safety and Integrated Pest Management (IPM) Resources

### The Environmental Protection Agency (EPA)

#### Pesticide Site

<http://www.epa.gov/pesticides/index.htm>

Pesticide policy developments, IPM information, and safety information.

### Northwest Coalition for Alternatives to Pesticides

<http://www.pesticide.org/>

Fact sheets with thorough instructions for safer management of every imaginable pest.

### National Environmental Training and Education Foundation

<http://neetf.org/Health/publications.shtml#PestPractice>

Information about pesticide safety and health effects including publications for health care professionals. National Pesticide Practice Skills Guidelines for Medical & Nursing Practice is particularly useful.

### The IPM Institute of North America

<http://www.ipminstitute.org/>

News about IPM and links to state and school IPM programs across the country.

### New York State IPM Program

<http://www.nysipm.cornell.edu/publications/>

Useful publications about community IPM.

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