STATE OF CALIFORNIA—HEALTH AND WELFARE AGENCY

PETE WILSON, *Governor*

DEPARTMENT OF HEALTH SERVICES
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February 25, 1994

Richard W. Niemeier, Ph.D., Director
Division of Standards Development and
Technology Transfer
Centers for Disease Control and Prevention
National Institute for Occupational Safety
and Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati, OH 45226-1998

Dear Dr. Niemeier:

Enclosed please find examples of take-home exposures from our investigations of occupational and environmental hazards and illness. Please except my apology for the delay.

If you have any questions, please feel free to call me at (510) 450-2400.

Sincerely,

Ana Maria Osorio, MD

Ana Maria Osorio, M.D., M.P.H., Chief
Division of Environmental and
Occupational Disease Control

Enclosure

cc: Ms. Diane Manning
National Institute for Occupational
Safety and Health
Robert A. Taft Laboratories
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The Childhood Lead Poisoning Prevention Branch (CLPPB) within the California Department of Health Services performs a broad array of functions, including data collection and case management coordination statewide. Blood lead levels of 25 µg/dL and above have been reportable in California since 1987, and the Surveillance Section within CLPPB collects blood lead and demographic data on children under the age of 16 from all clinical laboratories. A case management system is also operated through the computerized data collection system, and notification letters are sent to the local health department serving the area where each reported child lives. Local health departments receive funding, technical assistance and laboratory support to provide case management and environmental investigation functions for each child that meets current CDC follow-up criteria. The local health departments use an 11-page follow-up form to conduct case management activities and send a completed copy to the Surveillance Section so that follow-up data can also be entered for each child reported. This follow-up form includes information on potential occupational lead take-home exposures.

The occupational and childhood lead poisoning prevention programs within the California Department of Health Services closely coordinate surveillance activities and refer cases that require both occupational and environmental case management activities. When a worker who may be bringing lead home is identified, the childhood program is notified and in turn notifies the local health department to investigate possible take-home exposures. When a follow-up by a local health department of a child reveals a potential take-home exposure, the occupational program is notified for follow-up as necessary in the workplace.

Data from the childhood Surveillance Section show that of 1232 cases under the age of 16 with follow-up information, 10% had a potential take-home exposure identified in the home. Of those with information reported about the lead workers in the household, 33% changed clothes before leaving work, 13% showered before going home, and 18% had ever had a blood lead test for work. Among the occupations identified in the households of childhood lead poisoning cases: radiator repair, autopaint sander, welder, housepainter, remodeler, foundry worker, metal polisher, metal cutter for airplane parts, lead recovery worker, bullet manufacturer, solderer, battery manufacturer and truck dismantler.

TAKE-HOME LEAD EXPOSURE

Information provided to NIOSH per 11/15/93 Federal Register request for existing information relevant to implementing the Workers' Family Protection Act

Occupational Lead Poisoning Prevention Program (OLPPP), Occupational Health Branch, Division of Environmental and Occupational Disease Control, California Department of Health Services

February 10, 1994

Contributions from the following OLPPP staff: Barbara Materna, PhD, CIH, Program Coordinator; David Harrington, MPH, Health Education Consultant; Peter Scholz, MPH, CIH, Associate Industrial Hygienist; Karen Hipkins, RNP, MPH, Occupational Health Nurse Practitioner; Susan Payne, MA, Epidemiologist; Luz Soluaga, BA, Bilingual Epidemiologic Interviewer; Mary Edgerly, Associate Office Services Technician

For more information about OLPPP, contact Barbara Materna, Program Coordinator, at (510) 540-3481 or write to OLPPP, California Department of Health Services, 2151 Berkeley Way, Annex 11, Berkeley, CA 94704.

DESCRIPTION OF PROGRAM RESPONSIBILITIES:

Background

In 1986, California regulations were passed requiring laboratories that analyze blood for lead content to report blood lead levels (BLLs) of 25 micrograms per deciliter (ug/dl) or higher to the California Department of Health Services and to the local health department in the county of residence of the person involved. The two California Department of Health Services' programs involved in blood lead surveillance and case follow-up activities are: for surveillance and follow-up of adults, the Occupational Lead Poisoning Prevention Program (OLPPP); and, for surveillance of childhood exposures, the Childhood Lead Poisoning Prevention Branch (CLPPB). Local health departments conduct case follow-up activities for children and non-occupationally exposed adults, with consultation and financial support from CLPPB. OLPPP and CLPPB are funded by fees assessed on industries that use or disturb lead, or have been responsible for lead environmental contamination, respectively.

OLPPP Follow-up of Take-home Lead Cases

OLPPP typically becomes aware of cases involving take-home lead exposure in one of two ways: 1) a worker is reported with a high BLL, and OLPPP's case follow-up activities reveal that workers' household members have been exposed; or 2) a local health department representative conducting follow-up on a childhood case identifies that a parent or other household member works in a job with lead exposure and has been bringing home lead on clothing or shoes.

OLPPP's follow-up protocol at the current time is that a reported BLL of 60 ug/dl or higher initiates telephone interviews of the worker, employer, and any physicians who are involved (personal and/or company physician). A bilingual interviewer conducts worker interviews, including those who prefer or have to be interviewed in Spanish. The standard questionnaires contain questions about taking work clothing and shoes home, hygiene practices, and workers' household members. Educational information about lead is sent to all interviewed parties. When any children aged 6 or under, or pregnant or nursing women are identified in the workers' households, a referral is made to CLPPB that is sent to the local health department to initiate blood lead testing and follow-up. The local health department personnel do ongoing follow-up with families, and provide guidance (in consultation with CLPPB) on decontamination of the homes and vehicles.

OLPPP interviewers stress (especially to the workers involved) the importance of testing household members' blood lead levels. OLPPP provides written recommendations to employers on discontinuing unsafe work practices, including those that contribute to take-home exposure. Employers are requested to provide blood lead testing to all workers at risk of lead exposure, and to encourage these workers to have their household members tested. Employers are put on a time line for implementing a lead safety program that is in compliance with OSHA standards. Where employers fail to cooperate and correct hazardous working conditions, OLPPP refers the companies to Cal/OSHA for enforcement action.

Other OLPPP Activities

OLPPP has other mandates, in addition to maintaining the Occupational Blood Lead Registry and providing follow-up to cases of workers with elevated blood lead levels. A major focus is in the area of outreach and education. Target audiences include employers, trade associations, workers, unions, health professionals (physicians, nurses, industrial hygienists, safety personnel), other governmental agencies, and the general public. OLPPP develops brochures, fact sheets, training materials, and a publication called Lead in the Workplace. OLPPP staff speak regularly at seminars, conferences, and meetings on the subject of lead poisoning prevention. Most recently, OLPPP has been concentrating on informing construction employers and workers about the requirements of the new Lead in Construction OSHA standard. Special focus intervention projects targeted toward high risk industries are also conducted; OLPPP is currently conducting a NIOSH-funded intervention study with San Francisco painters who disturb lead. Employer seminars, worker trainings, an employer compliance assistance manual, and other educational materials and resources are being developed for this project. The message about preventing take-home lead exposure is routinely featured in all of these outreach and education efforts.

Children 6 or under/Pregnant or nursing women referred to CLPPB for Possible Take-home Exposure, 1993:

Summary of referrals

Age/condition:	Number of referrals:
< 1 yr	2
1-2 yr	7
3-4 yr	3
5-6 yr	2
pregnant	2
nursing	2
Total:	18 persons

Industries: auto radiator repair, auto radiator manufacture, ceramics product manufacture, pump manufacture, battery manufacture, small arms manufacture, lead recycling/bullet manufacture, demolition

A SERIES OF CASE STUDIES OF TAKE-HOME LEAD EXPOSURE INVESTIGATED BY OLPPP (1992-93):

Take-home Lead Case Study #1: Lead Recycler/Bullet Manufacturer

A small lead reclamation and bullet manufacturing company was responsible for its two employees (both Hispanic) having highly elevated blood lead levels (BLLs). One of the employees' two children also had extremely high BLLs as a result of take-home lead exposure from this shop. This family has no health insurance.

The county health department first had contact with these two children as part of a routine BLL screening by the Child Health and Disability Program. A series of BLL tests found that the two year old girl had extremely elevated BLLs with the highest reported at 44 ug/dl. The girl's one year old sister had a peak BLL of 36 ug/dl. The child with the highest BLL was referred to a hematologist for consultation under a special California Children Services program for indigent children. At the site investigation by the County Public Health Nurse, environmental point sources were ruled out. The source of the exposure was determined to be the father bringing home lead dust on his work clothes and shoes. It was also concluded that the apartment and furnishings were contaminated with lead dust.

During the same time period, the Occupational Lead Poisoning Prevention Program (OLPPP) received laboratory reports indicating that the father of the two children had a BLL of 66 ug/dl and the other employee had a BLL of 56 ug/dl. Per the program's protocol, interviews were conducted of the index case employee, the employer and the physician who had requested the blood lead test. English and Spanish language educational materials were sent to all three parties. At OLPPP's request both employees were placed on Medical Removal Protection. It was determined by the program's nurse practitioner that the treating physician was not competent to be an ongoing medical supervisor. A letter with recommendations for creating a lead safety program (including addressing the take-home exposure problem) and a timeline for compliance was sent to the employer. The employer was informed in writing and over the telephone that failure to respond adequately and in a timely manner to the recommendations would result in a referral to Cal/OSHA for a compliance inspection of the business.

At this time, OLPPP staff continues to work with this employer to institute a lead safety program while the two employees are still on Medical Removal Protection. The employer has contracted with a qualified medical provider to act as the medical supervisor. While the shop is temporarily closed down, housekeeping is being done with a newly purchased HEPA vacuum, a uniform and shoes program has been established, as well as hygiene and work practices, and respirators have been purchased for use as a temporary measure. Engineering control requirements will be evaluated upon the return of the employees, when air monitoring will be performed by Cal/OSHA Consultation Services.

The employer has shown progress in instituting a lead safety program. At this time the company will not be referred to Cal/OSHA for enforcement action. Follow-up over time and future BLLs will be tracked to determine future actions. However, the issue of the children's future developmental and health care needs being met is uncertain. As mentioned, the children are uninsured and the county is limited in what it can offer regarding on-going follow-up. The employer could have liability here, but there are no incentives presently to compel the company to cover these costs.

Take-home Lead Case Study #2: Radiator Repair Shop

A county health department public health nurse was conducting follow-up on BLLs in the 20's for two children, aged 4 years and 18 months. The father was identified as a radiator repair man, and was instructed to get a BLL test; the level was found to be 53 ug/dl. The nurse contacted the Childhood Lead Poisoning Prevention Branch (CLPPB) for advice on how to deal with the adult case, and was referred to OLPPP. Since other employees of the same business lived in the same house, several other children received BLL tests which were not found to be elevated.

OLPPP did a telephone interview with the employer, and followed-up with a site visit. The adult worker's physician (an occupational health physician) and a representative from CLPPB accompanied the OLPPP industrial hygienist. Deficiencies in the shop's working conditions included: no local exhaust ventilation at the locations where lead-containing solder was used or where radiators were dismantled by melting existing solder with a torch, no blood lead monitoring or medical program, no respirators, no worker training regarding lead safety, and no air monitoring for lead levels ever done. Although the company issued uniforms and laundered them once a week, there was apparently no awareness and no training provided about the need to change out of dirty clothes at the shop and wash up before going home. There was no shower at the workplace.

OLPPP staff and the occupational health physician talked with the workers and employer, explained what had happened with the one worker and his children, and recommended that all other workers receive BLL and ZPP tests immediately. A written report with recommendations was provided to the company. The company contracted with a medical supervisor who conducted medical exams and blood testing, and two additional workers were subsequently identified with BLLs of 50 and 51 ug/dl. The three workers with BLLs in the 50's were put on Medical Removal Protection. The company purchased respirators and arranged for the workers' compensation carrier to send an industrial hygienist to conduct air monitoring. Personal air sampling in this shop of one radiator repair worker showed a TWA airborne lead level of 210 ug/m^3 (based on a 4-hour sample).

This company did not continue to cooperate with the physician who had been hired as the medical supervisor, and was not complying with the Cal/OSHA standard's requirements for a medical surveillance program. OLPPP referred the company to Cal/OSHA for enforcement action.

Take-home Lead Case Study #3: Cable Cutting Operation

A county health department public health nurse initiated follow-up of a 3 year old child with a BLL of 28 ug/dl. The siblings were referred for BLL testing; it was determined that a 5 year old had a BLL of 27 ug/dl and a 9 month old had a BLL of 21 ug/dl. The home was found to be constructed post-1978, with no lead paint sources identified.

These children had an uncle living with them for 4-5 years who had been working the entire time as lead cable cutter. In the prior 3 months, the father had also been employed in this trade. The work involves cutting down lead-sheathed cable from telephone lines for replacement. The father, who was interviewed by OLPPP, reported stripping lead sheathing off the cable, wearing work clothing home and laundering it with the family laundry, and not observing basic hygiene practices (no facilities were provided by the employer for handwashing on-site or showering at the end of the shift). His BLL was found to be 38 ug/dl. He agreed to discontinue bringing work clothing home.

Lead contamination (1517 ug/dl and 1609 ug/dl) was found in the soil of the family's back yard, where they reported bringing home lead-contaminated telephone poles to use as firewood. Lead levels of 1700 ppm were found in a composite sample of indoor dust in living room carpeting and couches. Environmental sampling was done by the county health department, with analysis by the Department of Health Services' Environmental Health Laboratory Branch. Recommendations were provided by the county health department, in consultation with CLPPB, regarding decontamination of the home, yard and personal vehicle.

The company was interviewed by an OLPPP industrial hygienist. OLPPP recommended testing all other workers (and their household members), providing washing facilities and protective clothing and work shoes, training workers in the hazards of lead, conducting air monitoring, setting up a lead medical program, and implementing safe clean-up methods. The company agreed to follow the recommendations and to reduce lead exposure by changing the work process. Crews were trained to roll up cable without disturbing the lead sheathing and ship the rolls to a recycling facility for processing.

Take-home Lead Case Study #4: Communication Cable Salvage Operation

In November 1993, OLPPP received a number of reports of employees with elevated blood levels. The employees worked at a communication cable salvage operation. Because two of the employees had blood lead levels over 60 ug/dl, OLPPP initiated its standard follow-up with the two employees, the employer and the company medical provider.

The elevated blood lead levels were also received by the county health department, which contacted employees' households to conduct blood lead testing of children at risk of lead poisoning as a result of take-home exposure. The county program contacted OLPPP and a cooperative effort was initiated.

Through interviews with the employer, OLPPP determined that the business purchased scrap communication cable from the local telephone company and processed it, reclaiming various materials for recycling. The operations included handling, shearing and baling lead-sheathed communication cable. No engineering or process controls were in place to control lead dust exposure or contamination. Dry sweeping was being used to clean work areas in which the lead-sheathed cable was processed. The employer did not provide separate work clothing to employees and, as a result, employees regularly wore work clothes home. Employees were not required to wash up at the end of the day, and there were no showers on site.

Of the 18 employees who were initially blood lead tested during the month of October, 10 had blood lead levels at or above 40 ug/dl. OLPPP made comprehensive recommendations to the employer to improve the company's lead safety program. The employer subsequently took steps to improve hygiene and housekeeping, and to prevent lead contamination from being taken home. An OLPPP site visit confirmed that substantial changes had been made.

One employee, whose initial blood lead level was 36 ug/dl, had a 10 month old child. The child was tested and found to have a BLL of 26 ug/dl. The employer reported that this employee regularly went home for lunch wearing his work clothes. The county health department conducted a site visit of the home and made standard recommendations for remediation of the home environment. The child's BLL has subsequently decreased to 17 ug/dl. The employer, employees, and the child continue to be actively followed by both the state and county programs.

Take-home Lead Case Study #5: Battery Repair Operation

The parent of a 6 year old child received some information from the child's school which said that lead could cause learning and behavioral problems, and that children should be screened. This child had had long-standing learning and behavior difficulties and chronic constipation, noted for at least two years. The mother took her child to a nurse practitioner, and the child's BLL was found to be 36 ug/dl.

The county health department nurse became involved in follow-up and, when she learned that the father's job had something to do with batteries, she requested that he be tested. The father, who had worked in a facility that repaired lead batteries since the child was one year old, was found to have a BLL of 105 ug/dl. A repeat BLL was 121 ug/dl. The father's reported symptoms included headaches, extreme fatigue, irritability, joint/muscle pain, abdominal pain, constipation, nausea, loss of appetite, and weight loss. His wife reported that the husband was having difficulty concentrating and his memory was poor.

The father, who was interviewed by OLPPP, described his work as disassembling and repairing batteries in a small crowded area with little light and ventilation. He wore a disposable mask and gloves, but did not have separate work clothes and there was no shower facility at work. He is a smoker. He had no training about the hazards of lead and no prior blood lead testing. The work involved using lead solder sticks with a propane torch to repair batteries. Lead from unrepairable batteries was melted down and cast into solder sticks and battery cell conductors. No air monitoring was ever done at the company to assess exposure levels. The company owns a battery manufacturing plant elsewhere in the state.

The worker was placed on Medical Removal Protection and was orally chelated with DMSA. Shortly afterward, his BLL was 50 ug/dl. After 10 months, he still remains on MRP. The company has not been cooperative with OLPPP or Cal/OSHA, and large fines have been assessed by Cal/OSHA for violations of the general industry lead standard. The family is concerned about possible permanent health effects in both the child and father, and has sought legal consultation.

State of California

Department of Health Services

Memorandum

Date : December 24, 1993

To : S. Kimberly Belshe'
Director
714 P Street, Room 1253
Sacramento, CA 95814

Via : John Rodriguez
Chief Deputy Director of Programs
714 P Street, Room 1253
Sacramento, CA 95814

: George W. Rutherford, M.D.
Deputy Director
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714 P Street, Room 1253
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From : Division of Environmental and
Occupational Disease Control
5801 Christie Avenue, Suite 600
Emeryville, CA 94608
(510) 450-2400

Subject : CA EPI-92-13-2 Childhood Pesticide Exposure Methods Development

SUMMARY

Exposure of infants and children to pesticides is of increasing concern, particularly in rural agricultural areas. Since little information is available on the different ways children may be exposed, the California Department of Health Services (DHS) carried out a pilot project to develop and test methods to collect information in housedust and on children's hands. The project focused on developing methods to analyze for pesticides in housedust because other studies have suggested that hand-to-mouth intake of housedust may be a major source of pesticide exposure to young children. Handwipes of toddler's hands were also collected to investigate links between environmental levels and potential individual exposures. The pilot project was not large enough to draw conclusions about exposures, but was able to test field and laboratory methods.

Field samples were collected in September 1992. Samples were collected from ten homes and one day care center in a small town in the San Joaquin Valley, and one suburban home in Fresno. Five homes had at least one resident who was a farmworker. Each residence had a toddler ages 1-5 whose hand was wiped to test for pesticides. Housedust samples were collected primarily from carpets; a small number of samples were from bare floors or couches. A questionnaire was administered in English or Spanish to a parent to ascertain information on occupation, home pesticide use, and child activities. The laboratory tested for 36 pesticidal compounds in the housedust and 9 common pesticides in the handwipe samples. The field and laboratory methods piloted were largely

successful in screening for pesticides at a level of detection meaningful for exposure assessment, in both housedust and handwipes.

A total of 12 different pesticides were detected in the housedust samples. Although diazinon and chlorpyrifos, two organophosphate pesticides, were found at the highest levels in housedust in two farmworker homes, it was not possible to determine the source of these compounds. One or both of these compounds was found on the hands of three children, with the two highest handwipe levels from the two homes with the highest diazinon and chlorpyrifos levels. A preliminary risk assessment using a standard exposure scenario for soil or dust ingestion by children showed that ingestion exposures to the two children in the homes with the highest levels of diazinon exceeded the reference dose for diazinon, which is based on cholinesterase inhibition. Because of the 100-fold safety factor incorporated into the reference dose for diazinon, exceedence of the reference dose does not imply that there is an inevitable risk of a child developing symptoms of pesticide poisoning. DHS concluded in notification letters to the participating two residents with higher detected levels of diazinon that, "We do not expect that the levels found in your home will cause health problems, but they are high enough that we recommend that steps be taken to reduce the levels". The recommendations included precautions regarding work clothes, pesticide storage and use, floor cleaning and washing of children's hands.

The National Academy of Sciences (NAS 1993) recently investigated dietary pesticide exposure and suggested that residential environmental pesticide exposure is likely to be an important component of total childhood pesticide exposure. The results of this pilot project confirm that pesticide residues can be found in the home environment of children, and suggest a potential for higher residential exposure to some pesticides for children of farmworkers versus children of nonfarmworkers.

We concluded from an analysis of the pilot data for diazinon that 20-40 homes would be a sufficient study size to detect statistical difference between the two groups in a larger study. We also conclude from our experience that the collective and laboratory methodology can be made reliable. DHS recommends that such a study be carried out and include a broader focus on the class of pesticides which are cholinesterase inhibitors. Such a project would concomitantly help address concerns raised about this class of pesticides in the NAS report, "Pesticides in the Diets of Infants and Children".

<u>BACKGROUND</u>

The widespread use of pesticides in California has raised concerns about potential exposures in residential communities from home uses or nearby agricultural applications. To date, environmental investigations lack data needed for quantifying these exposures. To begin characterizing potential exposures and routes of exposures, DHS initiated a pesticide exposure project.

There are at least four potential sources of housedust contamination in agricultural communities: (1) drift from commercial agricultural use, (2) farmworker "carry home" contamination on clothing or skin, (3) structural pest control, and (4) garden or other home use.

The objectives of this pilot project were to:

(1) Develop and test field sampling methods;

(2) Develop and validate laboratory methods;

(3) Obtain preliminary information on pesticide levels in homes that may be used to plan for a larger pesticide-exposure study.

This preliminary effort focused primarily on housedust for several reasons, including: (1) other studies, particularly for lead, suggest that housedust may be an important route of toxicant exposures to young children; (2) recent studies by the United States Environmental Protection Agency (U.S. EPA 1990) have found a wide variety of contaminants in both rural and urban housedust, including pesticides, combustion products, and heavy metals, (Roberts et al., 1993; Lewis et al., 1991; Lewis 1990; Davies et al., 1975; Laxen et al., 1987; ATSDR 1988; Starr et al, 1974), and (3) community concerns about home exposures, particularly "take-home" exposures from farmworkers, where materials accumulated in the field may be inadvertently brought into the home, or track-in exposures from home, lawn, and garden use. Handwipes of toddler's hands were collected to investigate links between environmental levels and potential individual exposures. Table 1 describes all components of the project. Because of the small size of the project, no statistical comparison may be drawn between farmworker and non-farmworker homes; the data are also not adequate to characterize overall risks to children from home pesticide exposures.

METHODS

Study Population: Sampling was conducted in a small town in the San Joaquin Valley. All homes are within one quarter mile of agricultural fields. Participants were recruited through a local health clinic or by door-to-door requests. Dust samples were collected from five homes with at least one farmworker, five homes with no farmworkers, and a day care center in a state-operated housing center for migrant farmworkers. Households were not randomly selected; however, they were evenly distributed throughout the town. One suburban home in Fresno, California, located several miles from any commercial agricultural area, was also sampled to serve as a "control" home. An individual was considered a farmworker if they had worked in the fields during the previous six months; all farmworkers in the study were currently working in the fields. Handwipes were collected from one child age 1-5 at each home (excluding the day care center). Questionnaires were administered in English or Spanish.

Field Sampling and Laboratory Methodology: Housedust samples were collected from carpet, couches and bare floors with specially designed vacuum samplers. Handwipes were taken of toddlers' hands using gauze moistened with propanol. Laboratory analysis of samples was by gas chromatography and mass spectrometry. Appendix I contains a detailed description of field and laboratory methods.

Pesticide Use Evaluation: Pesticide use within one mile of the town for several months prior to the sampling effort (January and May through August, 1991) was reviewed to evaluate potential agricultural sources of pesticide exposure and to identify candidate pesticides for chemical analyses (Appendix II). Commercial or self-applied pesticide use at homes was determined from questionnaire data, and follow-up with housing managers and commercial applicators when possible.

Risk Assessment: A preliminary risk assessment was conducted on the housedust and handwipe data to test whether ingestion and dermal absorption of pesticides might represent a health concern. This is a health-protective approach to assessing environmental data, since the exposure scenarios on which the risk estimates are based assume that exposures occur for many years, at near maximum exposures. Since the pilot study was intended to evaluate potential exposures of toddlers and young children, risks were evaluated for children ages 1-6. However, cancer risk estimates assumed a full lifetime exposure of 70 years. An adult exposure to housedust ingestion was also estimated for two homes where higher levels of organophosphate pesticides were found.

All risk scenarios followed the general guidance provided by the U.S. EPA and the California EPA (Department of Toxic Substances Control). Appendix I contains detailed descriptions of the methodology and assumptions used to evaluate cancer and non-cancer risks.

RESULTS

Pesticide Use Evaluation: Approximately 50 agricultural pesticides were used within one mile of the town in January and May through August, 1991 (Appendix II). Organophosphate (OP) and carbamate pesticides were the classes used most often. Excluding the day care center, eight of the eleven households reported commercial or self-applied pesticide use (Table 2). For the commercial applications, no residents knew which active ingredient had been used, or had recorded the application information. As a result, little questionnaire data were extractable with regard to active ingredients applied commercially. According to managers of the migrant housing center, both the day care center and the unit sampled were sprayed for roaches in March of 1992 (7 months prior to sampling); however, no information is available on the pesticide(s) applied. Active ingredients stored by residents for home use included diazinon, chlorpyrifos, malathion, propoxur, glyphosate, methane arsonate, 2,4-D, pyrethrins and piperonyl butoxide, dicamba, MCPP, disulfoton, chlorothalonil, carbaryl, lindane, triforine, metaldehyde, chlordane, and oryzalin.

Household Characteristics: Table 2 summarizes basic household characteristics. There were no apparent differences in recent reported activities of children with hand residues compared to children with no detected hand residues. Farmworkers at house ID #1 and #9 reported working in recently sprayed fields or using a hand sprayer as part of their job duties. No information was available on the type(s) of pesticides applied.

Housedust and Handwipe: The mass of dust collected at each home ranged from 0.4 to 36.0 g/m2. The fraction less than 150 microns ranged from 19% to 89% of the total dust, with an average of 60%. Data from the field QA/QC samples indicated good laboratory precision and minimal changes during shipping and handling (differences between split samples averaged 9%). The average difference in concentration between replicates was 46%; for loading (i.e. mass of pesticide per meter squared) the difference was 67%.

Pesticides were detected in housedust at nine of the twelve locations sampled (Table 2). A total of 12 different pesticides were detected in the samples (three chlordane and two endosulfan isomers were counted as technical grade composites; DDE was counted separately from DDT).

Table 3 summarizes mean concentration and loading data for each of the pesticides detected by type of sampling location. (Pesticide "concentrations" present the amount of pesticide found in one gram of dust, expressed as micrograms per gram. "Loading" describes the amount of pesticide collected from a surface area expressed as micrograms per square meter.) Levels of diazinon, chlorpyrifos, and propoxur were somewhat higher in farmworker homes compared to other locations. Chlorpyrifos detected in the Fresno home may correspond with use and storage reported at this site. Levels of the combined chlordane isomers were higher in the Fresno home; however, chlordane was not among the large number of pesticides stored and used at this location. Relatively few homes had detectable levels of the other compounds, and no qualitative comparisons are possible. Carbaryl was detected by GC mass spectrometry in three homes, but quantitation was not feasible.

Diazinon and/or chlorpyrifos were detected on the hands of 3 of the 11 toddlers (Table 4). Higher levels of diazinon and chlorpyrifos detected on handwipes coincide with higher loading or concentrations in the housedust samples from the homes.

Risk Assessment: Diazinon was identified as a potential health concern for cholinesterase inhibition. Two of the homes (HH ID#'s 9 and 7) had levels of diazinon in housedust at 20 μg/g and 169 μg/g (parts per million), respectively. These levels were used in an exposure scenario of a toddler ingesting dust on a chronic basis (Appendix I), and resulted in estimated daily intakes which exceeded the reference dose for cholinesterase inhibition by several-fold. The lower levels of diazinon measured in other homes did not produce an estimated exposure that exceeded the reference dose. No scenarios suggested that other pesticides found in housedust presented a health risk to children, either singly or grouped by common health effect.

Estimates of dermal exposure of young children to diazinon in housedust suggest that this route poses less risk than direct oral ingestion of dust (approximately 10% of the combined risk). However, there are inherently greater uncertainties in the exposure assumptions for the dermal route which may limit the interpretation of the dermal estimates. Uncertainties include amount of body area exposed, dust retention on the skin, and dermal absorption of the pesticide from the dust.

Handwipe data were also included in the risk analysis. Each toddler with measurable dermal residues was assumed to ingest daily up to ten times the amount of pesticide found on the hand (i.e. by mouthing their hand ten times a day) (Appendix I). This intake, adjusted for body weight, was compared to the health-based reference dose. Using this method, diazinon was identified as a potential health concern in two cases. These two children resided in the homes which also had the highest detected levels of diazinon in housedust (HH ID#'s 9 and 7). Estimated chlorpyrifos intakes did not exceed the chlorpyrifos reference dose in a similar analysis.

Cancer risks were estimated for the pesticides with cancer-causing potential. These included the older chlorinated pesticides (aldrin, chlordanes, DDT/DDE, dieldrin and lindane) and propoxur. Cancer risk estimates ranged from nine in a billion for propoxur, to eight in a million for the chlorinated pesticides, assuming a lifetime exposure. Levels of chlorinated pesticides were highest in a non-farmworker home and in the Fresno home. These levels and their associated risk estimates are similar to what has been seen in other studies of U.S. homes (and would not produce excess risks detectable in epidemiological studies).

DISCUSSION

Results of this pilot project have several implications for the investigation of residential childhood pesticide exposures. In terms of sampling methodology, we defined several technical areas that should be addressed before conducting a larger study. Inspection of the sampling train of the vacuum sampler revealed that dust particles accumulated in several locations and also outside the threads of the sample bottle. The amounts appeared small, but suggest that not all particles were collected as expected, and demonstrate a potential for cross-contamination between samples. Thorough cleaning was necessary between each use.

Pesticide loading (the amount of pesticide per unit area), compared to concentration (amount of pesticide per gram of dust collected), may predict exposures more accurately, particularly for bare floors. Indeed, pesticides lodged deeply in carpets may pose little risk, even though the vacuum devise is able to remove it. Thus, loading based on vacuumed carpet samples may overestimate exposures from this source.

We achieved good cooperation with parents and children while collecting housedust samples and handwipes. However, additional wipes to increase sampling efficiency, which has been suggested (Que Hee et al., 1985), would have intimidated many children.

Two pesticide studies piloting similar housedust collection methods were recently conducted in suburban North Carolina and Florida homes (Fortmann et al. 1991; Roberts et al.,1991). For comparative purposes, levels of several pesticides detected in housedust in these studies are presented in Table 5. The maximum level for diazinon in housedust in the Roberts study was 10.4 ppm. Maximum values were not presented in the Fortmann study. Diazinon levels in farmworker homes in our study appear to be higher by comparison, both in mean concentration (39 ppm) and in the maximum detected level (169 ppm). It is unlikely that this difference is due to geographical variability in the home use of diazinon, since diazinon is among the most frequently used household pesticides nationwide (Lewis 1990; U.S. EPA 1990).

The North Carolina study also included hand rinses on four toddlers (Fortmann et al. 1991; Lewis et al. 1991). The pesticides most frequently found on children's hands in the North Carolina study and in indoor air and housedust included chlorpyrifos, chlordane, heptachlor, dieldrin and PCP. Chlordane was found at the highest level (500 ng from both hands of one child). Chlorpyrifos was detected twice, at a maximum of 60 ng from the hands of one child. Diazinon was not among the pesticides detected on children's hands. There was a limited correlation between the pesticides observed on the children's hands and the pesticides detected in house dust in individual homes. The frequently detected pesticides in the North Carolina study share in common their historical or current use as termiticides or wood preservatives. The older chlorinated pesticides and PCP were not tested in handwipes in the California DHS study, in part due to funding limitations and the focus on current agricultural pesticide usage.

The risk estimates for the DHS pilot study suggest that a concern may exist for potential exposure of toddlers to cholinesterase inhibiting pesticides in housedust. Two of the eleven homes, both farmworker homes, had diazinon concentrations in housedust which could result in intakes that exceeded the reference dose for this route. At these same two homes, toddlers were observed to have the highest levels of detected hand residues. Since diazinon and several of the pesticides detected have the same toxicity (cholinesterase inhibitors), the possibility of multiple exposures, either through the environment or diet, is also a potential concern.

The geometric mean difference between housedust diazinon levels in farmworker versus nonfarmworker residences is nearly two orders of magnitude, with the nonfarmworker mean being close to the background limit of detection. Based on this data, sample size calculations (with an 80 percent power and alpha = 0.05) indicate approximately 20 homes per group are necessary to detect a 10-fold mean difference and 10 homes per group are necessary to detect a 100-fold difference.

Due to the limited scale of this pilot study and the lack of information on the specific pesticides used in the fields where participants worked and the materials used in homes, no conclusions can be made about sources of contamination. A prospective exposure study, where baseline environmental parameters for rural and urban families were established and then followed over time, would help answer questions about occupationally-related residential exposures and also characterize general, non-farm pesticide exposures. The National Academy of Sciences recently investigated dietary pesticide exposure and suggested that residential environmental pesticide exposure is likely to be an important component of total childhood pesticide exposure (NAS 1993). The results of this pilot project confirm that pesticide residues can be found in the home environment of California children, and may contribute significantly to combined exposures from dietary and nondietary sources.

RECOMMENDATIONS

In the short term, investigators have followed-up with specific recommendations to participants to reduce indoor exposures, including:

- Showering and changing clothes after field work or any activity involving pesticides;
- Washing agricultural work clothes between each use and separately from other clothes;
- Storage of work clothes in covered containers away from other clothing;
- Use, store, and disposal of pesticides according to label instructions;
- Frequently mop or sweep and vacuum floors;
- Frequently wash children's hands;

In the longer term, additional research is warranted to (1) determine whether there are significant risks to children from residential pesticide exposures, (2) determine the source of these exposures, and (3) allow development of appropriate public health recommendations and policy.

Additional comments and recommendations are included as Attachment 1 to this report from the United Health Centers of the San Joaquin Valley and the Mayor of Parlier. Grateful acknowledgement is extended to the Centers and the Mayor for their participation and support in this project.

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TABLES AND FIGURES

Table 1. Project Components:

- Agriculutral pesticide use patterns:	Use within one mile of town derived from pesticide use reports
- Questionnaire development:	determinants of exposure parental/household occupation home pesticide use occupational hygiene habits child care patterns etc.
- Sampling Methods:	housedust dermal loading (handwipe) other environmental media QA/QC
- Laboratory Methods:	use of existing methods development of new methods gradients by particle size QA/QC

Table 2. Household Characteristics

Farmworker Homes and Day Care Center

House ID#	Pesticide Application[1]	Months Since Applied	Number Pesticides Stored	Age of Structure (years)	Pets	Number of Pesticides Detected
1	None	--	0	Unknown	1	1
3	Comm. & Self	2	2	6	0	3
7 (Mig. Housing)	See text	--	0	25+	0	4
9	Comm. & Self	5	1[2]	3.5	0	7
10	Comm.	1	0	17	2	1
6(Day Care)	See text	--	0	25+	0	2

Non-Farmworker Homes

House ID#	Pesticide Application[1]	Months Since Applied	Number Pesticides Stored	Age of Structure (years)	Pets	Number of Pesticides Detected
2	Self	--	14	30	2	1
5	None	--	0	6	0	0
8	Self	--	9	30+	0	8
11	Comm.	12	0	10	0	0
12	Self	--	6	20	0	0
4 (Fresno)	Self	--	14	20	2	3

[1]Home use within last year; active ingredient not known for commercial applications.

[2]Chinese roach pills - active ingredient unknown.

Table 3. Mean Loading and Concentration of Pesticides in Housedust

Analyte	5 Farmworker Homes			5 Non Farmworker Homes			Day Care Center		Fresno Home	
	Mean Loading (µg/m2)	Mean Conc. (µg/g)	# Homes with pos. Detects	Mean Loading (µg/m2)	Mean Conc. (µg/g)	# Homes with pos. Detects	Loading (µg/m2)	Conc. (µg/g)	Loading (µg/m2)	Conc. (µg/g)
Diazinon	56	39	4	0.29	0.19	1	1.7	0.10	7.9	1.7
Chlorpyrifos	6.9	11.1	3	1.1	0.71	1	–	–	1.1	0.19
Propoxur	16.9	0.52	1	0.15	0.10	1	–	–	–	–
Malathion	–	–	–	2.4	1.6	1	–	–	–	–
T-nonachlor	–	–	–	1.0	0.24	2	–	–	3.3	1.0
T-chlordane	–	–	–	0.47	0.12	2	1.6	0.10	1.5	0.48
Cis-chlordane	–	–	–	0.20	0.13	1	–	–	1.4	0.50
a-Endosulfan	0.08	0.18	1	–	–	–	–	–	–	–
b-Endosulfan	0.12	0.19	2	0.10	0.10	2	–	–	–	–
2,4-DDT	–	–	–	0.91	0.34	2	–	–	–	–
4,4-DDE	0.36	0.08	1	–	–	–	–	–	–	–
Dieldrin	0.45	0.10	1	–	–	–	–	–	–	–
Aldrin	0.31	0.11	1	–	–	–	–	–	–	–
Lindane	0.30	0.13	1	–	–	–	–	–	–	–
Carbaryl	NQ	NQ	2	NQ	NQ	1	–	–	–	–

Notes:
Arithmetic mean values, excludes non-detects.
Values for Fresno home are average of two replicates.
Mean values exclude unsieved fraction, except for bare floor and loveseat, which were bulk samples.
"–" = not detected.
NQ = not quantified.
"Loading"=amount per unit area.
"Concentration"=amount per weight of dust.

CDHS Methods Developmnt Project
Source: CDHS 1993

Table 4 Pesticide Residues Detected on Children's Hands

Site	House ID	Diazinon (ng)	Chlorpyrifos (ng)
Farmworker Home	9	220	---
Farmworker Home	7	125	100
Farmworker Home	1	52	20

Notes:
Analysis limited to dichlorvos, naled, dimethoate, diazinon, ronnel, malathion, chlorpyrifos, methidathion, and azinphos-methyl.
Only diazinon and chlorpyrifos detected.
"--" = Not detected.

CDHS Methods Development Project
Source: CDHS 1993

Table 5. Pesticide Levels in Suburban Housedust

Pesticide	North Carolina[1] Median (ppm)	Florida[2] Median (ppm)
Diazinon	0.4	0.5
Chlorpyrifos	4.7	1.1
Propoxur	0.6	0.7
Chlordane	6.3	2.0
DDT	0.4	4.0
Dieldrin	0.5	0.2

[1]Roberts et al., 1991; Nine homes
[2]Fortmann et al., 1991; Nine homes

APPENDICES

Attached.

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Appendix I: Field Sampling and Laboratory Analysis Methodology

Housedust and Handwipes: Carpet dust samples were collected with a vacuum sampler (HVS3) developed by the U.S. EPA (Roberts et al. 1991). For collecting samples from non-carpeted floors, a cannister vacuum and hose with short nozzle and filter cassette (0.5 micron paper filter) was used. The entire sampling train for each vacuum was cleaned between each use and air-dried. All dust samples were stored on dry ice until delivered to the laboratory. Appendix Table Ia summarizes the types of housedust samples collected.

For handwipes, staff, wearing clean gloves, uniformly moistened two clean gauze dressing pads with analytic grade propanol. All surfaces of the child's dominant hand were wiped twice with the gauze dressing pad using a constant pressure. The pad was then transferred to a clean sample container and 50 ml of propanol was added. Immediately afterward, the child's hand was washed with fresh water and soap. Samples were stored on dry ice until delivery to the laboratory. A total of eleven handwipes were collected.

Laboratory: Candidate pesticides for laboratory analysis were those with high agricultural use and either high acute toxicity or carcinogenic potential. Other factors considered included potential current or historical residential use and findings of other studies. Prior to the study no validated methods were available for many of these compounds. Moreover, use of the U.S. EPA's Nonoccupational Pesticides Exposure Study (NOPES) methods (U.S. EPA 1990), intended for analysis of certain home-use pesticides in air, were found to be inadequate for housedust. The laboratory obtained standards for each of the compounds of interest and evaluated new approaches to extraction, analysis, and confirmation. The pesticide data reported are limited to those where (1) confirmation was obtained by either analysis on a second gas chromotography column or by mass spectrometry and (2) where acceptable recovery was established.

All samples were stored in a freezer prior to analysis. Weighed dust samples were passed through a 150 micron sieve and fine fraction weight recorded. Generally, only the fine fraction was analyzed for consistency with previous studies (Roberts et al. 1993; Fortmann et al. 1991), although for a limited group of samples pesticide levels in the unsieved samples were measured to evaluate distribution between coarse and fine fractions.

Dust was Soxhlet extracted with n-hexane-diethyl ether. The extracts were concentrated and analyzed by gas chromotography using instruments equipped with a nitrogen-phosphorous detector (NPD), flame photometric detector (FPD), and electron capture detector (ECD). The use of multiple detectors was needed for sensitive analysis of pesticides in the various chemical classes, i.e., OP's are detected by FPD and NPD, carbamates are detected by NPD and older, chlorinated compounds are detected by ECD. Confirmation was obtained by GC analysis on a gas chromatograph column or by mass spectrometry. In total, over 30 pesticides were analyzed in housedust (Appendix Tables Ib and Ic) with satisfactory recoveries and sensitivity. Estimated detection limits for organophosphate pesticides in housedust were less than 10 parts per billion (ppb) and for other pesticides the limits were generally in the range of 50-100 ppb.

Handwipe samples also were extracted with hexane-diethyl ether. In order to detect the very low concentrations of pesticides present, these extracts were concentrated to one milliliter for analysis using the FPD-GC which was capable of detecting dichlorvos, naled, dimethoate, diazinon, ronnel, malathion, chlorpyrifos, methidathion, and azinphos methyl.

Appendix I

Table Ia. Summary of Dust Samples by Location

Farmworker Homes and Day Care Center

House ID#	Sample Type	Number Samples	Quality Assurance	Control/
1	Carpet Dust	1	--	
3	Carpet Dust	2	Split	
7	Bare Floor Dust	1	--	
9	Carpet Dust	2	Split	
9	Couch Dust	1	--	
10	Carpet Dust	1	--	
6 (Day Care Center)	Carpet Dust	1	--	

Non-Farmworker Homes

House ID#	Sample Type	Number Samples	Quality Assurance	Control/
2	Carpet Dust	1	--	
4 (Fresno)	Carpet Dust	2	Replicates	
5	Carpet Dust	1	--	
8	Carpet Dust	2	Replicates	
8	Bare Floor Dust	2	1 Blank	
11	Carpet Dust	1	--	
12	Carpet Dust	1	--	
Total Dust Samples:		19		

Appendix I

TABLE Ib SOXHLET EXTRACTION RECOVERY OF PESTICIDES FROM HOUSEDUST (Nitrogen Phosphorous Detector)

Common Name	Residue Concentration (μg/g) No. 4936	No. 4936 Spike #1	No. 4936 Spike #2	Average Recovery (%)	Instrument Detection Limit(μg/g)
propoxur[a]	ND	0.41	0.42	83	0.15
naled[b]	0.10	0.064	0.18	8	0.046
atrazine[a]	ND	0.35	0.46	81	0.044
diazinon[a,b]	1.62	2.04	2.17	97	0.027
chlorothalonil[a]	ND	0.30	0.36	66	0.13
ronnel[a,b]	ND	0.42	0.46	88	0.016
malathion[a,b]	ND	0.86	0.98	92	0.013
chlorpyrifos[a,b]	0.12	0.57	0.61	94	0.022
methidathion[b]	ND	0.49	0.53	102	0.013
norflurazon	ND	0.54	0.35	89	0.050
phosmet	0.30	0.69	0.78	87	0.013

TABLE Ic SOXHLET EXTRACTION RECOVERY OF ELECTRON CAPTURING PESTICIDES

Common Name	Residue Concentration (μg/g) No. 4936	No. 4936 Spike #1	No. 4936 Spike #2	Average Recovery (%)
dichloran	ND	0.16	0.17	129
lindane[a]	ND	0.15	0.15	118
methyl parathion	ND	0.12	0.12	96
heptachlor[a]	ND	0.090	0.090	72
ronnel[a,b]	ND	0.13	0.099	93
aldrin[a]	ND	0.12	0.13	98
dachthal	ND	0.089	0.10	76
heptachlor epox[a]	ND	0.10	0.094	79
oxychlordane[a]	ND	0.098	0.10	80
captan[a]	ND	0.12	0.15	108
trans-chlordane[a]	ND	0.13	0.14	109
2,4'1-DDE	ND	0.083	0.092	70
a-endosulfan	ND	0.073	0.088	64
cis-chlordane[a]	ND	0.10	0.11	83
trans-nonachlor	ND	0.079	0.063	57
dieldrin[a]	ND	0.068	0.073	56
4,4'1-DDE[a]	ND	0.099	0.096	78

TABLE Ic, continued

Common Name	No. 4936	No. 4936 Spike #1	No. 4936 Spike #2	Average Recovery (%)
oxyfluorfen	ND	0.15	0.17	126
B-endosulfan	ND	0.12	0.14	103
2,4'-DDD	ND	0.082	0.099	72
4,4'-DDD[a]	ND	0.089	0.091	72
2,4'-DDT	ND	0.14	0.13	111
phosmet	ND	0.10	0.103	82
methoxychlor[a]	ND	0.11	0.10	84
octachloronaphthalene	ND	0.15	0.23	150

[a]NOPES method target compound.
[b]Handwipe target analyte. Dichlorvos, dimethoate, and azinphos methyl also analyzed in handwipes.

Appendix I: Methodology for Risk Calculations

Ingestion of pesticides in housedust: The equation used to characterize ingestion exposure to pesticides in housedust was based on the U.S. EPA Risk Assessment Guidance for Superfund (RAGS, US EPA 1989a) in Exhibit 6-14 "Residential Exposure: Ingestion of Chemicals in Soil". The equation describes intake in mg of chemical/kg body weight/ day using the chemical concentration in dust or soil x ingestion rate of the soil. The equation and the standard assumptions for the equation are:

$$\text{Intake (mg/kg-day)} = \frac{C \times IR \times EF \times CF \times ED}{BW \times AT}$$

- pesticide concentration (C) in dust (mg/kg)
- 200 mg dust/day ingestion rate (IR) for a young child
- 100 mg dust/day ingestion rate (IR) for an adult
- conversion factor (CF) of $1x10^{-6}$ kg/mg soil
- exposure frequency (EF) year-round or allowable tenancy at residence
- exposure duration (ED) equal to 70 yr lifetime for adults, or ages 1-6 for a child
- 16 kg average body weight (BW) for children ages 1-6
- 70 kg average body weight (BW) for adults
- averaging time (AT) equal to ED x 365 days per year

The estimated daily intake is subsequently divided by a reference dose, the level at or below which no harmful effects are believed to occur. Reference doses for each pesticide were obtained from the U.S. EPA Office of Pesticide Programs or Office of Research and Development. This division yields a hazard quotient:

Daily Intake/RfD = Hazard Quotient

A hazard quotient exceeding one indicates a potential for adverse health effects from the exposure. The hazard quotients for pesticides with similar health effects, such as the cholinesterase inhibitors, are added together, resulting in a "hazard index" for that group of similarly-acting pesticides.

Cancer risks for the potentially carcinogenic pesticides found in housedust (the older chlorinated pesticides and propoxur) were estimated using the same equation above for a lifetime daily intake. Current risk assessment methodology is not well developed for assessing cancer risks to children. Hence, a lifetime exposure assumption was employed along with adult body weight and dust ingestion rate. The daily pesticide intake was multiplied by the pesticide's slope factor (SF), which is an estimate of the potency of the pesticide as a carcinogen, to derive a risk estimate for cancer occurring from a lifetime of exposure. [This risk estimate is typically cited as 1 in so many thousand, million or other ratio. Slope factors were obtained from the U.S. EPA Office of Pesticide Programs or Office of Research and Development.

Dermal exposure to pesticides in housedust: A screening level risk estimate was carried out to evaluate the potential contribution of the dermal route to the risk to toddlers from pesticides in housedust observed in this study. The intake equation was based on the U.S. EPA RAGS Exhibit 6-15 "Residential Exposure: Dermal Contact with Chemicals in Soil" (U.S. EPA 1989a). Diazinon was selected for the screen since it was the pesticide of concern by the ingestion route in some housedust samples. The assumptions and intake equation for this scenario are as follows:

$$\text{Absorbed dose (mg/kg/day)} = \frac{C \times SA \times AF \times CF \times ABS \times EF \times ED}{BW \times AT}$$

- pesticide concentration (C) in dust (mg/kg)
- exposed skin surface area (SA) of 2,100 cm^2 (area of both hands and both legs and feet for a 2-3 year old child, U.S. EPA 1989b)
- soil-to-skin adherence factor (AF) of 1.45 mg/cm^2
- conversion factor (CF) of $1x10^{-6}$ kg/mg soil
- absorption factor (AF) equal to 3% (diazinon alone) x 15% (soil matrix factor)
- exposure frequency (EF) year-round or allowable tenancy at residence
- exposure duration(ED), one year for children age 2-3
- average body weight (BW) for children age 2-3, 13.1 kg
- averaging time (AT) equal to ED x 365 days per year

The absorption factor for diazinon is a best estimate based on data for similar pesticides and represents a significant uncertainty in the risk calculations. There is little data available in the literature for chemical-specific dermal absorption factors. The dermal absorbed dose was compared to the oral reference dose for diazinon (9E-5 mg/kg/day), since no dermal RfD is available. This route-to-route extrapolation from an oral to dermal reference dose also increases the uncertainty in the estimate. Because of these considerations and others such as actual housedust adherence rates compared to soil, exposed skin area and skin conditions (wet, dry, etc.), relatively less weight can be given to the dermal estimates compared to ingestion risks.

Toddler exposure - ingestion of pesticides, handwipe data: The average body weight of children 1-2 years old (the age of children participating in our study with positive handwipes) is 10.7 kg (US EPA 1989b). The health-based reference dose for diazinon is 9E-5 mg/kg-day (US EPA Office of Pesticide Programs), or 90 ng/kg-day. To estimate exposure, we assumed that a toddler may reasonably be expected to put his/her hands or fingers in their mouth up to 10 times per day during normal mouthing behavior; further, we assumed that all the detected pesticide is transferred from the hand during a single hand-to-mouth incident and that an equal amount of pesticide re-accumulates on the hand for the nine successive mouthing episodes.

In summary, intake (ng/kg-day) was estimated as:

$$\frac{\text{Observed handwipe concentration (ng)} \times 10}{\text{10.7 kg body weight}} = \text{Daily intake (ng/kg-day)}$$

Comparing daily intake with the reference dose, a hazard quotient was estimated by:

Daily intake/Reference dose = hazard quotient

Appendix II

Agricultural pesticides used within 1 mile of the community

Pesticide	Jan '91	May '91	June '91	July '91	Aug '91
	Pounds of Active Ingredient				
Abamectin			0.1		
Aldicarb *				12	
Aluminum phosphide	0.3				
Azinphos methyl *			18		
Bacillus thuringiensis v. kur. (biol.)		26	2	14	6
Benomyl		20	47	87	
Carbaryl *		32	775	64	674
Chloropicrin	93				
Chlorpyrifos *	911	11	7	18	
Cryolite		8424	3126	4072	
DCNA				126	105
Diazinon *	561	405	667	428	39
Dicofol				4	
Dimethoate *		3	144	50	
Diuron	40				
Endosulfan		87	306	204	39
Esfenvalerate					1
Ethephon				111	13
Fenarimol		16	14	4	
Fenbutatin oxide		59	199	110	69
Fluazifop-p-butyl				8	
Formetanate *		652	108	131	
Gibberellic acid (hormone)		14	45	0.8	
Glyphosate	45	368	465	728	279
Iprodione		52	24	86	62
Manzate					13
Metalaxyl					3
Methidathion *	619				
Methomyl *		49	115	292	273
Methyl bromide	7120				
Methyl parathion *		28			23
Metolachlor		8			1
Monosodium methane arsonate					108
Myclobutanil		100	59	36	
Naled *				236	453
Naphthalene acetic acid					0.03
Norflurazon	351				
Oryzalin	185		12		
Oxyfluorfen	162			18	
Oxythioquinox				1	
Paraquat	4	105	50	36	42
Parathion *	1185		10	36	12
Phosmet *		174	586	266	59
Piperonyl butoxide				5	
Propargite		336	1334	1489	52
Pyrethrins				1	
Simazine	130				
Stirrup				7	
Strychnine	0.2	0.07			
Triadimefon		8	7	13	
Trifluralin	43	7	4		0.4
Triforine			3		3
Vinclozolin		15			3
Ziram	188				

* Organophosphate or carbamate acetylcholinesterase inhibitor

Source = California Agricultural Pesticide Use Reports

United Health Centers
of the San Joaquin Valley, Inc.

ADMINISTRATION PLAZA
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November 18, 1993

Ms. Sharon Seidel
California Department of Health Svs.
Environmental Health
Investigations Branch
5900 Hollis Street, Suite E
Emeryville, CA 94608

Dear Ms. Seidel:

Thank you for sharing your analysis of the pesticide pilot project conducted in Parlier in September, 1992.

I have reviewed the document and as expected I was not surprised by the results. Your study, however, validates the suspicion we had all along. For more than twenty years we have questioned the application of pesticides. There exists evidence that pesticides travel miles beyond targeted areas and expose non-farmworker populations. We can conclude pesticide residues are being transported by wind, dust, soil, and on farmworker's clothing.

Another consideration is the toxicity exposure to children by these chemicals. The pesticide manufacturing companies, when registering a chemical for Environmental Protection Agency's approval, are not required to conduct toxicity studies taking in consideration possible effects on children. We know that children's metabolism are different than adults. What may be considered an acceptable exposure of pesticides on adults could be disastrous on the metabolism of children. I believe there is much more to investigate when it comes to children's exposure to pesticides.

As for the possible carrier of pesticide residues to the farm worker's home via his/her work shoes and clothing, I have recommendations toward solving this problem. The poultry industry already provides their workers protective clothing and shower facilities. In this industry the worker showers before entering and leaving the work area. The worker is given clean work clothes every day. The industry does it solely to protect the health of poultry from diseases the worker may carry on his clothing. Some may say that this proposal is not possible when it comes to farmworkers due to their large numbers and the nature of the industry. But if the industry is deriving profits from the use of pesticides, then worker's protection must be made part of the equation of doing business.

I consider your research to be pioneering in this area. You are discovering the "tip of the iceberg". There is much more to learn about these levels of exposure.

Please continue your efforts in this area of research and expand it to a larger study group. If I can be of any additional help, do not hesitate to call me at (209) 646-6618.

Sincerely,

ARCADIO VIVEROS
CEO of United Health Centers &
Mayor of the City of Parlier

AV:lsg

"children"