Children’s environmental health is an increasingly prominent policy issue (Clinton 1997; Kaiser 1999; Landrigan and Carlson 1995; Needham and Sexton 2000b; National Research Council 1993; Wargo 1998) as well as a pressing scientific issue (Carlson 1998; Galson 1998; Landrigan et al. 2000; Mukerjee 1998; Needham and Sexton 2000a, 2000b; Selevan et al. 2000). Poor minority children are thought to be particularly vulnerable because they tend to be both more exposed to many environmental hazards and more susceptible to related adverse health effects than the general population (Landrigan et al. 1999; Needham and Sexton 2000b; Sexton and Anderson 1993; Sexton 1997, 2001). Current and future exposure monitoring studies and epidemiologic investigations will necessarily involve intensive and repeated contacts with children and their families (Needham and Sexton 2000b). Yet relatively little has been published on recruiting, retaining, and monitoring children from low-income, ethnically diverse communities. Available information suggests that these populations present special challenges for investigators because they often lack telephones, do not speak English, change address frequently, and mistrust researchers, among other problems (Fitzgibbon et al. 1998; Janson et al. 2001; Julian and Gross 2000; Mitchell et al. 1997; Pletsch et al. 1995; Pressel et al. 2001; Senturia et al. 1998; Sexton et al., 2000; Sorkness et al. 2001). In this article we summarize recruitment, retention, and compliance results from a novel school-based investigation of children’s exposure to multiple hazardous chemicals in two low-income neighborhoods of Minneapolis.

Study Design and Methods

The School Health Initiative: Environment, Learning, and Disease (SHIELD) study examined children’s exposure to complex mixtures of environmental agents [i.e., volatile organic chemicals (VOCs), environmental tobacco smoke, allergens, bioaerosols, metals, and pesticides]. It also incorporated a pilot epidemiologic study to examine links between measured exposures and effects on both respiratory health (e.g., spirometry and peak flow data) and learning outcomes (e.g., standardized test scores, measures of academic performance, attendance). A more detailed description of the SHIELD study design and monitoring methods has been published previously (Sexton et al. 2000).

Recruitment for year 1 occurred from November 1999 through January 2000, and reenrollment for year 2 took place from November 2000 through January 2001. Environmental, personal, and biologic data were collected during two monitoring sessions in each school year. Numerous activities were undertaken before and during recruitment to inform and involve community members in the study (e.g., letters to key community groups, presentations at parent–teacher meetings and school open houses, distribution of brochures). In year 1, blood and urine samples were collected in February–March and April–May 2000. In year 2, blood and urine samples were collected in February–March and May 2001.

A stratified-random sampling design was used to ensure adequate numbers within defined subgroups of children with known sampling probabilities. Strata were defined by school attended (Lyndale, Whittier), grade (second, third, fourth, fifth), language category (English or non-English spoken at home), and sex (female, male), which produced 32 distinct strata. The goal was to have a sample of five children within each stratum (5 \times 32), which meant a target sample size of 80 from each school. The sampling strategy...
ensured that these 80 children (referred to as “index” children) were from 80 different families.

Study population. Children living in the adjacent neighborhoods of Lyndale and Whittier were the focus of SHIELD. According to the 2000 Census (U.S. Census Bureau 2000), the Lyndale neighborhood had a population of 7,690 (4,274 white, 1,513 African American, 105 American Indian, 342 Asian or Pacific Islander, 1,041 other, 415 who identified themselves as being of two or more races), and the Whittier neighborhood had a population of 15,247 (8,161 white, 3,044 African American, 328 Native American, 841 Asian or Pacific Islander, 1,990 other, 883 self-identified as being of two or more races). Median household income from the 1990 Census (U.S. Census Bureau 1990) was $15,392 in Lyndale and $17,325 in Whittier, with more than 35% of all families (as well as more than 55% of all families with children younger than 18 years) living in poverty.

All 558 children enrolled in grades 2–5 at the Lyndale (269 children) and Whittier (289 children) elementary schools for the start of the 1999–2000 school year were eligible to participate in SHIELD. Children attending the Lyndale and Whittier elementary schools were among the poorest (90% or more below poverty) and least likely to speak English (34% at Lyndale and 42% at Whittier did not speak English) in the Minneapolis Public Schools (MPS) system. One hundred fourteen (70 at Lyndale and 44 at Whittier) spoke primarily Spanish (12 at Lyndale and 96 at Whittier), 18 spoke primarily Cambodian (all at Lyndale), and 23 (all at Lyndale) spoke primarily other languages (including Laotian, Cree, and three African languages—Oromo, Amharic, Yoruba). A more complete description of this study population was published previously (Sexton et al. 2000).

Recruitment. Children and their families eligible to participate in SHIELD were identified and contacted on the basis of enrollment information obtained from the Student Accounting Department, MPS. The list included names, first language, addresses, telephone numbers, and other contact information. The recruitment procedures were similar for both years of SHIELD. In the fall of year 1, all randomly selected households received an initial contact letter (in the appropriate language) from the principal of their child’s school describing the study, encouraging them to volunteer, and explaining that a recruiter would contact them. A bilingual education assistant from the schools contacted families that spoke Cambodian, Somali, or Spanish. English-speaking families were contacted by either a bilingual education assistant or an experienced recruiter with knowledge of the challenges involved in conducting research studies among economically disadvantaged populations.

After successful contact, recruiters met with children/families in their homes to explain the study and answer any questions. For those who agreed to volunteer, recruiters obtained verbal and written consent/assent and administered the baseline questionnaire. Total time for the home visit was typically from 1 to 2 hr.

Only children who participated in year 1 were eligible for reenrollment, so we did not send another letter from the school principal in the fall of year 2. Otherwise, recruitment procedures were the same. To the extent possible, we tried to ensure that the same recruiter from year 1 approached each of the children and their families. The initial home visit, during which recruiters obtained signed consent/assent and administered the shorter year 2 baseline questionnaire, usually took about 30 min.

Children and families volunteering for SHIELD were offered, with institutional review board (IRB) approval, financial incentives for successful completion of research-related tasks. The total yearly compensation for successfully completing all research tasks (including providing blood and urine samples) could be as much as $140 per child per year ($280 for both years). In addition, children were given a choice of small gifts when they completed specific research-related tasks.
Hispanic, 23% other), and 19% of African Americans and 17% of “other” ethnic/racial groups earning more than $30,000 per year (vs. 3% Somali and 0% Hispanic). To put these household incomes in perspective, the 2002 Health and Human Services poverty guidelines set the poverty level for a family of four at $18,100 per year (range from $8,860 for a single person to $30,420 for a family of eight).

Regarding education, 44% of participating households had no occupant with a high school degree or equivalent, 32% had a high school graduate [or general educational development (GED) credit], and 23% had at least a college graduate or technical certificate holder. Again, there were differences by ethnicity/race, with 76% of Somali and 91% of Hispanic households having no occupant at least a high school degree (vs. 4% African American and 33% other), and 43% of African-American households having an occupant at least a college degree or technical certificate (vs. 2% Hispanic, 12% Somali, 25% other).

**Recruitment and retention.** In year 1, a random sample of 311 “index” children was selected. Forty-one of these children had transferred out of the Lyndale and Whittier schools by the time recruiting ended. Of the remaining 270 eligible children, 153 index children were later enrolled in year 1. If the index child had siblings in grades 2–5, they were also asked to participate, and 51 siblings were enrolled in year 1. The original 153 index children (plus their 51 siblings) were eligible for year 2 provided they were registered at a school within the MPS system. One hundred seven index children along with 36 siblings were ultimately reenrolled for year 2. A child was considered to be enrolled (or reenrolled) when the parent or guardian signed the written consent form, the child signed the written assent form, and the parent or guardian completed the baseline questionnaire.

The overall enrollment rate for year 1 was 57%, with English-speaking families (42%) volunteering at a substantially lower rate than non-English-speaking families (71%). For year 2, the overall reenrollment rate was 79% and the disparity between English-speaking (62%) and non-English-speaking (88%) families persisted. A summary of overall recruitment results for both years is provided in Tables 2 and 3, and the reasons children were not enrolled (year 1) or reenrolled (year 2) are summarized in Table 4.

A breakdown by ethnicity of weighted enrollment rates for year 1 is provided in Table 5. Of the three largest ethnic groups, enrollment rates were relatively high for Hispanic children (80%) and children of Somali immigrants (66%). However, the enrollment rate for African-American children (35%) was significantly lower. Although absolute numbers were relatively small for other groups, enrollment rates were also reasonably high for Cambodian (89%) and white (71%) children, but comparatively low for Native-American (42%) and Laotian (39%) children.

### Table 3. Summary of monitoring results from years 1 and 2 of the SHIELD study.

| Data capture | At least one sample | Both samples | At least one sample | Both samples |
|-------------|---------------------|--------------|---------------------|--------------|
| Blood       | No. 128/139 114/139 | 99/103       | 90/103              |
| Raw rate    | 92% 82%           | 96% 87%      |                     |
| Weighted ratea | 92% 85%        | 97% 92%      |                     |
| Urine       | No. 143/153 131/153 | 105/107     | 100/107             |
| Raw rate    | 93% 86%           | 98% 93%      |                     |
| Weighted rate | 93% 87%       | 99% 97%      |                     |
| VOC Badge   | No. 127/140 115/140 | NA NA       |                     |
| Raw rate    | 91% 82%           | NA NA       |                     |
| Weighted rate | 91% 83%       | NA NA       |                     |
| TA log      | No. 124/140 92/140 | NA NA       |                     |
| Raw rate    | 89% 66%           | NA NA       |                     |
| Weighted rate | 89% 67%       | NA NA       |                     |
| Spirometry  | No. 137/153 NA    | 103/107     | NA NA               |
| Raw rate    | 93% 98%           | NA NA       |                     |
| Weighted rate | 91% 98%       | NA NA       |                     |
| Peak Flowa  | No. 57/74 24/74 | NA NA       |                     |
| Raw rate    | 77% 32%           | NA NA       |                     |
| Weighted rate | 76% 34%       | NA NA       |                     |

### Table 4. Summary of reasons not enrolled for year 1 compared to reenrollment for year 2 of the SHIELD study (October 1999–July 2001) by number (%).

| Reason                  | Year 1, 1999–2000 | Year 2, 2000–2001 |
|-------------------------|-------------------|-------------------|
| **Reason**              | Non-English      | English           | Total            | Non-English | English | Total |
| Transferredb            | 10 (7)           | 31 (19)           | 41 (13)          | 12 (12)     | 5 (9)   | 17 (11) |
| Contact problemsc       | 25 (18)          | 35 (27)           | 60 (22)          | 2 (2)       | 8 (16)  | 10 (7)  |
| Follow-through problemsd| 4 (3)            | 20 (15)           | 24 (9)           | 3 (3)       | 5 (10)  | 8 (6)   |
| Refusede                | 11 (8)           | 22 (17)           | 33 (12)          | 5 (6)       | 6 (12)  | 11 (8)  |
| Enrolled                | 98 (71)          | 55 (42)           | 153 (57)         | 76 (88)     | 31 (62) | 107 (79) |
| Total attempted to contact | 148 (100)    | 163 (100)         | 311 (100)        | 98 (100)    | 55 (100) | 153 (100) |

### Table 5. Enrollment rates (%) for index children within ethnic groups.

| Ethnic group                  | Year 1 Enrollment4 | Rate (95% CI) |
|-------------------------------|--------------------|---------------|
| Native American               | 7 3               | 42 (15–69)    |
| Black, U.S. born              | 101 35            | 35 (28–42)    |
| Black, Somali                 | 60 40             | 66 (56–78)    |
| Asian, Cambodian              | 9 8               | 93 (72–100)   |
| Asian, Laotian                | 11 4              | 89 (68–111)   |
| Hispanic                      | 58 47             | 80 (72–88)    |
| White                         | 17 12             | 71 (54–87)    |
| Other                         | 6 3               | 47 (14–80)    |

χ² (p-value) 70.9 (<0.0001)

4Enrollment rate indicates number enrolled children/number eligible children selected. The rates, χ² statistic and associated p-value are calculated using weighted counts that adjust for selection probabilities. The normal approximation to the binomial distribution is used to calculate the confidence intervals.

Abbreviations: NA, not applicable; TA, time–activity.

*Number of children providing valid peak flow data for the winter and spring monitoring sessions 2000. #The weighted rates are calculated using weighted counts that adjust for selection and response probabilities.
and retention year 1), no clear patterns were apparent.

Collection of blood and urine samples.
Rates of data capture for blood and urine samples are presented in Table 3. These results are further broken down in Table 7 according to stratification variables. As shown in Table 7, statistically significant differences (chi-square statistic, χ², p < 0.05) were found between: schools (children at Lyndale were consistently more likely to provide blood samples in both years, and urine samples in year 1), grades (blood and urine samples in both years), sex (blood and urine samples in year 2), and language (in year 2, students from English-speaking homes were more likely to provide both samples of blood and urine and at least one urine sample than were children from non-English-speaking homes).

Ninety-seven index children agreed to provide blood and urine samples for both year 1 and year 2 of SHIELD. The maximum possible number of biologic samples from each of these children was four blood and four urine samples (collected in the winter and spring of both years). We obtained all four blood samples from 77 children (84%), three or more from 91 children (93%), and two or more from 96 children (> 99%). Results for urine collection were somewhat higher, with 93 children (91%) providing four samples, and 105 (99%) providing three or more samples.

Collection of personal VOC, time–activity, and lung-function data. In year 1, index children were asked to wear a small passive monitor (clip-on badge) for 48 consecutive hr (before the blood sample) to measure airborne VOC concentrations. Each child was also asked (year 1 only), with the help of parents/guardians, to maintain a 48-hr diary (in the form of a simple questionnaire) of time spent in seven microenvironments (inside at home, school, other; outside at home, school, other; in transit). In the spring of both years, the school nurse at each school conducted lung spirometry for children enrolled in SHIELD. In addition, for year 1 only, all students in the 4th and 5th grades at both schools (whether they were enrolled in SHIELD or not) were asked, as part of an in-class experiment, to participate in measurements (using small, hand-held flow measuring devices) of peak expiratory flow and forced expiratory volume in 1 sec (FEV₁).

A summary of data capture for personal VOC badges, time–activity diaries, and lung function tests is given in Table 3. Data capture rates were relatively high for personal VOC badges (83% provided both samples), personal time–activity diaries (67% provided both samples), and spirometry data (> 90% of the children completed this testing each year). Complete peak flow data were obtained at progressively decreasing rates, starting in fall 1999 (91%) and continuing in the winter (76%) and spring (47%). Only 34% (weighted percentage) of the children provided valid peak values.

Table 6. Enrollment, reenrollment, and retention, and weighted rates (%) for index children.

| School      | Year 1 Enrollment | Year 1 Retention | Year 2 Enrollment | Year 2 Retention |
|-------------|------------------|------------------|------------------|------------------|
|             | No. | Rate (%) | No. | Rate (%) | No. | Rate (%) | No. | Rate (%) |
| Lyndale     | 138 | 71.51    | 62 | 88       | 49 | 74       | 47 | 96       |
| Whittier    | 132 | 82.62    | 68 | 80       | 58 | 72       | 54 | 95       |
| χ² (p-value) | 5.7 (0.017) | 5.5 (0.019) | 0.1 (0.763) | 0.5 (0.498) |
| Grade       |      |          |      |          |      |          |      |          |
| 2           | 72  | 41.59    | 33 | 77       | 26 | 71       | 25 | 95       |
| 3           | 68  | 38.53    | 29 | 82       | 27 | 80       | 27 | 100      |
| 4           | 64  | 36.61    | 36 | 93       | 28 | 79       | 26 | 93       |
| 5           | 66  | 36.51    | 32 | 87       | 26 | 62       | 23 | 94       |
| χ² (p-value) | 2.9 (0.409) | 12.3 (0.006) | 10.9 (0.012) | 7.6 (0.056) |
| Sex         |      |          |      |          |      |          |      |          |
| Female      | 130 | 72.54    | 60 | 80       | 52 | 74       | 50 | 98       |
| Male        | 140 | 81.58    | 70 | 88       | 55 | 72       | 51 | 93       |
| χ² (p-value) | 0.9 (0.348) | 6.7 (0.010) | 0.1 (0.739) | 6.6 (0.010) |
| Language    |      |          |      |          |      |          |      |          |
| English     | 132 | 55.41    | 43 | 80       | 31 | 58       | 29 | 94       |
| Non-English | 138 | 98.71    | 87 | 86       | 79 | 89       | 72 | 97       |
| χ² (p-value) | 42.6 (< 0.0001) | 5.9 (0.015) | 55.6 (< 0.0001) | 1.3 (0.262) |

*Year 1: Enrollment rate indicates number enrolled children/number eligible children; year 2: enrollment rate indicates number reenrolled children/number enrolled children from year 1 who are eligible for year 2 enrollment. Retention rate indicates number children who gave at least one blood or urine sample and did year end questionnaire/number enrolled children. The rates, χ² statistic, and associated p-value are calculated using weighted counts that adjust for selection and response probabilities.

Table 7. Blood and urine compliance and weighted rates (%) for index children.

| School      | Blood At least one | Urine At least one | Blood At least one | Urine At least one |
|-------------|--------------------|--------------------|--------------------|--------------------|
|             | No. | Rate (%) | No. | Rate (%) | No. | Rate (%) | No. | Rate (%) |
| Lyndale     | 57  | 70.58    | 91  | 94       | 91  | 94       | 44  | 97       |
| Whittier    | 57  | 79.70    | 92  | 94       | 92  | 94       | 46  | 86       |
| χ² (p-value) | 10.9 (0.001) | 0.04 (0.848) | 17.7 (< 0.0001) | 0.2 (0.658) |
| Grade       |      |          |      |          |      |          |      |          |
| 2           | 25  | 77.27    | 83  | 86       | 86  | 86       | 24  | 100      |
| 3           | 25  | 83.32    | 96  | 96       | 96  | 96       | 23  | 95       |
| 4           | 37  | 97.10    | 100 | 100      | 100 | 100      | 26  | 98       |
| 5           | 27  | 83.31    | 88  | 88       | 88  | 88       | 17  | 92       |
| χ² (p-value) | 17.1 (0.0007) | 25.7 (< 0.0001) | 11.7 (0.008) | 17.0 (0.0007) |
| Sex         |      |          |      |          |      |          |      |          |
| Female      | 53  | 81.61    | 90  | 92       | 92  | 92       | 47  | 96       |
| Male        | 61  | 87.67    | 93  | 94       | 94  | 94       | 43  | 98       |
| χ² (p-value) | 3.1 (0.079) | 1.2 (0.274) | 2.0 (0.156) | 0.8 (0.378) |
| Language    |      |          |      |          |      |          |      |          |
| English     | 40  | 87.46    | 94  | 94       | 94  | 94       | 29  | 96       |
| Non-English | 74  | 82.90    | 91  | 93       | 93  | 93       | 61  | 87       |
| χ² (p-value) | 2.3 (0.127) | 2.5 (0.112) | 0.8 (0.381) | 0.3 (0.567) |

*The denominator used to calculate blood compliance rates is the number of children who, at the beginning of each year, agreed to provide blood samples. The denominator used to calculated urine compliance rates is the number of children who enrolled each year. Samples: both or at least one. The rates, χ² statistic, and associated p-value are calculated using weighted counts that adjust for selection and response probabilities.
flow samples for both the winter and spring 2000 monitoring sessions.

The primary reason that requested VOC badges and time–activity diaries were not obtained from some children was that they had transferred to another school. The relatively low data capture rate for peak flow data is explained at least partially by the demanding nature of the testing, which required that children be present in class on mornings and afternoons of at least two of three testing days during the designated testing week, and successfully complete three valid FEV₁ measurements in both the morning and afternoon.

**Discussion**

In a probability sample, much emphasis is usually placed on collecting data from a relatively small sample with known probabilities so that findings can be generalized to the larger population. Comparatively little has been published, however, on recruitment, retention, and data capture results for probability-based environmental health studies, particularly those that focus on children (Adgate et al. 2000; Callahan et al. 1995; Janson et al. 2001; Mitchell et al. 1997; Pletsch et al. 1995; Senturia et al. 1998). Notwithstanding the current paucity of information, it has become apparent that economically disadvantaged groups and people of color present a special challenge for a variety of reasons, including mistrust of investigators, frequent address changes, and lack of telephones (Fitzgibbon et al. 1998; Janson et al. 2001; Julian and Gross 2000; Pletsch et al. 1995; Preloran et al. 2001; Pressel et al. 2001; Senturia et al. 1998; Sexton et al. 2000; Sorkness et al. 2001).

The SHIELD data on recruitment, retention, and compliance are based on a probability sample of economically disadvantaged and ethnically diverse children. No randomly selected children were deemed ineligible for SHIELD regardless of whether they and their family spoke English, their household had a telephone, or they were enrolled in a special education program. Of the children/families enrolled, many changed addresses frequently, spoke little or no English, did not have a telephone, endured economic hardships, and exhibited a variety of nontraditional lifestyles and living arrangements. Moreover, because the Lyndale and Whittier neighborhoods are home to many immigrants (Somali, Mexican and Latino, Cambodian, Laotian), 45% of the index children in year 1 and 49% in year 2 were not born in the United States. Immigrant children participating in SHIELD year 1 had been in this country for a median of 3 years.

**Enrollment rates.** Seventy-one percent of non-English-speaking families, including many recent immigrants, volunteered to participate in SHIELD year 1. Bilingual education assistants at Lyndale and Whittier were hired as recruiters to contact Spanish, Cambodian, and Somali families. Because they knew and were known by members of their respective ethnic/racial communities, the bilingual education assistants were highly effective recruiters of non-English-speaking families.

In contrast, the year 1 response rate for English-speaking families (primarily African American) was only 42%. Despite the invaluable assistance we received from the MPS (e.g., contact information), this population presented a wide variety of recruitment problems: They transferred their children more often (19% vs. 7% for non-English-speaking families), were harder to contact (27% vs. 18% for non-English-speaking families), more frequently posed follow-through challenges after they were contacted (15% vs. 3% for non-English-speaking families), and were more likely to refuse requests to participate (17% vs. 8% for non-English-speaking families). In year 1, 51% of the English-speaking versus 40% of the non-English-speaking families moved or changed their phone number at least once. In several cases the children were willing to enroll or reenroll, but their parents could not be contacted to obtain their consent despite repeated attempts. It is unlikely that traditional contact methods (random digit dialing, mailings based on commercially available address lists) would have been effective in identifying, let alone recruiting, many of the English-speaking African-American families with grade-eligible children.

Our experience suggests that without investing substantially more time and resources, there is little likelihood of improving response rates significantly for African-American children/families in the Lyndale and Whittier neighborhoods. It was difficult to find recruiters with the same level of connection to the African-American community, as was the case for our Somali, Hispanic, and Cambodian recruiters. The simple expedient of increasing incentives is probably not a realistic option because of IRB concerns about possible economic coercion. Contacting parents/guardians directly through their children (e.g., accompanying the child home after school) raises confidentiality and privacy issues.

**Sample collection.** Obtaining blood and urine samples from elementary school children is always a challenge. In SHIELD, successful collection of blood samples depended directly on the ability, personality, and skill of the phlebotomist. It is essential that the pediatric phlebotomist have substantial experience in taking venipuncture samples from children, be able to take the sample quickly and relatively painlessly, and be skilled at reassuring children and putting them at ease. Similarly, the key to collecting urine samples was the involvement of the school nurses who were well known to the children. Their familiarity to the students and friendly demeanor encouraged the children to feel comfortable about providing a sample. They also supervised the sample collection process to ensure privacy for the children as well as validity of the samples.

The children did a good job of adhering to the VOC-badge monitoring protocol, thereby contributing to the overall completeness and validity of the data. At the beginning of the 48-hr monitoring period, field technicians uncapped the badge and affixed it (in the breathing zone) to an article of clothing worn by the child. Overnight while the child was sleeping, the badge was placed near his or her head, and then in the morning it was reaffixed to the clothing. Before class each monitoring day, the child reported to the school nurse, who recorded whether the badge was being worn properly and gave the child a decorated pencil. Badges were retrieved and capped by field technicians at the end of the 48-hr monitoring period.

Results indicate that, with proper care, it is practicable to obtain personal VOC measurements and time–activity data for elementary school children. In-school spirometry testing by school nurses generally worked well, and valid measurements were obtained from more than 90% of participating children in both years. In-class peak flow testing of 4th and 5th graders was less successful over time, owing to the relatively complicated nature of the protocol.

**Summary and Conclusions**

Recruitment, retention, and data capture rates for SHIELD were comparable with other children’s studies (Adgate et al. 2000; Mitchell et al. 1997; Senturia et al. 1998), despite the complexity and comparatively invasive nature of the SHIELD protocols. The data indicate that a school-based, probability sampling strategy is a practical, affordable, and effective method for studying children’s environmental health in poor minority neighborhoods. The primary advantages of a school-based design are numerous: a) the process of identifying households with age-eligible children is direct, simple, and relatively inexpensive; b) contact information (i.e., names, telephone numbers, addresses) and sociodemographic information (e.g., race/ethnicity of child, language spoken at home) is readily available, provided appropriate safeguards are in place to protect privacy; c) the involvement of school personnel (e.g., recruitment letter from the principals, use of bilingual education assistants as recruiters) lends credibility to the study and increases the likelihood that children/families will volunteer to participate; and d) information available
from the schools (e.g., race/ethnicity of child, language spoken at home, academic performance, standardized test scores) makes it easier to assess differences in responders and nonresponders; and (e) the in-school collection of biologic samples (blood and urine) and testing of lung function (spirometry and peak flow) is a convenient and effective way to monitor children's environmental health. Notwithstanding these advantages, the enrollment rate for English-speaking, predominantly African-American families was just 42%, compared with 71% for non-English-speaking families (predominantly Somali and Hispanic). Once enrolled, however, virtually all children/families participated fully in this relatively burdensome study, doing their best to comply with sometimes-demanding study protocols and willingly providing blood and urine samples. The primary reason that children/families dropped out of SHIELD was that they moved and/or transferred to another school. Although results from SHIELD are encouraging, findings also indicate that there to hazardous environmental chemicals: an overview of selected research challenges and complexities. J Expo Anal Environ Epidemiol 10(6):611–629.

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