Survey of Selected Activities Relevant to Exposures to Soils

E. Y. Wong, J. H. Shirai, T. J. Garlock, J. C. Kissel

Department of Environmental Health, University of Washington, Seattle, WA 98195-7234, USA

Received: 5 April 2000/Accepted: 20 July 2000

In the summer and fall of 1996, a survey of randomly selected U.S. households was conducted by computer assisted telephone interview (CATI). The primary purpose of the survey, dubbed Soil Contact Survey (SCS-I), was quantification of behavioral patterns pertinent to dermal exposure to soil. Results of the survey and a follow-up (SCS-II) conducted in 1998 have been applied to estimation of a metric of dermal soil exposure termed the soil contact rate (SCR). Partial results have been presented elsewhere (Garlock et al., 1999; Wong et al., in press). The purpose of this paper is dissemination of selected data gathered in SCS-I that have not been formally incorporated in SCR estimation, but are of potential interest to exposure assessors. In SCS-I, respondents were questioned regarding multiple activities potentially relevant to evaluation of residential exposure to soil. Data presented here describe frequency of consumption of homegrown produce, frequency of shoe removal prior to residence entry, type of floor covering, indoor/outdoor pet ownership, occurrence of bare yard soil and residential proximity to vacant lots or fields.

Ingestion of foods grown in home gardens is of concern because local soil contamination may lead to elevated exposures (USEPA, 1997a). Chemical contaminants in soil may be transferred to plant tissues by absorption or adsorption (McKone, 1994). Produce may also be a vehicle for ingestion of soil not washed from edible plant surfaces. A survey performed by the National Gardening Association reported that 34 million U.S. households (38 percent of the total) participated in vegetable gardening in 1986 (USEPA, 1997a). Tomatoes, peppers, onions, cucumbers, lettuce, beans, carrots, and corn are the most commonly grown vegetables. EPA analysis of USDA Nationwide Food Consumption Survey (NFCS) data from 1987-88 produced estimates that 18% of U.S. citizens ≥ 1 year of age consume homegrown vegetables and 8% consume homegrown fruit (USEPA, 1997a).

Residential exposures to contaminants in outdoor soils may occur indoors if house dust is impacted by track-in of soil. House dust is considered to be a mixture of biologically-derived material, deposited aerosols and soil particles brought in by foot traffic (Thatcher and Layton, 1995; USEPA, 1997b). The fraction attributable to outdoor soil has been estimated to be 30 to 40 percent (Fergusson and Kim, 1991). Outdoor soil and indoor dust lead levels have been found to be positively associated (Rabinowitz and Bellinger, 1988; Thornton et al., 1990; Berny et al., 1994). Thatcher and Layton (1995) studied “tracked” and “untracked” areas of floor surfaces and found that areas subject to foot traffic showed higher accumulation (mass/area) of dust. Nishioka et al. (1996) demonstrated transfer of herbicide from treated turf to carpet in a track-in simulation. Due to size selection, lack of degradation indoors or
other factors, contaminants may become enriched in house dusts. For instance, pesticide levels in indoor dust were found to be much higher than in outdoor soils in an agricultural community in Washington state (Simcox et al., 1995). Shoe removal has been hypothesized to reduce soil track-in (Ott and Roberts, 1998; Roberts et al., 1999).

Pets may assist children with access to soil by digging or by accumulating soil and dust in their fur. Pets with access to both the indoors and outdoors can also bring outdoor soil and dust into the home. Thomas et al. (1976) linked increased blood lead levels in dogs with increased blood lead levels in children aged 1 to 6 in the same households. Berny et al. (1995) found a similar result for dogs and/or cats. The strongest association occurred in the youngest age group (children ≤ 6) with "mostly inside" pets.

Type of floor covering may also be important in assessing exposure to house dust and related contaminants. Carpets appear to act as storage reservoirs for some persistent contaminants (Lewis et al., 1994; Whitmore et al., 1994; Roberts et al., 1999). Carpeted areas also typically have higher dust mass per unit area than uncarpeted areas (Thatcher and Layton, 1995).

Patches of bare soil in yards provide easy access to soil. Hwang et al. (1997) reported an association between urinary arsenic in children and soil arsenic in bare spots in yards. Residential proximity to vacant lots or fields is of interest because vacant land represents a possible opportunity for exposure to bare soils for children who are otherwise locally restricted to well maintained yards or to paved surfaces. Vacant lots may also have a history of use as dumping grounds due to lack of oversight.

**MATERIALS AND METHODS**

In the summer of 1996, the SCS-I was administered via CATI. A national sample of 450 households was queried on behavior that could lead to dermal soil exposures. Households were chosen through random-digit dialing and respondents were required to be 18 or older. Demographic characteristics of the sample are discussed below and further described elsewhere (Garlock et al., 1999; Wong et al., in press).

The first section included a brief introduction and description of the survey. The second section was comprised of questions regarding residential activities of both adults and children and clothing and bathing choices. This component included questions on participation in gardening. Persons reporting gardening were asked what sorts of homegrown produce they personally consumed. Responses were recorded for 1) any tree fruit (such as apples or cherries), 2) any root vegetables (such as potatoes or carrots), and 3) any other garden vegetables (such as lettuce, tomatoes or beans). The next section contained questions about employment of family members that could lead to soil exposure. The fourth section included miscellaneous questions about other characteristics potentially relevant to soil exposure in the home. Respondents with minor children were asked if there were areas of bare soil in their yards (other than gardens) or if there were any accessible vacant lots or fields within walking distance of the residence. All respondents were queried regarding whether street shoes were regularly removed prior to entry or worn in the home. Questions were also presented regarding predominant floor coverings in the home, the presence of pets, and whether those pets spent time both indoors and outdoors. The last section of the SCS dealt with demographics of the population. Geographic location (region and zip code) and socioeconomic status