PART B - CHAPTER 12

DESCRIPTIONS OF HUMAN ACTIVITY

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12.1 INTRODUCTION

Human activities play a crucial role in the nature and magnitude of exposure to pesticides. For example, in agriculture, the type of crop and the type of work performed has an impact on exposure. Human activity data provide information concerning the way humans are exposed to the pesticide being evaluated. Information on human activity patterns is important in understanding the potential routes and pathways of exposure. Activity data such as the frequency and duration of exposure are needed for the exposure calculations. These data are also useful for evaluating potential differences in exposures between different subpopulations (i.e., adults and children) and for determining how specific activity patterns affect exposure levels. Also, it is human activity that links the transferable residue data to dermal exposure data via the transfer coefficient. The Agency also needs data on how the pesticide under investigation is used and applied. This latter data requirement is described in Part B, Chapter 11 - Product Use Information.

12.2 DATA REQUIREMENT

Study investigators should prepare a brief description that includes the following items associated with the pesticide being studied:

Nature of human activity. The types of human activities associated with use of the pesticide need to be described. For agricultural situations, this would be a description of the reentry activities that are performed after pesticide application such as harvesting, thinning, scouting, etc. For residential situations, such activities would include children playing on pesticide-treated lawns and indoor surfaces (e.g., carpet). For industrial scenarios, this would be a description of the activities after application of the pesticide in a manufacturing process or to the aqueous system being treated.

Principal source(s) of exposure. Pesticide exposures may occur from various sources. For agricultural scenarios, sources could include foliage, soil, and air; for residential scenarios, sources of exposure could include lawn, carpets, air, and counter tops.

Conditions mitigating exposure. For industrial pesticide uses, a description of any occupational safety and health regulatory and other requirements that directly mitigate potential exposures should be described. This may include mandatory air exchanges, engineering controls, air concentration exposure limits

(permissible exposure limits PELs), short-term exposure limits (STELs), threshold limit values (TLVs)), personal protective equipment requirements, etc.

Level of physical exertion. Postapplication activities involve mild, moderate, and heavy forms of exertion. Such information is particularly important in biological monitoring studies as exertion levels may effect the metabolism of the pesticide under investigation.

Expected frequency and duration of activity. The frequency and duration of certain activities would impact exposure in accordance with the pattern of use of a pesticide product. In a residential environment, exposure would be dependent on the label uses and the frequency of ues in association with the duration and frequency of residential activities. The frequency of pesticide use, the number of hours worked per day, and number of days worked per year are all inputs into exposure/dose risk calculations that should be well documented by investigators.

Exposed Populations. The populations most likely to be exposed should be identified. For example, are adults or children, or males or females most likely to be exposed?

Unusual conditions contributing to exposure. Unusual conditions that might contribute to unforeseen and unpredictably heightened exposure should be considered. Are there specific conditions that may contribute to exposure during postapplication activities?

Efficiency of individuals conducting tasks. The act of performing human activities such as fruit or vegetable harvesting would be expected to contribute to exposure to pesticide residues through the transfer of residues from treated foliage to the skin. The efficiency of these operations would be expected to enhance exposure. For example, certain individuals might conform with or exceed the typical number of pounds of a commodity (e.g., fruits or vegetables) harvested on a daily basis. Such information will provide the Agency with insight on the intensity of the activity level associated with postapplication exposures.

Experience. The efficiency of the execution of an activity such as harvesting might be expected to depend on the experience of the individual. What is the typical experience level of individuals performing the task, using the product, and using any special or personal protective equipment? Also, how are experience levels likely to affect exposures?

EPA recommends that investigators document, in as complete a fashion as possible, the postapplication activities under which individuals may be exposed to the pesticide of interest via

photographic and or videotape records (U.S. EPA, 1998a). These records should be retained with the raw data in archives unless specifically required by the Agency.

In connection with the submittal of descriptions of human activities, the study investigator should state which activity is the most likely to result in maximum human exposure to pesticide residues for each site. In some pesticide use situations, the most significant human exposure to pesticide residues occurs when harvested commodities are transferred from the application site and handled (e.g., sorting of fruits and vegetables). The study investigator should include a brief rationale supporting the selection.

12.3 ACTIVITY PATTERN (TIME USE) DATA SOURCES

An individual's choice of time use will vary according to parameters such as personal preference, age, gender, culture, hobbies, occupation, location, etc. Socioeconomic status and education attainment may also influence chosen activities and time spent. Activity pattern information and activity related exposure monitoring tools can be found in, but not limited to, the data sources that are briefly described below.

Exposure Factors Handbook - The Handbook, an EPA, Office of Research and Development (ORD) publication, presents information from various published time use/activity patterns surveys for adults and children in the U.S. general population and various subpopulations. The data included are for type of activity, time spent engaging in an activity, location of an activity, and number of times an individual may perform or engage in an activity. In addition, a description of each survey is provided (i.e., study design, study population, response rate, etc.). Activity Patterns Survey data are aggregated based on age, gender, race, geographic location, specific activity, etc. These data may be used to develop exposure duration and frequency estimates for specific exposure scenarios. (U.S. EPA, 1996a).

National Human Activity Patterns Survey (NHAPS) - NHAPS, an EPA/ORD effort, is the largest and most current human activity patterns survey and is representative of the U.S. general population. Data are available for 91 activities and for 82 different possible locations. Information was collected via 24-hour diaries on duration and frequency of selected activities and of time spent in selected microenvironments. Statistical summaries were generated for specific subgroups of the U.S. population (i.e., gender, age, race, employment status, education, census region, season, etc.). Data are reported in the form of means, percentages of time spent, and percentage of respondent occurrences. These data are useful for obtaining national representative distributions of time spent in a large variety of activities and locations in a single day. (U.S. EPA, 1996b).

National Human Exposure Assessment Survey (NHEXAS) - NHEXAS, scheduled to be completed in FY 97, is a Federal interagency program to measure exposure using estimates of frequency and durations of exposure-related human activities and data on pollutant concentrations in environmental and biological media. Among the target chemicals in the survey are pesticides. Human time-activity patterns information was collected and estimated using questionnaires and diary data. In addition, there are several special studies conducted that address activity or behavioral patterns: measurement and analysis of children's exposures to pesticides and PAHs (a feasibility study to evaluate total pesticide exposure and incorporate reported and observed activity patterns of children); quantification of children's hand and mouthing activities through a videotaping methodology (a videotaping methodology to quantify children's activity patterns by totaling the frequency and occurrence of behaviors of interest); and the Region 5 NHEXAS time/activity diary (a daily time-activity diary completed over a 7-day period). (Sexton et al., 1995; Quackenboss et al., 1997; Reed et al., 1997; Freeman et al., 1997).

ADP Information Resources Management and Support Services (AIRMS) Time-Location Methodology - AIRMS is in support of an EPA/ORD initiative to study incidental exposure of children in residential environments. It provides an analysis of available literature data on children's behavioral patterns: hand-to-mouth activity, object-to-mouth activities, locomotor activities, pica and geophagia, and other miscellaneous exploratory behaviors. The report is a summary of the statistical analysis of prediction (age, sex, ethnicity, socioeconomic status, etc.) and response (drop or bang objects, touch or grasp object, look at object, mouthing object) variables. Frequency and duration data are available for selected activities. (U.S. EPA, 1998b).

Consolidated Human Activity Database (CHAD) - CHAD was developed to support exposure/intake dose/risk assessment for the EPA Office of Research and Development. CHAD is a relational data base with graphical user interface that facilitates queries and report generation. It contains data bases from existing human activity patterns surveys (questionnaire or diary data) that are either national in scope or are site-limited. These data bases have been incorporated into CHAD as the original raw data and as data modified to format requirements. The graphical user interface design includes button and pull-down menus for customizing queries and a user may access personal diary information (age, gender, ethnicity, education and activity, and other questionnaire information) for each survey respondent. Queries can be made of the original survey data or the modified CHAD data, and a user can select a single variable (e.g., respondent's age) and apply it to all studies contained in CHAD. Interpretation of the variable (e.g., activity codes) is identical for all studies in CHAD for the modified data, but not for the original survey data. (U.S. EPA, 1997).

Jazzercize TM - Exposure Monitoring Tool - Jazzercize TM, as an activity-related exposure monitoring tool, was purposefully designed to achieve maximum contact of the entire body with the floor using low impact aerobic movements. Jazzercize TM is exercise that has been choreographed to music. Because the body motions are described on paper and timed to the beat of the music, Jazzercize TM is a very reproducible means of establishing the same extent of body contact with a treated surface anywhere a certified instructor can be found. Every surface of the human body (dorsal, ventral, and lateral) contacts the floor multiple times in a series of exercises which are timed to the nearest second. Repetitive movements are standardized by executing them to the beat of popular jazz music. Four stretching exercises are interspersed with four aerobic movement exercises. Test subjects wearing whole body dosimeters are lead through a prescribed set of exercises on a carpet or lawn previously treated with a pesticide. Immediately following the exercise, the dosimeters are collected, extracted, and analyzed to determine the amount of chemical transferred from treated surface to the dosimetry clothing.

In order to relate the degree of contact in this standardized exposure monitoring test to normal adult or children's behavior, one must know the kinesiology of both the test method (e.g., Jazzercize) and normal human behavior. The number of contacts various body parts make with a carpet, the intensity and duration of normal contact must be compared to the test method. Several studies have recorded activity patterns and, more recently, studies on children's behavior have better defined their kinesiology. However, at this time, no study has related the test method estimates of exposure to exposures measured following normal use. (Ross et al., 1990).

In a recent study, Krieger et al. (1996) used the Jazzercize TM method to evaluate exposure to disodium octaborate tetrahydrate, on indoor flea control pesticide used on carpets. Study participants performed a 20-minute set of Jazzercize TM routines on treated carpet. Exposure was measured using whole body dosimeters and biological monitoring (i.e., urine). The availability of pesticide on the carpet was evaluated using the California Cloth Roller as a sampler (see Part B, Chapter 6 - Indoor Surface Residue Dissipation for a description of this technique).

Time-Motion Videoanalysis - Recently, EPA has been conducting research using videotape analysis to determine how and to what extent humans, particularly biologically sensitive individuals, such as children, are exposed via the dermal route to pesticides used in residential microenvironments (U.S. EPA, 1997b). To accomplish this goal, video recordings were made of adult volunteers performing prescribed and choreographed activities of children (crawler/walker stage 8-18 months of age) reentering a pesticide treated room. Contact and transfer of residues were examined to obtain passive dosimetric data in conjunction with time-motion analysis of the videotapes. The study examined the concordance of exposure duration, anatomical areas exposed, and skin surface area exposed with direct measurement of contact by passive

dosimetry. Duration of exposure, as determined by time-motion analysis of activities within a microenvironment, was found to correlate with dosimetric measurements of the anatomical regions of the body in contact with contaminated surfaces. As part of this research, a videotape analytical technology was identified that converted video images into reproducible and quantitative computer data using digital systems instead of analog systems. This technology, the Peak Performance Technologies Motion Measurement System (PPT-MMS) was able to capture activities at the level of detail important to EPA to make informed judgements about location of contact, anatomical area of contact, duration of contact, and the activity associated with exposure. The PPT-MMS provided a quantitative and reproducible method for the measurement of the biomechanics of exposure that may be adaptable to the modeling of exposures under a variety of scenarios. This "ergonomic approach" would enable the risk assessor/modeler to determine the exposure potential associated with individual activities in relation to surface area of contact and anatomical area of contact.

EPA's purpose in studying the biomechanics of exposure in confined spaces (microenvironments) is to reduce or eliminate the need for exposure studies that require human participation. The studies were designed to generate a computer assisted scenario-based model that can interpret spatial and temporal relationships of human dermal contact and transfer of surface residues. The initial studies were proposed to study dermal exposure and nondietary ingestion of toxic substances in children. The methodologies thus far developed could have wider applications to situations where humans may be occupationally exposed.

12.4 DATA PRESENTATION

Human activity information relevant to the pesticide being evaluated may be reported in narrative form. Where practical, tabular format should be used.

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