National Human Exposure Assessment Survey (NHEXAS)

Arizona Study

Quality Systems and Implementation Plan for Human Exposure Assessment

The University of Arizona
Tucson, Arizona 85721

Cooperative Agreement CR 821560

Standard Operating Procedure **SOP-IIT-A-6.0**

Title: Calculating Ingestion Exposure from Day 4 Composite Measurements, the Direct Method of Exposure Estimation

Source: The University of Arizona

U.S. Environmental Protection Agency
Office of Research and Development
Human Exposure & Atmospheric Sciences Division
Human Exposure Research Branch

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STANDARD OPERATING PROCEDURE FOR CALCULATING INGESTION EXPOSURE FROM DAY 4 COMPOSITE MEASUREMENTS, THE DIRECT METHOD OF EXPOSURE ESTIMATION.

This Standard Operating Procedure (SOP) uses data that have been properly coded and certified with appropriate QA/QC procedures by the University of Arizona NHEXAS team.

Objective

Calculate the ingestion exposure using composite food chemical residue values from the day of direct measurements.

Exposure Calculation

The equation used to calculate the direct ingestion exposure for each subject is as follows:

$$E_T = \frac{\left[\sum_S C_S \times W_S + \sum_L C_L \times W_L\right]}{BW} \qquad (3\text{-}1)$$

where E_T is the total ingestion exposure to all chemical residues found in the food items consumed by each subject during the day of measurement, kg/day.

C_S is the concentration of the chemical residue, chlorpyrifos or diazinon, in the composited solid food items consumed by each subject during the day of measurement, mg/kg.

W_s is the weight of composited solid food items consumed by each subject during the day of measurement, kg.

C_L is the concentration of the chemical residue, chlorpyrifos or diazinon, in the composited liquid food items consumed by each subject during the day of measurement, mg/kg.

W_L is the weight of the composited liquid food items consumed by each subject during the day of measurement, kg.
BW is the body weight of each subject, kg.

Up to 2 percent of chlorpyrifos or diazinon concentrations of in beverages and water are detectable. Therefore, we conclude that the population exposures to chlorpyrifos or diazinon from consumption of beverages and water are equivalent to zero. Only exposure to the chemicals in solid food are discussed in this SOP.

The consumption unit used in the Diet Diary questionnaire is "serving". This unit has to be converted to kilograms. The conversion is explained in SOP#8.

Variable List

Variable	Description
HHID	household I.D.
DAY4SERV	number of servings of each food item on Day 4
FOODMASS	mass of each food item consumed (kg)
TFDMASS	total mass of solid food consumed (kg)
BW	body weight (kg)
C_ZERO	measured concentration of chlorpyrifos in the composite of solid food with the BDL values censored to be equal to zero. The unit is mg of chemical residue per kg of food, mg/kg.
C_DL	measured concentration of chlorpyrifos in the composite of solid food with the BDL values censored to be equal to the detection limit. The unit is mg of chemical residue per kg of food, mg/kg.
C_RB	measured concentration of chlorpyrifos in the composite of solid food with the BDL values censored using the robust method. The unit is mg of chemical residue per kg of food, mg/kg.
D_ZERO	measured concentration of diazinon in the composite of solid food with the BDL values censored to be equal to zero. The unit is mg of chemical residue per kg of food, mg/kg.
D_DL	measured concentration of diazinon in the composite of solid food with the BDL values censored to be equal to the detection limit. The unit is mg of chemical residue per kg of food, mg/kg.
D_RB	measured concentration of diazinon in the composite of solid food with the BDL values censored using the robust method. The unit is mg of chemical residue per kg of food, mg/kg.
EC_ZERO	exposure to chlorpyrifos in solid food, using the concentration data with the BDL values censored to be equal to zero. The unit is mg/kgBW.day.
EC_DL	exposure to chlorpyrifos in solid food, using the concentration data with

Variable	Description
	the BDL values censored to be equal to the detection limit. The unit is mg/kgBW.day.
EC_RB	exposure to chlorpyrifos in solid food, using the concentration data with the BDL values censored using the robust method. The unit is mg/kgBW.day.
ED_ZERO	exposure to diazinon in solid food, using the concentration data with the BDL values censored to be equal to zero. The unit is mg/kgBW.day.
ED_DL	exposure to diazinon in solid food, using the concentration data with the BDL values censored to be equal to the detection limit. The unit is mg/kgBW.day.
ED_RB	exposure to diazinon in solid food, using the concentration data with the BDL values censored using the robust method. The unit is mg/kgBW.day.

Procedure

The concentration data in each media will be censored with the approaches explained in SOP # 4. Generally, 3 sets of data resulted from the censored data treatment will be used in the exposure estimation:

1) Data set with all below detection limit values substituted by zero.
2) Data set with all below detection limit values substituted by the detection limit.
3) Data set with all below detection limit values substituted by values selected using the Robust Method.

The procedure explained next is for estimating unweighted exposure for the data sets. Weighted exposure estimates can be obtained by using the SUDAAN program. The unweighted exposure estimates, with corresponding sampling weights, will be used as the program's inputs. The sampling weights used will be calculated and adjusted according to the processes explained in details in SOP # 9 and 10.

The procedure for the unweighted exposure estimation in this SOP is the following:

1. In Excel, open PAGE FOR EXPOSURE CALCULATION INDIRECT, select only ***HHID, DAY4SERV, AZCODE, BW, FB,*** and ***KG***. Save them as PAGE FOR EXPOSURE CALCULATION DIRECT.
2. In PAGE FOR EXPOSURE CALCULATION DIRECT, calculate total solid food mass consumed by each respondent. The resulting column is called ***TFDMASS***. Also, convert body weight from pound mass unit to kilograms and call the resulting column ***BW***. Select ***HHID, TFDMASS,*** and ***BW***; and save them as HHID BW AND TOTAL FOODMASS.

3. In SPSS, open HHID BW AND TOTAL FOODMASS. Merge this file with the censored concentration data files: FUPF BDL = ZERO CHLOR, FUPF BDL = DL CHLOR, FUPF BDL = RB CHLOR FUPF BDL = ZERO DIAZ, FUPF BDL = DL DIAZ and FUPF BDL = RB DIAZ. The first 3 files contain the concentration values of chlorpyrifos with BDL values censored to zero, to the detection limit, and censored with the robust method, respectively. The last 3 files contain the concentration values of diazinon with BDL values censored to zero, to the detection limit, and censored with the robust method, respectively. Exclude variables which are irrelevant to the exposure calculation. The merged file will then contain, for each respondent, body weight, total solid food mass consumed on day 4, and the 6 sets of concentration values of chlorpyrifos and diazinon. The variables include ***HHID, TFDMASS, BW, C_ZERO, C_DL, C_RB, D_ZERO, D_DL,*** and ***D_RB***. Save this file as INGESTION EXPOSURE DIRECT.
4. In INGESTION EXPOSURE DIRECT, calculate ingestion exposure for each respondent by using equation 3-1. See spreadsheet format shown below. The calculated exposure results are in variables ***EC_ZERO, EC_DL, EC_RB, ED_ZERO, ED_DL,*** and ***ED_RB***.

Spreadsheet Format

In INGESTION EXPOSURE DIRECT:

Column	Variable
1	***HHID***
2	***BW***
3	***TFDMASS***
4	***C_ZERO***
5	***C_DL***
6	***C_RB***
7	***D_ZERO***
8	***D_DL***
9	***D_RB***
10	***EC_ZERO***, calculated from (***TFDMASS*** × ***C_ZERO***)/***BW***
11	***EC_DL***, calculated from (***TFDMASS*** × ***C_DL***)/***BW***
12	***EC_RB***, calculated from (***TFDMASS*** × ***C_RB***)/***BW***
13	***ED_ZERO***, calculated from (***TFDMASS*** × ***D_ZERO***)/***BW***
14	***ED_DL***, calculated from (***TFDMASS*** × ***D_DL***)/***BW***
15	***ED_RB***, calculated from (***TFDMASS*** × ***C_RB***)/***BW***