THE CONSOLIDATED HUMAN ACTIVITY DATABASE (CHAD) Documentation and User's Guide

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THE CONSOLIDATED HUMAN ACTIVITY DATABASE (CHAD)

Documentation and Users' Guide

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Acronyms and Abbreviations

APEX	Air Pollutants Exposure model
ATUS	American Time Use Survey
BAL	Baltimore Retirement Home Study
BLS	Bureau of Labor Statistics (part of U.S. Census Bureau)
CAA	California Adults Activity Patterns Study
CAC	California Children Activity Patterns Study
CATI	Computer Assisted Telephone Interviewing
CAY	California Youth Activity Patterns Study
CHAD	Consolidated Human Activity Database
CIN	Cincinnati Activity Patterns Study
CO	Carbon monoxide
CPS	Current Population Survey
CSV	Comma-separated values
DC	District of Columbia
DEA	Detroit Exposure and Aerosol Research Study
DEN	Denver, Colorado Personal Exposure Study
EMSL	Environmental Monitoring Systems Laboratory
EPA	U.S. Environmental Protection Agency. Also, the EPA Longitudinal Studies when referring to the specific activity study.
HAPEM	Hazardous Air Pollutant Exposure Model
ISR	PSID studies I, II, and III
LAE	Los Angeles Ozone Exposure Study: Elementary School
LAH	Los Angeles Ozone Exposure Study: High School
MET	Metabolic equivalent of task
NERL	National Exposure Research Laboratory
NHA	NHAPS Air Study
NHAPS	National Human Activity Pattern Study
NHW	NHAPS Water Study
NOAA	National Oceanic and Atmospheric Administration
NSA	National-scale Activity Study
OAB	RTI Ozone Averting Behavior Study
OAQPS	Office of Air Quality Planning and Standards
PEM	Personal exposure monitor
PM	Particulate matter
PM2.5	PM with diameters no larger than 2.5 microns
PSID	Population Study of Income Dynamics
QA	Quality assessment
QC	Quality control. Also, quality count when referring to QC variables in CHAD-Master.
QCLCD	Quality-controlled Local Climatological Dataset
QF	Quality flag
RTP	Research Triangle Park. Also, the RTP Particulate Matter Study when referring to the specific activity study.
SEA	Seattle Study
SHEDS	Stochastic Human Exposure and Dose Simulations model(s)
SUPERB	Study of Use of Products and Exposure-related Behaviors
SUP	Study of Use of Products and Exposure-related Behaviors (as CHAD component)
US (or U.S.)	United States
VAL	Valdez Air Health Study
WAS	Washington, DC Study

1. Introduction

The Consolidated Human Activity Database (CHAD) is a comprehensive human-activity database maintained by the U.S. Environmental Protection Agency (EPA) National Exposure Research Laboratory (NERL). CHAD currently (as of November 2016) contains approximately 180,000 individual person-days of detailed human behavior. The current CHAD data files are referred to as "CHAD-Master," but CHAD in general is often referred to in this document simply as "CHAD."

The CHAD activity data come from numerous studies since 1982, conducted by a variety of government, private, and other entities, and covering diverse local and nationwide population demographics. New activity data are added to CHAD on an ongoing basis.

CHAD was created to support assessments of human exposure, intake doses, and risk by providing scientists with accurate information on what people do every day. CHAD data can be used as input to a variety of EPA exposure-simulation models including the

- Air Pollutants Exposure Model (APEX);
- Stochastic Human Exposure and Dose Simulations (SHEDS) models for multimedia, multipathway chemicals (SHEDS-Multimedia), high-throughput chemical exposure (SHEDS-HT), particulate matter (SHEDS-PM), and air toxics (SHEDS-AirToxics); and
- Hazardous Air Pollutant Exposure Model (HAPEM).

CHAD data are freely available to the public and are regularly used by scientists, academics, and private organizations. Individuals who study human exposure and health, create or use models to assess exposure and risk, and develop programs focusing on human health benefit from the information included in CHAD. Furthermore, disciplines such as sociology, urban geography, urban economics, urban planning, and transportation engineering frequently use research on human-activity patterns.

This Users' Guide is designed to inform any potential user of CHAD with details and summaries regarding CHAD, its purpose, development history (which is ongoing), and structure. This Users' Guide also describes relevant information on each activity study comprising CHAD and provides statistics summarizing the activity and location data across CHAD. This Users' Guide will be updated periodically as additional studies are incorporated into CHAD.

2. Brief History of CHAD

2.1. Initial Development: 1997–1999

In an effort to improve the Multicity Activity Database—a data file of three large-scale human-activity studies conducted in the 1980s (in Cincinnati, Ohio, Denver, Colorado, and Washington, DC; referred to in CHAD respectively as CIN, DEN, and WAS)—NERL began development of CHAD in 1997 with the assistance of ManTech Environmental Technology, Inc. (McCurdy et al., 2000). ManTech consulted with scientists regarding human-activity studies, availability of data, and requirements of potential users of a consolidated database, and they incorporated suggestions from the anticipated consumer base into CHAD's development (NERL, 1997). Concurrently, NERL began identifying and obtaining human-activity datasets with sequential, variable-length activity information of at least 1 day in length, i.e., person-days or diary-days of recorded activity (McCurdy et al., 2000).

The list below identifies some of the key concerns and interests during this initial-development stage.

- Identify, adapt, or create an appropriately detailed coding structure to describe what study respondents are doing and where they are doing it.
- Maintain potentially useful descriptors of study respondents, including their age, gender, race, occupation, education level, health status (including certain maladies such as asthma), and various household characteristics (including housing structures, climate control, appliances, and smokers).
- Bridge any gaps in the time series of a respondent's activities, in order to maintain a continuous time series.
- Perform routine checks on data quality and provide corresponding quality flags in CHAD.
- Consider studies that are regional or national in scope or studies that follow an individual across a substantial amount of time (e.g., a year).

The studies originally considered are listed in Table 2-1, with references to the sections in Appendix A of this Users' Guide that describe them in more detail. The activity, location, and demographic codes used in the National Human Activity Pattern Study formed the general basis for the codes used in CHAD.

Table 2-1. Activity Studies Incorporated into the Initial CHAD Development

Study Name	Section of Appendix A Where Study is Described	Study Abbreviation in CHAD
California Adults Activity Patterns Study	A.5	CAA
California Children Activity Patterns Study	A.5	CAC
California Youth Activity Patterns Study	A.5	CAY
Cincinnati Activity Patterns Study	A.6	CIN
Denver, Colorado Personal Exposure Study	A.8	DEN
National Human Activity Pattern Study: Air	A.12	NHA
National Human Activity Pattern Study: Water	A.12	NHW
Valdez Air Health Study	A.18	VAL
Washington, DC Study	A.19	WAS

2.2. CHAD-2000

By the year 2000, several additional studies (shown in Table 2-2) were included in CHAD and CHAD was made available in a Microsoft® Access program with a graphical user interface to allow users to browse the database and generate reports. The database ("CHAD-2000") incorporated 22,968 person-days of recorded activity and included all available demographic data. Activity and location data were allocated with 144 activity codes and 115 location codes to promote consistency (McCurdy et al., 2000). CHAD-2000 also included available meteorological information, body-mass data, and values for metabolic equivalent of task (MET; an energy-expenditure metric equal to a multiple of the basal or resting metabolic rate, useful in estimating intake-dose rates via inhalation and dietary pathways; NERL, 2002).

Table 2-2. Activity Studies Incorporated into CHAD-2000 (in addition to those shown in Table 2-1 included in 1997–1999)

Study Name	Section of Appendix A Where Study is Described	Study Abbreviation in CHAD
Baltimore Retirement Home Study	A.4	BAL
Population Study of Income Dynamics I	A.10	ISR
Los Angeles Ozone Exposure Study: Elementary School	A.11	LAE
Los Angeles Ozone Exposure Study: High School	A.11	LAH

2.3. Development of CHAD-Master: 2000 to Present

Since the development of CHAD-2000, many studies have been added (shown in Table 2-3). The current (November 2016) version of the database, known as "CHAD-Master," is a SAS®-based and comma-separated-values (CSV) text dataset, with 23 studies. Additional studies will continue to be added as they become available.

Table 2-3. Activity Studies Incorporated into CHAD-Master as of November 2016 (in addition to those shown in Table 2.2 included in CHAD-2000)

Study Name	Section of Appendix A Where Study is Described	Study Abbreviation in CHAD
American Time Use Survey, Bureau of Labor Statistics	A.3	BLS
Detroit Exposure and Aerosol Research Study	A.7	DEA
EPA Longitudinal Studies	A.9	EPA
Population Study of Income Dynamics II	A.10	ISR
Population Study of Income Dynamics III	A.10	ISR
National-scale Activity Study	A.13	NSA
RTI Ozone Averting Behavior Study	A.14	OAB
RTP Particulate Matter Panel Study	A.15	RTP
Seattle Study	A.16	SEA
Study of Use of Products and Exposure-related Behaviors	A.17	SUP

In early 2015, EPA updated the set of activity codes used in CHAD so that some specific activities undertaken by study respondents now have correspondingly specific activity codes, whereas they previously were grouped with similar activities into broader, less-specific activity codes. For example, the previous "Participate in sports" activity code included four specific sub-categories of activities (Hunting, fishing, hiking; Golf; Bowling / pool / ping pong / pinball; and Yoga), and those not fitting into those four sub-categories were allocated to the broad "Participate in sports" code. In early 2015, the broad "Participate in sports, general" activity still exists, but there are now more than 30 sub-categories spanning combat, racquet, team, water, and winter sports. The current set of CHAD activity codes is shown in Section 4. A crosswalk from the previous activity codes to the current codes is provided in Appendix B. For the purposes of using CHAD in APEX, MET distributions were updated in early 2015 to reflect the new set of activity codes, where specific activities are matched to specific MET distributions where they are known (see discussion on MET data in Section 5).

CHAD-Master is designed to have a straightforward data format that will allow EPA to update it with newly available data in a timely manner. The database contains two files, a Questionnaire file (comprised of demographic and daily variables for each diary-day) and an Events file (comprised of the human-activity records—activities and locations—for each diary-day). The files are fully indexed using a unique CHADID for each diary-day.

3. CHAD Studies

A total of 23 CHAD studies are currently included in CHAD, with 179,250 diary-days entered. The geographic coverages range from specific cities to collections of metropolitan areas to the entire US, and the respondents tend to be adults but some studies include (or are limited to) children. CHAD contains human-activity data from these studies, coded into a harmonized set of location and activity codes. Note, however, that the data collected in the original studies differed in level of detail in terms of activity, location, and time resolution. In addition, the translation of the original study data into CHAD format was performed by different individuals or groups. Therefore, the CHAD data themselves will vary in specificity and resolution across the studies. One of the goals of this Users' Guide is to provide any user with enough information to assess each study within CHAD for appropriateness for their application.

An overview of the studies is provided in Table 3-1 below. More detailed descriptions of each individual study can be found in Appendix A. Appendix A also contains details on how the data from each study were coded into CHAD, including quality-assessment (QA) steps. The remainder of Section 3 below contains discussions on standardizing the time data and handling uncertain or missing data when translating study data into CHAD.

Table 3-1. Overview of Activity Studies Included in CHAD-Master (as of November 2016)

Study Name	Geographic Coverage	Dates (as incorporated into CHAD)	Respondent Ages (years; as incorporated into CHAD)	Data Gathering	Diary-days (as incorporated into CHAD)	Study References[a]
Baltimore Retirement Home Study (BAL)	Baltimore County, MD	01–02/1997 07–08/1998	≥65	daily recall data collected by study staff over a 3-week period	391	Williams et al., 2000
American Time Use Survey (ATUS), Bureau of Labor Statistics (BLS)	Whole US	2003–2011	≥15	24-hour recall data collected by telephone interview combining structured questions and conversational interviewing	124,517	BLS, 2014
California Activity Pattern Studies (CAA, CAC, CAY)	California	CAA and CAY: 10/1987–09/1988 CAC: 04/1989–02/1990	CAA: 18–94 CAY: 12–17 CAC: ≤11	24-hour recall data collected by telephone interviews with structured questions	CAA: 1,579 CAY: 183 CAC: 1,200	Wiley et al., 1991a; 1991b
Cincinnati Activity Patterns Study (CIN)	Cincinnati, OH	03–04 and 08–09/1985	≤86	activity diary and background questionnaire	2,614	Johnson, 1989
Detroit Exposure and Aerosol Research Study (DEA)	Detroit, MI	06/2004–10/2007	≥18	activities recorded via free-form entry, while location data were structured	340	Williams et al., 2008
Denver, Colorado Personal Exposure Study (DEN)	Denver, CO	11/1982–02/1983	18–70	activity diary and background questionnaire	805	Johnson, 1984; Johnson et al., 1986

Table 3-1. Overview of Activity Studies Included in CHAD-Master (as of November 2016)

Study Name	Geographic Coverage	Dates (as incorporated into CHAD)	Respondent Ages (years; as incorporated into CHAD)	Data Gathering	Diary-days (as incorporated into CHAD)	Study References[a]
EPA Longitudinal Studies (EPA)	Respondents residing in central NC (Raleigh, Durham, Chapel Hill)	1999–2000, 2002, 2006–2008, 2012–2013	0, 35–72	paper diary; free-from questionnaire	1,786	Isaacs et al., 2012
Population Study of Income Dynamics (PSID) I, II, III (ISR)	Whole US	I: 02–12/1997 II: 2002–2003 III:09/2007–05/2008	I: ≤12 II and II: <18	interviews; time diaries	I: 5,616 II: 4,997 III: 2,741	Alion Science and Technology, 2012; University of Michigan, 2014
Los Angeles Ozone Exposure Study: Elementary School/High School (LAE/LAH)	Los Angeles, CA	Fall/1989, Fall/1990	10–17	real-time diaries	94	Roth Associates, 1988; Spier et al., 1992
National Human Activity Pattern Study (NHAPS): Air/Water (NHA/NHW)	48 states	09/1992–10/1994	≤93	telephone interview and questionnaire	NHA: 4,723 NHW: 4,663	Klepeis et al., 1995; Tsang and Klepeis, 1996
National-scale Activity Study (NSA)	7 metropolitan areas	06–09/2009	35–92	recall activity-diary questionnaire	6,862	Knowledge Networks, 2009
RTI Ozone Averting Behavior Study (OAB)	35 metropolitan areas	07–09/2002, 08/2003	2–12	no information provided at this time	2,907	Mansfield et al., 2009
RTP Particulate Matter Panel Study (RTP)	Wake and Orange Counties, NC	06–11/2000, 01–05/2001	55–85	diaries recorded in real time	998	Williams et al., 2001; 2003a,b
Seattle Study (SEA)	Seattle, WA	10/1999–05/2001	6–91	diaries recorded in real time	1,692	Liu et al., 2003

Table 3-1. Overview of Activity Studies Included in CHAD-Master (as of November 2016)

Study Name	Geographic Coverage	Dates (as incorporated into CHAD)	Respondent Ages (years; as incorporated into CHAD)	Data Gathering	Diary-days (as incorporated into CHAD)	Study References[a]
Study of Use of Products and Exposure-related Behaviors (SUP)	California	06/2006–03/2010	≤88	24-hour recall data, collected by phone interview	9,446	Bennett et al., 2012
Valdez Air Health Study (VAL)	Valdez, AK	04–05/1990, 08/1990, 02–03/1991	11–71	information not provided	397	Goldstein et al., 1992
Washington, DC Study (WAS)	Washington, DC	11/1982–02/1983	18–71	activity diary and background questionnaire	699	Hartwell et al., 1984; Johnson et al., 1986; Settergren et al., 1984

[a]The full references of these citations are provided in each study's section in Appendix A.

3.1. Standardization of Time

The activity data in each study should reflect activities for a complete 24-hour period that begins at midnight. However, records from a study's original dataset (before incorporation into CHAD) may have missing activity data such that a complete 24-hour period is not represented. Also, start and end times may not be consistent from person to person in the study's original dataset. The CHAD variable WRAPTIME indicates the true starting time diary-day as recorded in the study's original dataset. Any diary event in the study's original dataset that crossed from one clock hour to another was divided at the hour boundary, creating two diary events in CHAD (one ending at the hour and the other beginning at the next hour, with cumulative duration maintained) rather than the original one diary event. This convention was initially implemented to allow for easier merging between CHAD and EPA air-quality data in EPA's exposure models.

3.2. Coding of Uncertain Activities

In a number of diary records in the original study datasets, the applicable CHAD activity code was uncertain. These are coded as "U". Too many instances of the "U" code would result in a record with a large amount of uncertain activity time. Activities coded as "U" are distinct from activities not recorded at all, since other data may have been provided (such as the location, the presence of smokers, etc.). Often, "U" signifies a combination of activities (such as eating and TV watching) for which the respondent was uncertain of the proper coding method.

3.3. Coding of Missing or Non-sequential Activities

Missing data may result from unreported gaps in the diary data, diaries that are shorter than 24 hours, or missing questionnaire data. This could result when the original study did not cover a full 24 hours, the original respondent was non-compliant in some way, or the original study design allowed respondents to code certain activities as personal or refused. Blank diary data or gaps in diary data are filled by "dummy" activity records that have activity = "X" and location = "X", indicating that the activity and location information are not known.

4. Content and Format of the Current CHAD-Master

CHAD-Master consists of two files. The Questionnaire file contains demographic and daily variables for each diary-day in CHAD. The corresponding Events file contains the time series of human-activity records (activities and locations) for each diary-day. The two files are indexed by a unique CHADID for each diary-day, composed of a three-letter study identifier (see Table 3-1), a respondent index, and a day identifier for the respondent. The tables listed below describe the variables and codes which make up CHAD-Master.

CHAD Contents

Table 4-1. Descriptive table of the CHAD questionnaire variables.

Table 4-2. Descriptive table of the CHAD events variables.

Questionnaire Inventory

Table 4-3. An inventory table describing available CHAD Questionnaire variables for each study.

Events Inventory

Table 4-4. An inventory table describing available CHAD Events variables for each study.

CHAD Codes

Table 4-5. A listing of the harmonized CHAD location codes.

Table 4-6. A listing of the harmonized CHAD activity codes.

Table 4-5 and Table 4-6 contain the location (loc) and activity (act) codes used in the Events file. These codes were determined from the activity and location information collected in the original studies. Note that the codes are hierarchal in nature (Tier 1 through Tier 4, with Tier 1 representing the major location or activity category and each subsequent tier representing more detailed levels of location or activity). The specificity of the codes used for each study depends on the level of detail collected in the original study protocol.

Table 4-1. CHAD Questionnaire Variables

CHAD Variable	Format	Description	Values[a]
Diary Variables			
CHADID	Character	EPA-assigned ID for this diary-day	text ID
rawid	Character	Raw data ID in the current study. May be missing or anonymized based on conditions imposed by the original investigators for inclusion in CHAD.	
study	Character	EPA-assigned three-letter abbreviation used for the study (first three letters of CHADID)	
chadbase	Character	EPA-assigned ID for this respondent	
daynum	Numeric	Index of current diary-day for this respondent	Integer, 1 though totaldays
totaldays	Numeric	Number of diary-days in CHAD for this respondent	Integer
Date Variables			
month	Numeric	Month of diary-day	number, 1 through 12
daymonth	Numeric	Day of the month of diary-day	1 though 31
year	Numeric	Year of diary-day	e.g., 1999
dayofweek	Character	Day of the week (abbreviation)	SUN MON TUE WED THU FRI SAT
wdwe	Character	Day type of diary-day	WE Weekend WD Weekday
weekend	Numeric	Flag for weekend for current diary-day	0 No 1 Yes
Location Variables			
county	Character	County of residence	Name of county
state	Character	State of residence	Name of state
zipcode	Character	Zip code of residence	Zip code
Weather Variables			
avgtemp	Numeric	Average temperature for diary-day	Degrees F
maxtemp	Numeric	Maximum temperature for diary-day	
inchrain	Numeric	Inches of rainfall for diary-day	Inches
hourrain	Numeric	Hours of rainfall for diary-day	Hours
Personal Variables			
age	Numeric	Age	Age in years (may be age 0)
gender	Character	Gender	Male/Female (M/F)
weight	Numeric	Weight	kg

Table 4-1. CHAD Questionnaire Variables

CHAD Variable	Format	Description	Values[a]
education	Character	Level of education	N None SE Some elementary E Elementary school SH Some high school H High school graduate SC Some college C College graduate SG Some graduate school G Graduate or professional degree
occup	Character	U.S. Census Bureau occupation group	ADMIN Executive, Administrative, and Managerial PROF Professional TECH Technicians SALE Sales ADMSUP Administrative support HSHLD Private Household PROTECT Protective Services SERV Services FARM Farming, Forestry, and Fishing PREC Precision Production, Craft, and Repair MACH Machine Operators, Assemblers, and Inspectors TRANS Transportation and Material Moving LABOR Handling, Equipment Cleaners, Helpers, Laborers
race	Character	Racial/Ethnic group	W White B Black A Asian H Hispanic O Other
income	Numeric	Household income before taxes	Income in thousands of dollars (at time of original study, so not adjusted for inflation)
housingtype	Character	Best description of living quarters	SF A one-family house detached from any other house MF A one-family house attached to one or more houses AP An apartment building MT A mobile home or trailer O Other

Table 4-1. CHAD Questionnaire Variables

CHAD Variable	Format	Description	Values[a]
heatingtype	Character	Type of heating for living quarters	S Steam or hot water system VB Furnaces and nonportable room heaters E Other built-in electric units (installed in wall, ceiling, baseboard etc.) UV Room heaters without flue or vent burning gas, oil, or kerosene; fireplaces O Other WH No heating method
fueltype	Character	Fuel or energy source used to heat living quarters	G Gas ES Electric or solar OK Fuel oil or kerosene C Coal or coke W Wood NF No fuel used O Other
hrsworked	Character	Hours worked in the last 7 days	Number of hours: 0 0_9 10_19 20_29 30_39 40_49 50_79 80_
Personal Flags			
aircond	Character	Air conditioning	YES/NO (Y/N)
asthma	Character	Having asthma	
employed	Character	Employed outside home	
fulltime	Character	Working full-time	
garage	Character	Attached garage	
gasstove	Character	Gas stove used in house	
heartlung	Character	Having a heart or lung condition	
pesticides	Character	Pesticide exposure	
student	Character	Attending school	
smoker	Character	Being a smoker	
nearsmoker	Character	Having been around smoker	
pregnant	Character	Being pregnant	
Quality Variables			
qcactloc	Numeric	Total minutes where QFACTLOC=1 (indicating location/activity mismatch)	minutes
qceattime	Numeric	Total eating minutes on diary-day	

Table 4-1. CHAD Questionnaire Variables

CHAD Variable	Format	Description	Values[a]
qcheavy	Numeric	Total minutes in heavy breathing (as reported by survey respondent)	
qcinfer	Numeric	Total minutes that were inferred from previous location when act was missing	
qclong	Numeric	Longest number of minutes in the same act/loc	
qcmeals	Numeric	Number of meals (groups of eating events separated by non-eating events) on diary-day	# meals
qcmetab	Numeric	Total minutes in activities with mean MET>3	minutes
qcmiss	Numeric	Total missing minutes (either act or loc)	
qcsleep	Numeric	Total sleep minutes on diary-day	
qftravel	Numeric	Flag indicating AM/PM (6–9 AM/4–7 PM) travel time inconsistencies. Flag is ON if (1) Person is employed AND (2) diary is a weekday AND (3) AM and PM travel time disagree within a factor of 2 AND (4) AM or PM travel time was 30 minutes or greater	1/0 (ON/OFF)
recount	Numeric	Number of records (events) on the diary-day	integer
wraptime	Character	Actual diary-day start time before wrapping into the standard midnight-midnight format	four-digit 24-hour time

[a]Missing numeric variables are given as -999; missing character variables are given as 'X'.

Table 4-2. CHAD Events Variables

CHAD Variable	Format	Description	Values
CHADID	Character	EPA-assigned ID for this diary-day	text ID
starttime	Character	Time of start of event	four-digit 24-hour time
endtime	Character	Time of end of event	four -digit 24-hour time
duration	Numeric	Duration of event	minutes
act	Character	CHAD activity code	six-digit code
loc	Character	CHAD location code	
actdesc	Character	Original activity description from survey	text string (up to 100 characters)
qfactloc	Numeric	Quality flag for activity/location logic mismatch (for example, activity is outdoor activity, location is not outdoor)	0 no 1 yes
qfinfer	Numeric	Quality flag for inference of data done by coder	
qfmetab	Numeric	Quality flag for an event with mean MET>3	
gasstove	Character	Gas stove used during event	YES/NO (Y/N), X if missing
smoking	Character	Smokers near	
heavybreathing	Character	Heaving breathing	
cookingself	Character	Cooking by self	
cookingother	Character	Cooking by other	
ETSmon	Character	ETS indicated by personal monitoring	
vocs	Character	Volatile organic compounds (VOCs) near	
windowsopen	Character	Windows open (car or house)	YES/NO (Y/N), X if missing
combustion	Character	Combustion occurring (candle or cooking, etc.)	
seq	Numeric	Sequential event number for this respondent on this diary-day	1 to n, where n is the number of events
study	Character	EPA-assigned three-letter abbreviation used for the study (first three letters of CHADID)	text ID
rawid	Character	Raw data ID in the current study. May be missing or anonymized based on conditions imposed by the original investigators for inclusion in CHAD.	

Table 4-3. Inventory of Variables: Questionnaire File

Study	airconc	asthma	county	education	fulltime	employed	garage	gasstove	heartlung	fueltype	heatingtype	hrsworked	housingtype	income	occup	pesticides	pregnant	race	student	smoker	nearsmoker	state	weight	weather[a]	zipcode
American Time Use Survey (ATUS), Bureau of Labor Statistics (BLS)	-	-	S	P	P	P	-	-	S	-	-	P	-	P	P	-	P	P	P	-	-	P	S	P	-
Baltimore Retirement Home Study (BAL)	P	-	P	-	P	P	P	P	-	P	P	P	P	-	-	-	-	P	P	P	-	P	-	P	P
California Adults Activity Patterns Study (CAA)	P	-	P	P	P	P	P	P	-	P	P	P	P	P	P	P	-	-	P	P	P	P	-	P	P
California Children Activity Patterns Study (CAC)	P	-	P	P	-	-	P	P	-	P	P	-	P	P	-	P	-	-	P	P	P	P	-	P	P
California Youth Activity Patterns Study (CAY)	P	-	P	P	P	P	P	P	-	P	P	P	P	P	P	P	-	-	P	P	P	P	-	P	P
Cincinnati Activity Patterns Study (CIN)	P	P	-	P	P	P	P	P	P	P	P	P	P	P	-	-	-	P	P	P	-	-	-	P	-
Detroit Exposure and Aerosol Research Study (DEA)	P	-	-	-	-	P	P	P	-	P	P	-	P	-	-	-	-	P	P	P	P	P	P	P	-
Denver, Colorado Personal Exposure Study (DEN)	P	-	-	-	S	S	P	P	-	-	P	-	P	-	P	-	-	-	-	P	-	P	-	P	-
EPA Longitudinal Studies (EPA)	P	P	P	P	P	P	P	P	P	P	P	P	P	-	P	-	P	P	P	P	P	P	P	P[b]	P
Population Study of Income Dynamics (PSID) I (ISR)	-	P	-	P	P	P	-	-	P	-	-	P	-	P	-	-	-	P	P	P	-	-	P	P	-
Population Study of Income Dynamics (PSID) II (ISR)	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	P	-	-	-	P	P	P	-
Population Study of Income Dynamics (PSID) III (ISR)	P	P	-	P	-	P	-	-	P	P	-	-	-	-	-	-	-	P	P	-	-	P	P	P	-
Los Angeles Ozone Exposure Study: Elementary School (LAE)	-	-	P	P	P	P	-	-	P	-	-	P	-	-	-	-	-	P	P	-	P	P	P	P	-
Los Angeles Ozone Exposure Study: High School (LAH)	-	-	P	P	P	P	-	-	P	-	-	P	-	-	-	-	-	P	P	-	P	P	P	P	-
National Human Activity	-	P	-	P	P	P	P	P	P	S	S	P	P	-	-	P	S	P	P	P	S	P	-	P	P

Table 4-3. Inventory of Variables: Questionnaire File

Study	airconc	asthma	county	education	fulltime	employed	garage	gasstove	heartlung	fueltype	heatingtype	hrsworked	housingtype	income	occup	pesticides	pregnant	race	student	smoker	nearsmoker	state	weight	weather[a]	zipcode
Pattern Study (NHAPS): Air (NHA)																									
National Human Activity Pattern Study (NHAPS): Water (NHW)	-	P	-	P	P	P	P	P	P	P	P	P	P	-	-	P	S	P	P	P	P	P	-	P	P
National-scale Activity Survey (NSA)	-	P	P	P	P	P	-	-	P	-	-	P	P	P	-	-	-	P	-	-	-	P	-	P	-
RTI Ozone Averting Behavior Study (OAB)	-	P	-	-	-	P	-	-	P	-	-	-	-	-	-	-	-	P	-	P	P	P	-	P	P
RTP Particulate Matter Panel Study (RTP)	-	-	P	-	-	-	P	P	P	-	-	-	P	-	-	-	-	P	-	-	-	P	-	P	-
Seattle Study (SEA)	P	-	-	-	-	-	P	-	P	-	P	-	P	-	-	-	-	-	-	-	-	P	-	P	-
Study of Use of Products and Exposure-related Behaviors (SUP)	-	-	P	P	-	P	-	-	-	-	-	-	-	-	-	-	P	P	-	P	-	P	-	P	-
Valdez Air Health Study (VAL)	P	-	P	-	-	P	P	-	P	P	P	-	-	-	P	-	-	-	-	-	-	P	P	P[b]	-
Washington, DC Study (WAS)	-	-	-	-	S	P	P	P	P	-	-	-	-	-	P	-	-	-	-	P	P	-	-	P	-

Notes: P = variable present for all (or most) diary-days; S = variable present for some, but not most, of diary-days; - = variable missing for all diary-days in study. The following variables were assumed to be present in all studies: Age, Gender, Date, DayofWeek, Day, Year, Month, WEWD, Weekend.

[a]"Weather" in this table corresponds to the following discrete CHAD variables: AvgTemperature, MaxTemperature, RainfallInches, RainfallHours.

[b]Rainfall for Valdez is not available. RainfallHours is missing for all EPA data.

Table 4-4. Inventory of Variables: Events File

Study Name	actdesc	gasstove	smoking	heavybreathing	cookingself	cookingother	ETSmon	VOCs	windowsopen	combustion
American Time Use Survey (ATUS), Bureau of Labor Statistics (BLS)	P	-	-	-	-	-	-	-	-	-
Baltimore Retirement Home Study (BAL)	-	P	P	-	-	-	-	-	-	-
California Adults Activity Patterns Study (CAA)	P	-	P	-	-	-	-	-	-	-
California Children Activity Patterns Study (CAC)	P	-	P	-	-	-	-	-	-	-
California Youth Activity Patterns Study (CAY)	P	-	P	-	-	-	-	-	-	-
Cincinnati Activity Patterns Study (CIN)			P	P	-	-	-	-	-	-
Detroit Exposure and Aerosol Research Study (DEA)	P	-	-	-	-	-	-	-	-	-
Denver, Colorado Personal Exposure Study (DEN)	-	P	P	-	-	-	-	-	-	-
EPA Longitudinal Studies (EPA)	P	-	P	P	S	S	-	P	P	P
Population Study of Income Dynamics (PSID) I (ISR)	-	-	-	-	-	-	-	-	-	-
Population Study of Income Dynamics (PSID) II (ISR)	-	-	-	-	-	-	-	-	-	-
Population Study of Income Dynamics (PSID) III (ISR)	-	-	-	-	-	-	-	-	-	-
Los Angeles Ozone Exposure Study: Elementary School (LAE)	-	-	P	P	-	-	-	-	-	-
Los Angeles Ozone Exposure Study: High School (LAH)		-	P	P	-	-	-	-	-	-
National Human Activity Pattern Study (NHAPS): Air (NHA)	P	-	P	P	-	-	-	-	-	-
National Human Activity Pattern Study (NHAPS): Water (NHW)	P	-	P	P	-	-	-	-	-	-
National-scale Activity Survey (NSA)	P	-	-	P	-	-	-	-	-	-
RTI Ozone Averting Behavior Study (OAB)	-	-	-	-	-	-	-	-	-	-
RTP Particulate Matter Panel Study (RTP)	P	-	P	-	P	P	P	P	-	-
Seattle Study (SEA)	P	-	P	-	P	P	-	-	-	-
Study of Use of Products and Exposure-related Behaviors (SUP)	P	-	-	-	-	-	-	-	-	-
Valdez Air Health Study (VAL)	-	-	-	-	-	-	-	-	-	-
Washington, DC Study (WAS)	-	P	P	-	-	-	-	-	-	-

Table 4-5. CHAD Location Codes

Location Code	Location
30000	**Residence, General**
30010	Your Residence
30020	Other's Residence
30100	Residence, indoor
30120	Your residence, indoor
30121	Kitchen
30122	Living room / family room
30123	Dining room
30124	Bathroom
30125	Bedroom
30126	Study / Office
30127	Basement
30128	Utility room / Laundry room
30129	Other indoor
30130	Other's residence, indoor
30131	Other's Kitchen
30132	Other's living room / family room
30133	Other's Dining room
30134	Other's Bathroom
30135	Other's Bedroom
30136	Other's Study / Office
30137	Other's Basement
30138	Other's utility room / laundry room
30139	Other indoor
30200	Residence, Outdoor
30210	Your residence, Outdoor
30211	Your residence - Pool, spa
30219	Your residence - Other outdoor
30220	Other's residence, outdoor
30221	Other's residence - Pool, spa
30229	Other's residence - Other outdoor
30300	Garage
30310	Indoor garage
30320	Outdoor garage
30330	Your garage
30331	Your indoor garage
30332	Your outdoor garage
30340	Other's garage
30341	Other's indoor garage
30342	Other's outdoor garage

Table 4-5. CHAD Location Codes

Location Code	Location
30400	Other, residence
31000	**Travel, general**
31100	Motorized travel
31110	Travel by car
31120	Travel by truck
31121	Travel by truck (pick-up van)
31122	Travel by Truck (other than pick-up or van)
31130	Travel by Motorcycle /moped /motorized scooter
31140	Travel by bus
31150	Travel by Train / Subway / rapid transit
31160	Travel by airplane
31170	Travel by boat
31171	Travel by motorized boat
31172	Travel by unmotorized boat
31200	Non-motorized travel
31210	Travel by walk
31220	Travel by bicycle / skateboard /roller-skates
31230	Travel in a stroller or carried by an adult
31300	Waiting
31310	Wait for bus, train, ride (at stop)
31320	Wait for travel, indoors
31900	Other travel
31910	Travel by other vehicle
32000	**Other, indoor general**
32100	Office building / bank / post office
32200	Industrial plant / factory / warehouse
32300	Grocery store / convenience store
32400	Shopping mall / non-grocery store
32500	Bar / night club / bowling alley
32510	Bar / Night Club
32520	Bowling alley
32600	Repair shop
32610	Auto repair shop /gas station
32620	Other repair shop
32700	Indoor gym / sports or health club
32800	Childcare facility
32810	Childcare facility, house
32820	Childcare facility, commercial
32900	Public building / library / museum /theater
32910	Auditorium, sport's arena / concert hall

Table 4-5. CHAD Location Codes

Location Code	Location
32920	Library / courtroom / museum /theater
33100	Laundromat
33200	Hospital / health care facility /doctor's office
33300	Beauty parlor / barber shop /hair dresser's
33400	At work : no specific location, moving among locations
33500	At School
33600	At Restaurant
33700	At Church
33800	At Hotel /Motel
33900	At Dry cleaners
34100	Parking garage
34200	Laboratory
34300	Other, indoor
35000	**Other outdoor, general**
35100	Sidewalk / street / neighborhood
35110	Within 10 yards of street
35200	Public garage / parking lot
35210	Public garage
35220	Parking lot
35300	Service station / gas station
35400	Construction site
35500	Amusement park
35600	School grounds / playgrounds
35610	School grounds
35620	playground
35700	Sports stadium and amphitheater
35800	Park /golf course
35810	Park
35820	Golf course
35900	Pool, river, lake
36100	Restaurant, picnic
36200	Farm
36300	Other outdoor
U	Uncertain
X	Missing

Note on formatting: The bolded entries correspond to "Tier 1" location. Left-justified entries that are not bolded correspond to Tier 2 codes. Single-indented entries correspond to Tier 3 codes. Double-indented entries correspond to the Tier 4 codes.

Table 4-6. CHAD Activity Codes

Activity Code	Activity
10000	**Work and other income producing activities, general**
10100	Work, General
10110	Work, general, for organizational activities
10111	Work for professional/union organizations
10112	Work for special interest identity organizations
10113	Work for political party and civic participation
10114	Work for volunteer/ helping organizations
10115	Work of/for religious groups
10116	Work for fraternal organizations
10117	Work for child / youth / family organizations
10118	Work for other organizations
10120	Work, income-related only
10130	Work, secondary (income-related)
10200	Unemployment
10300	Breaks
11000	**Household activities, general**
11001	Other household
11100	Prepare food, general
11101	Washing
11110	Prepare and clean-up food
11120	Cooking
11121	Baking
11122	Fry, grill, sauté
11130	Simple food preparation
11131	Cutting/chopping
11200	Indoor chores, general
11210	Move things
11220	Put things away
11230	Straighten up
11231	Make bed
11240	Clean-up food
11300	Outdoor chores, general
11301	Shoveling
11310	Clean outdoors
11320	Chop wood
11330	Garden
11331	Harvest
11332	Watering
11333	Weeding
11340	Lawn/grass

Table 4-6. CHAD Activity Codes

Activity Code	Activity
11341	Lawn watering
11342	Lawn weeding
11343	Mowing
11344	Pruning
11345	Use rake/leaf blower
11350	Load/unload
11360	Mechanical chores
11370	Move objects
11400	Care of clothes, general
11401	Fold/sort
11410	Wash clothes
11411	Hand wash/dry
11412	Laundry
11420	Maintain clothes
11421	Mend/sew
11422	Press/iron/steam
11500	Build a fire
11600	Repair, general
11610	Repair of boat
11620	Paint home / room
11630	Repair / maintain car
11640	Home repairs, general
11641	Home improvement/construction, moderate level
11642	Home maintenance, low level
11650	Other repairs
11700	Care of plants, general
11710	Care of plants, low level
11720	Care of plants, moderate level
11800	Care for pets/animals
11900	Clean house, general
11901	Collect/empty trash
11902	Mop
11903	Sweep
11904	Vacuum
11910	Clean house, heavy
11911	Clean bathroom
11912	Clean carpet
11913	Clean floors
11914	Clean kitchen
11915	Wash windows

Table 4-6. CHAD Activity Codes

Activity Code	Activity
11920	Clean house, light
11921	Dust
11922	Use aerosol cleaner/freshener
12000	**Child care, general**
12100	Care of baby
12200	Care of child
12300	Help / teach
12400	Talk /read
12500	Play indoors
12600	Play outdoors
12700	Medical care-child
12800	Other child care
13000	**Obtain goods and services, general**
13100	Dry clean
13200	Shop/run errands, general
13201	Errands for children or pets
13202	Shopping, general
13203	Shop at mall or superstore
13210	Shop for food, general
13211	Grocery shopping
13212	Shop for meals/snacks
13220	Shop for clothes or household goods
13230	Run errands
13300	Obtain personal care service
13400	Obtain medical service
13500	Obtain government / financial services
13600	Obtain car services
13700	Other repairs
13800	Other services
14000	**Personal needs and care, general**
14001	Wake up
14100	Shower, bathe, personal hygiene
14110	Shower, bathe, general
14111	Bathe
14112	Shower
14120	Personal hygiene, general
14121	Use restroom
14122	Wash hands/teeth/face
14200	Medical care, general
14201	Use nebulizer/oxygen machine

Table 4-6. CHAD Activity Codes

Activity Code	Activity
14210	Feel sick
14300	Help and care
14400	Eat
14500	Sleep or nap
14600	Dress, groom
14700	Other personal needs
15000	**General education and professional training**
15100	Attend full-time school
15110	Attend day-care
15120	Attend K-12
15130	Attend college or trade school
15140	Attend adult education and special training
15200	Attend other classes
15300	Do homework
15400	Use library
15500	Other education
16000	**Social activities, general**
16001	Gamble
16002	Go to park or festival
16100	Attend sports events
16200	Participate in social, political, or religious activities
16210	Practice religion
16300	Watch movie
16400	Attend theater
16500	Visit museums
16600	Visit
16700	Attend a party, general
16701	Attend a party, dance
16702	Attend a party, eat/drink
16703	Attend a party, sit/stand
16704	Attend a party, talk
16705	Attend a party, walk
16800	Go to bar / lounge
16900	Other entertainment / social events
17000	**Leisure, general**
17010	Indoor leisure
17111	Hunting, fishing, hiking
17112	Golf
17113	Bowling / pool / ping pong / pinball
17114	Yoga

Table 4-6. CHAD Activity Codes

Activity Code	Activity
17120	Participate in outdoor leisure
17121	Passive, sitting
17140	Create art, music, participate in hobbies
17141	Participate in hobbies
17142	Create domestic crafts
17143	Create art
17144	Perform music / drama / dance
17150	Play, unspecified, general
17151	Play, unspecified, low level
17152	Play, unspecified, moderate level
17160	Use of computers
17170	Participate in recess and physical education
17180	Other sports and active leisure, general
17200	Passive leisure, general
17201	Indoor passive leisure
17210	Watch
17211	Watch adult at work
17212	Watch someone provide childcare
17213	Watch personal care
17214	Watch education
17215	Watch organizational activities
17216	Watch recreation
17220	Listen to radio / listen to recorded music / watch T.V.
17221	Listen to radio
17222	Listen to recorded music
17223	Watch TV
17230	Read, general
17231	Read books
17232	Read magazines / not ascertained
17233	Read newspaper
17240	Converse / write
17241	Converse
17242	Write for leisure / pleasure / paperwork
17250	Think and relax
17260	Other passive leisure
17300	Other leisure
17400	Walk, bike, or jog (not in transit), general
17410	Bike, general
17411	Bike
17412	Cycles, other

Table 4-6. CHAD Activity Codes

Activity Code	Activity
17413	Tricycle
17420	Run or jog, general
17421	Run around, casual
17422	Running, vigorous/sustained
17430	Walk, general
17431	Crawl
17432	Use of walker
17433	Walk dog
17434	Walk for chores
17435	Walk inside
17500	Participate in sports, general
17501	Archery
17502	Equestrian sports
17503	Frisbee
17504	Gymnastics
17505	Skateboarding
17506	Skating
17507	Track
17510	Combat sports
17511	Boxing
17512	Fencing
17513	Martial arts
17514	Wrestling
17520	Racquet sports
17521	Badminton
17522	Racquetball
17523	Squash
17524	Tennis
17530	Team sports
17531	Baseball
17532	Basketball
17533	Cheerleading
17534	Dodgeball
17535	Football
17536	Hockey
17537	Kickball
17538	Lacrosse
17539	Rugby
17541	Soccer
17542	Softball

Table 4-6. CHAD Activity Codes

Activity Code	Activity
17543	Volleyball
17550	Water sports
17551	Surfing
17552	Swimming
17560	Winter sports
17600	Play games, general
17610	Active games
17611	Fighting
17612	Running games
17613	Trampoline
17620	Board games/card games
17621	Board games
17622	Bingo
17623	Card games
17630	Dress-up/make believe
17640	Low energy games
17641	Arts and crafts
17642	Play with books
17643	Writing/drawing
17650	Outdoor play
17651	Playground/swings
17660	Play with animals
17670	Puzzles
17671	Jigsaw puzzle
17672	Word puzzle
17680	Toys
17681	Toy balls
17690	Video games
17691	Active video games
17692	Computer games
17700	Active leisure, general
17701	Camping
17702	Caving/rock climbing
17703	Climb trees/structures
17710	Dance
17720	Hiking
17730	Horseback riding
17740	Water recreation
17741	Boating
17742	Recreational swim

Table 4-6. CHAD Activity Codes

Activity Code	Activity
17743	Scuba diving
17800	Exercise, general
17810	Cardiovascular exercise
17811	Aerobics
17812	Bike for exercise
17813	Run or jog for exercise
17814	Swim for exercise
17815	Walk for exercise
17820	Strength/stretching
17821	Lift weights
17822	Physical therapy
17823	Stretching
18000	**Travel, general**
18010	Travel by bus, general
18020	Travel by foot, general
18030	Travel by motor vehicle, general
18031	Drive a motor vehicle, general
18032	Ride in a motor vehicle, general
18040	Wait, general
18100	Travel during work, general
18110	Travel during work by bus
18120	Travel during work by foot
18130	Travel during work by motor vehicle
18131	Travel during work, drive a motor vehicle
18132	Travel during work, ride in a motor vehicle
18140	Travel during work, wait
18200	Travel to/from work, general
18210	Travel to/from work by bus
18220	Travel to/from work by foot
18230	Travel to/from work by motor vehicle
18231	Travel to/from work, drive a motor vehicle
18232	Travel to/from work, ride in a motor vehicle
18240	Travel to/from work, wait
18300	Travel for education, general
18310	Travel for education by bus
18320	Travel for education by foot
18330	Travel for education by motor vehicle
18331	Travel for education, drive a motor vehicle
18332	Travel for education, ride in a motor vehicle
18340	Travel for education, wait

Table 4-6. CHAD Activity Codes

Activity Code	Activity
U	**Uncertain**
X	**Missing**

Note on formatting: The bolded entries correspond to "Tier 1" activity. Left-justified entries that are not bolded correspond to Tier 2 codes. Single-indented entries correspond to Tier 3 codes. Double-indented entries correspond to the Tier 4 codes.

5. MET for CHAD Activities

Each CHAD activity event has a corresponding CHAD activity code with an associated MET distribution. A MET is defined as the ratio of the metabolic rate achieved while completing an activity to the basal (resting) metabolic rate and is used in the calculation of the ventilation rate.

As of August 2014, there were 142 numbered and named CHAD activity codes, plus the "Uncertain" and "Missing" codes (totaling 144 activity codes). These were expanded in early 2015 to 320 numbered and named CHAD activity codes, plus "Uncertain" and "Missing" (see Table 4-6). The new set of activity codes consisted of new activity sub-categories (referred to "refined activities" and numbering 218) to replace some previously aggregated activities.

MET distributions were developed for each refined activity code using the Compendium of Physical Activities (Ainsworth et al., 2011; hereafter "the compendium"). The compendium was developed for use in epidemiological studies and contains a point value for the MET associated with 822 different activities. Activity-specific MET distributions were developed by crosswalking the activities in the compendium with the CHAD activities corresponding to each code (see Table 5-1). The shape of the distribution for each CHAD activity was selected based on the number of corresponding activities in the compendium and goodness-of-fit metrics, including the Kolmogorov-Smirnov, Cramer-von Mises, and Anderson-Darling. A summary of the relevant distribution shapes is given in Table 5-2.

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
10000	Work and other income producing activities, general	Any	ADMIN	LogNormal	1.7	1.2	0		1.4	2.7
10000	Work and other income producing activities, general	Any	ADMSUP	LogNormal	1.7	1.2	0		1.4	2.7
10000	Work and other income producing activities, general	Any	FARM	LogNormal	7	1.5	0		3.6	17
10000	Work and other income producing activities, general	Any	HSHLD	LogNormal	3.5	1.2	0		2.5	6
10000	Work and other income producing activities, general	Any	LABOR	Triangle	3.6	13.8	8.1			
10000	Work and other income producing activities, general	Any	MACH	Uniform	4	6.5				
10000	Work and other income producing activities, general	Any	PREC	Triangle	2.5	4.5	3.3			
10000	Work and other income producing activities, general	Any	PROF	Triangle	1.2	5.6	2.9			
10000	Work and other income producing activities, general	Any	PROTECT	Triangle	1.2	5.6	2.9			
10000	Work and other income producing activities, general	Any	SALE	Triangle	1.2	5.6	2.9			
10000	Work and other income producing activities, general	Any	SERV	Triangle	1.6	8.4	5.6			
10000	Work and other income producing activities, general	Any	TECH	Triangle	2.5	4.5	2.9			
10000	Work and other income producing activities, general	Any	TRANS	LogNormal	3	1.5	0		1.3	8.4
10000	Work and other income producing activities, general	Any	X	Triangle	1.2	5.6	1.9			
10100	Work, general	Any	X	Triangle	1.2	5.6	1.9			
10110	Work, general, for organizational activities	Any	X	Triangle	1.2	5.6	1.9			

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
10111	Work for professional/union organizations	Any	X	Triangle	1.2	5.6	1.9			
10112	Work for special interest identity organizations	Any	X	Triangle	1.2	5.6	1.9			
10113	Work for political party and civic participation	Any	X	Triangle	1.2	5.6	1.9			
10114	Work for volunteer/ helping organizations	Any	X	Triangle	1.2	5.6	1.9			
10115	Work of/for religious groups	Any	X	Triangle	1.2	5.6	1.9			
10116	Work for fraternal organizations	Any	X	Triangle	1.2	5.6	1.9			
10117	Work for child / youth / family organizations	Any	X	Triangle	1.2	5.6	1.9			
10118	Work for other organizations	Any	X	Triangle	1.2	5.6	1.9			
10120	Work, income-related only	Any	X	Triangle	1.2	5.6	1.9			
10130	Work, secondary (income-related)	Any	X	Triangle	1.2	5.6	1.9			
10200	Unemployment	Any	X	Triangle	1.2	5.6	1.9			
10300	Breaks	Any	Any	Uniform	1	2.5				
11000	Household activities, general	Any	Any	LogNormal	3.6	1.5	0		1.8	7.3
11001	Other household	Any	Any	Exponential	0.3	3			1	9
11100	Prepare food, general	Any	Any	Uniform	2	4				
11101	Washing	Any	Any	Point	3.3	0				
11110	Prepare and clean-up food	Any	Any	Exponential	1.1	1.9			1	4
11120	Cooking	Any	Any	Uniform	2	4				
11121	Baking	Any	Any	Uniform	2	4				
11122	Fry, grill, sautee	Any	Any	Triangle	2.9	4.9	3.4			
11130	Simple food preparation	Any	Any	Uniform	2	3.3				
11131	Cutting/chopping	Any	Any	Point	2.3	0				
11200	Indoor chores, general	Any	Any	Triangle	2	9	3.3			
11210	Move things	Any	Any	Uniform	5	9				
11220	Put things away	Any	Any	Uniform	2.5	3				
11230	Straighten up	Any	Any	Uniform	3.3	4.8				
11231	Make bed	Any	Any	Uniform	2.1	4.6				
11240	Clean-up food	Any	Any	Triangle	2	9	3.3			

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
11300	Outdoor chores, general	Any	Any	LogNormal	4.4	1.4	0		2.4	8
11301	Shoveling	Any	Any	Uniform	5	8.8				
11310	Clean outdoors	Any	Any	Exponential	0.4	2.6			1	6
11320	Chop wood	Any	Any	Uniform	4.5	6.3				
11330	Garden	Any	Any	Normal	4	1.6			1.4	6.6
11331	Harvest	Any	Any	Uniform	3.5	4.5				
11332	Watering	Any	Any	Uniform	1.5	2.5				
11333	Weeding	Any	Any	Uniform	3.5	5				
11340	Lawn/grass	Any	Any	Normal	4	1.1			2.2	5.8
11341	Lawn watering	Any	Any	Point	1.5	0				
11342	Lawn weeding	Any	Any	Uniform	3.5	5				
11343	Mowing	Any	Any	Uniform	2.5	6				
11344	Pruning	Any	Any	Uniform	3.5	4				
11345	Use rake/leaf blower	Any	Any	Uniform	2.5	4				
11350	Load/unload	Any	Any	Point	3.5	0				
11360	Mechanical chores	Any	Any	Uniform	3	4				
11370	Move objects	Any	Any	Uniform	3.3	8				
11400	Care of clothes, general	Any	Any	Triangle	1.3	4	2			
11401	Fold/sort	Any	Any	Uniform	2	2.3				
11410	Wash clothes	Any	Any	Point	2	0				
11411	Hand wash/dry	Any	Any	Uniform	2	4				
11412	Laundry	Any	Any	Uniform	2	4				
11420	Maintain clothes	Any	Any	Triangle	1.3	3.5	1.8			
11421	Mend/sew	Any	Any	Uniform	1.3	2.8				
11422	Press/iron/steam	Any	Any	Uniform	1.8	3.5				
11500	Build a fire	Any	Any	Point	2	0				
11600	Repair, general	Any	Any	Normal	4.5	1.5			2	8
11610	Repair of boat	Any	Any	Point	4.5	0				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
11620	Paint home / room	Any	Any	Exponential	0.7	3.5			1	6
11630	Repair / maintain car	Any	Any	Triangle	3	4.5	3			
11640	Home repairs, general	Any	Any	Uniform	2	6				
11641	Home improvement/construction, moderate level	Any	Any	Uniform	3.8	6				
11642	Home maintenance, low level	Any	Any	Uniform	2	3.3				
11650	Other repairs	Any	Any	Uniform	2	7				
11700	Care of plants, general	Any	Any	Uniform	2	4.3				
11710	Care of plants, low level	Any	Any	Uniform	2	2.5				
11720	Care of plants, moderate level	Any	Any	Point	4.3	0				
11800	Care for pets/animals	Any	Any	Uniform	3	3.5				
11900	Clean house, general	Any	Any	Triangle	2	6.5	3.2			
11901	Collect/empty trash	Any	Any	Uniform	2.4	2.8				
11902	Mop	Any	Any	Uniform	2.4	2.6				
11903	Sweep	Any	Any	Uniform	2.3	3.8				
11904	Vacuum	Any	Any	Uniform	2.3	3.9				
11910	Clean house, heavy	Any	Any	Triangle	2	6.5	3.5			
11911	Clean bathroom	Any	Any	Uniform	2	6.5				
11912	Clean carpet	Any	Any	Triangle	2	6.5	3.5			
11913	Clean floors	Any	Any	Uniform	2	6.5				
11914	Clean kitchen	Any	Any	Uniform	3.1	4.4				
11915	Wash windows	Any	Any	Uniform	3.2	3.5				
11920	Clean house, light	Any	Any	Uniform	2.3	3.8				
11921	Dust	Any	Any	Uniform	1.5	2.9				
11922	Use aerosol cleaner/freshener	Any	Any	Uniform	2.3	3.8				
12000	Child care, general	Any	Any	Uniform	2	5.8				
12100	Care of baby	Any	Any	Uniform	3	3.5				
12200	Care of child	Any	Any	Uniform	3	3.5				
12300	Help / teach	Any	Any	Uniform	2.5	3				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
12400	Talk /read	Any	Any	Uniform	2.5	3				
12500	Play indoors	Any	Any	Uniform	2.5	3				
12600	Play outdoors	Any	Any	Uniform	4	5				
12700	Medical care-child	Any	Any	Uniform	3	3.3				
12800	Other child care	Any	Any	Uniform	2.5	3.5				
13000	Obtain goods and services, general	Any	Any	Triangle	2	6	3.4			
13100	Dry clean	Any	Any	Uniform	2.5	4				
13200	Shop/run errands, general	Any	Any	Triangle	2.3	4.3	3.3			
13201	Errands for children or pets	Any	Any	Triangle	2.3	4.3	3.3			
13202	Shopping, general	Any	Any	Triangle	2.3	4.3	3.3			
13203	Shop at mall or superstore	Any	Any	Triangle	2.3	4.3	3.3			
13210	Shop for food, general	Any	Any	Triangle	2.3	4.3	3.3			
13211	Grocery shopping	Any	Any	Triangle	2.3	4.3	3.3			
13212	Shop for meals/snacks	Any	Any	Triangle	2.3	4.3	3.3			
13220	Shop for clothes or household goods	Any	Any	Uniform	2.3	4.5				
13230	Run errands	Any	Any	Uniform	2.5	4.5				
13300	Obtain personal care service	Any	Any	Uniform	2.5	4.5				
13400	Obtain medical service	Any	Any	Uniform	2.5	4.5				
13500	Obtain government / financial services	Any	Any	Uniform	2.5	4.5				
13600	Obtain car services	Any	Any	Uniform	2.5	4.5				
13700	Other repairs	Any	Any	Uniform	2.5	4.5				
13800	Other services	Any	Any	Uniform	2.5	4.5				
14000	Personal needs and care, general	Any	Any	Uniform	1	2.3				
14001	Wake up	Any	Any	Uniform	0.9	1.4				
14100	Shower, bathe, personal hygiene	Any	Any	Normal	2	0.3			1	4
14110	Shower, bathe, general	Any	Any	Uniform	1.5	2				
14111	Bathe	Any	Any	Point	1.5	0				
14112	Shower	Any	Any	Point	2	0				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
14120	Personal hygiene, general	Any	Any	Uniform	1.8	2				
14121	Use restroom	Any	Any	Point	1.8	0				
14122	Wash hands/teeth/face	Any	Any	Uniform	1.6	2.5				
14200	Medical care, general	Any	Any	Uniform	1	1.5				
14201	Use nebulizer/oxygen machine	Any	Any	Uniform	1	2.3				
14210	Feel sick	Any	Any	Uniform	1	1.3				
14300	Help and care	Any	Any	LogNormal	3	1.2	0		2.5	5
14400	Eat	Any	Any	Uniform	1.5	2				
14500	Sleep or nap	Any	Any	LogNormal	0.9	1.1	0		0.8	1.1
14600	Dress, groom	Any	Any	Point	2.5	0				
14700	Other personal needs	Any	Any	Triangle	1	2.9	2.1			
15000	General education and professional training	Any	Any	LogNormal	1.8	1.4	0		1.4	4
15100	Attend full-time school	Any	Any	Uniform	1.4	2.8				
15110	Attend day-care	Any	Any	Uniform	1.5	3				
15120	Attend K-12	Any	Any	Uniform	1.4	2.8				
15130	Attend college or trade school	Any	Any	Uniform	1.4	2.5				
15140	Attend adult education and special training	Any	Any	Uniform	1.4	2.2				
15200	Attend other classes	Any	Any	Uniform	1.4	3				
15300	Do homework	Any	Any	Point	1.8	0				
15400	Use library	Any	Any	Uniform	1.5	3				
15500	Other education	Any	Any	Uniform	1.5	4				
16000	Social activities, general	Any	Any	Triangle	1	7.8	1.8			
16001	Gamble	Any	Any	Uniform	1.4	2				
16002	Go to park or festival	Any	Any	Uniform	1.8	3.5				
16100	Attend sports events	Any	Any	Uniform	1.4	4				
16200	Participate in social, political, or religious activities	Any	Any	Uniform	1.4	2				
16210	Practice religion	Any	Any	Uniform	1.4	2				
16300	Watch movie	Any	Any	Uniform	1	1.6				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
16400	Attend theater	Any	Any	Uniform	1	2.3				
16500	Visit museums	Any	Any	Uniform	2	2.9				
16600	Visit	Any	Any	Uniform	1	1.9				
16700	Attend a party, general	Any	Any	Triangle	1.5	7.8	1.5			
16701	Attend a party, dance	Any	Any	Point	7.8	0				
16702	Attend a party, eat/drink	Any	Any	Uniform	1.5	2				
16703	Attend a party, sit/stand	Any	Any	Uniform	1.5	2.5				
16704	Attend a party, talk	Any	Any	Uniform	1.8	2				
16705	Attend a party, walk	Any	Any	Point	2	0				
16800	Go to bar / lounge	Any	Any	LogNormal	3	1.5	0		1.5	8
16900	Other entertainment / social events	Any	Any	Uniform	1.5	6				
17000	Leisure, general	Any	Any	LogNormal	5.7	1.8	0		2.2	15
17010	Indoor leisure	Any	Any	LogNormal	5.7	1.8	0		2.2	15
17111	Hunting, fishing, hiking	20	Any	Normal	5.6	2.1			1.4	9.8
17111	Hunting, fishing, hiking	30	Any	Normal	5.8	2.4			1	10.6
17111	Hunting, fishing, hiking	40	Any	Normal	4.7	1.8			1.1	8.3
17112	Golf	20	Any	Uniform	2	5.5				
17112	Golf	30	Any	Uniform	2	5.5				
17112	Golf	40	Any	Uniform	2	5				
17113	Bowling / pool / ping pong / pinball	Any	Any	Uniform	2	4				
17114	Yoga	Any	Any	Triangle	1.4	4	3.9			
17120	Participate in outdoor leisure	20	Any	LogNormal	3.9	1.4	0		2	9
17120	Participate in outdoor leisure	30	Any	LogNormal	3.9	1.4	0		2	9
17120	Participate in outdoor leisure	40	Any	Point	3.5	0				
17121	Passive, sitting	Any	Any	Uniform	1.2	1.8				
17140	Create art, music, participate in hobbies	20	Any	Normal	5.3	1.8			1.7	8.9
17140	Create art, music, participate in hobbies	30	Any	Normal	5.2	1.7			1.7	8.9
17140	Create art, music, participate in hobbies	40	Any	Normal	3.8	1			1.8	5.8

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
17141	Participate in hobbies	Any	Any	Triangle	1.5	5	1.9			
17142	Create domestic crafts	Any	Any	Triangle	1.5	3	1.5			
17143	Create art	Any	Any	Uniform	2	3				
17144	Perform music / drama / dance	20	Any	Normal	5.3	1.8			1.7	8.9
17144	Perform music / drama / dance	30	Any	Normal	5.2	1.7			1.7	8.9
17144	Perform music / drama / dance	40	Any	Normal	3.8	1			1.8	5.8
17150	Play, unspecified, general	Any	Any	Uniform	2.2	5.8				
17151	Play, unspecified, low level	Any	Any	Uniform	2.2	2.8				
17152	Play, unspecified, moderate level	Any	Any	Uniform	3.5	5.8				
17160	Use of computers	Any	Any	Uniform	1.2	2				
17170	Participate in recess and physical education	Any	Any	Uniform	2	8				
17180	Other sports and active leisure, general	Any	Any	LogNormal	5.7	1.8	0		2.2	15
17200	Passive leisure, general	Any	Any	Uniform	1	1.8				
17201	Indoor passive leisure	Any	Any	Uniform	1	1.8				
17210	Watch	Any	Any	Uniform	1.2	1.8				
17211	Watch adult at work	Any	Any	Uniform	1.2	1.8				
17212	Watch someone provide childcare	Any	Any	Uniform	1.2	1.8				
17213	Watch personal care	Any	Any	Uniform	1.2	1.8				
17214	Watch education	Any	Any	Uniform	1.2	1.8				
17215	Watch organizational activities	Any	Any	Uniform	1.2	1.8				
17216	Watch recreation	Any	Any	Uniform	1.4	4				
17220	Listen to radio / listen to recorded music / watch T.V.	Any	Any	LogNormal	1.2	1.4	0		0.9	2.3
17221	Listen to radio	Any	Any	Uniform	1	1.3				
17222	Listen to recorded music	Any	Any	Uniform	1.5	2.3				
17223	Watch TV	Any	Any	Point	1	0				
17230	Read, general	Any	Any	Uniform	1	1.6				
17231	Read books	Any	Any	Uniform	1	1.6				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
17232	Read magazines / not ascertained	Any	Any	Uniform	1	1.6				
17233	Read newspaper	Any	Any	Uniform	1	1.6				
17240	Converse / write	Any	Any	Uniform	1	1.8				
17241	Converse	Any	Any	Uniform	1	1.8				
17242	Write for leisure / pleasure / paperwork	Any	Any	Uniform	1	1.8				
17250	Think and relax	Any	Any	Uniform	1	1.3				
17260	Other passive leisure	Any	Any	Uniform	1.5	2.3				
17300	Other leisure	Any	Any	Uniform	1.2	1.8				
17400	Walk, bike, or jog (not in transit), general	Any	Any	LogNormal	5.8	1.7	0		2.4	14.1
17410	Bike, general	Any	Any	LogNormal	8	1.6	0		3.9	15
17411	Bike	Any	Any	LogNormal	8.3	1.6	0		3.9	15
17412	Cycles, other	Any	Any	Point	5	0				
17413	Tricycle	Any	Any	LogNormal	8	1.6	0		3.9	15
17420	Run or jog, general	Any	Any	LogNormal	11.3	1.5	0		6	15
17421	Run around, casual	Any	Any	Uniform	5.8	8.3				
17422	Running, vigorous/sustained	Any	Any	Uniform	9	13.3				
17430	Walk, general	Any	Any	LogNormal	4	1.6	0		1.9	8.4
17431	Crawl	Any	Any	LogNormal	4	1.6	0		1.9	8.4
17432	Use of walker	Any	Any	LogNormal	4	1.6	0		1.9	8.4
17433	Walk dog	Any	Any	LogNormal	4	1.6	0		1.9	8.4
17434	Walk for chores	Any	Any	LogNormal	4	1.6	0		1.9	8.4
17435	Walk inside	Any	Any	Uniform	1.5	2.6				
17500	Participate in sports, general	Any	Any	LogNormal	7	1.5	0		3.6	13.7
17501	Archery	Any	Any	Point	4.3	0				
17502	Equestrian sports	Any	Any	Uniform	3.8	8				
17503	Frisbee	Any	Any	Uniform	3	8				
17504	Gymnastics	Any	Any	Point	3.8	0				
17505	Skateboarding	Any	Any	Uniform	5	6				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
17506	Skating	Any	Any	Uniform	5.5	14				
17507	Track	Any	Any	Uniform	4	10				
17510	Combat sports	Any	Any	Uniform	5.3	12.8				
17511	Boxing	Any	Any	Uniform	5.5	12.8				
17512	Fencing	Any	Any	Point	6	0				
17513	Martial arts	Any	Any	Uniform	5.3	10.3				
17514	Wrestling	Any	Any	Uniform	5.3	12.8				
17520	Racquet sports	Any	Any	LogNormal	7	1.3	0		4.3	11.2
17521	Badminton	Any	Any	Uniform	5.5	7				
17522	Racquetball	Any	Any	Uniform	7	10				
17523	Squash	Any	Any	Uniform	7.3	12				
17524	Tennis	Any	Any	Uniform	4.5	8				
17530	Team sports	Any	Any	Normal	6.7	2.2			3.2	10.3
17531	Baseball	Any	Any	Normal	6.7	2.2			3.2	10.3
17532	Basketball	Any	Any	Uniform	4.5	9.3				
17533	Cheerleading	Any	Any	Point	6	0				
17534	Dodgeball	Any	Any	Point	5.8	0				
17535	Football	Any	Any	Uniform	2.5	8				
17536	Hockey	Any	Any	Uniform	7.8	10				
17537	Kickball	Any	Any	Point	7	0				
17538	Lacrosse	Any	Any	Point	8	0				
17539	Rugby	Any	Any	Uniform	6.3	8.3				
17541	Soccer	Any	Any	Uniform	7	10				
17542	Softball	Any	Any	Uniform	4	6				
17543	Volleyball	Any	Any	Uniform	3	8				
17550	Water sports	Any	Any	Uniform	3	13.8				
17551	Surfing	Any	Any	Uniform	3	5				
17552	Swimming	Any	Any	Uniform	4.8	13.8				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
17560	Winter sports	Any	Any	Uniform	4.3	15.5				
17600	Play games, general	Any	Any	LogNormal	2.6	1.7	0		1.1	6
17610	Active games	Any	Any	Uniform	3.5	6				
17611	Fighting	Any	Any	Point	6	0				
17612	Running games	Any	Any	Uniform	3.5	5.8				
17613	Trampoline	Any	Any	Uniform	3.5	4.5				
17620	Board games/card games	Any	Any	Point	1.5	0				
17621	Board games	Any	Any	Point	1.5	0				
17622	Bingo	Any	Any	Point	1.5	0				
17623	Card games	Any	Any	Uniform	1.4	2				
17630	Dress-up/make believe	Any	Any	Uniform	3.5	5.8				
17640	Low energy games	Any	Any	Triangle	1.3	3.5	2.8			
17641	Arts and crafts	Any	Any	Uniform	2.5	3.5				
17642	Play with books	Any	Any	Point	1.3	0				
17643	Writing/drawing	Any	Any	Point	1.8	0				
17650	Outdoor play	Any	Any	Uniform	3.5	5.8				
17651	Playground/swings	Any	Any	Normal	5.7	1.3			3.6	5.7
17660	Play with animals	Any	Any	Uniform	2.5	5				
17670	Puzzles	Any	Any	Uniform	1.3	2.2				
17671	Jigsaw puzzle	Any	Any	Point	2.2	0				
17672	Word puzzle	Any	Any	Point	1.3	0				
17680	Toys	Any	Any	Uniform	2.2	3.5				
17681	Toy balls	Any	Any	Uniform	2.8	3.5				
17690	Video games	Any	Any	Uniform	1	2.3				
17691	Active video games	Any	Any	Point	2.3	0				
17692	Computer games	Any	Any	Normal	1	0.2			1	1.4
17700	Active leisure, general	Any	Any	Normal	5.8	2.5			1.8	9.9
17701	Camping	Any	Any	Point	2.5	0				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
17702	Caving/rock climbing	Any	Any	Uniform	5	8				
17703	Climb trees/structures	Any	Any	Normal	5.8	2.5			1.8	9.9
17710	Dance	Any	Any	Uniform	3	11.3				
17720	Hiking	Any	Any	Uniform	5.3	7.8				
17730	Horseback riding	Any	Any	Uniform	3.8	9				
17740	Water recreation	Any	Any	LogNormal	4.9	1.8	0		1.9	12.3
17741	Boating	Any	Any	Uniform	1.3	4				
17742	Recreational swim	Any	Any	Point	6	0				
17743	Scuba diving	Any	Any	Point	7	0				
17800	Exercise, general	Any	Any	LogNormal	6.1	1.6	0		2.9	13.1
17810	Cardiovascular exercise	Any	Any	LogNormal	7.4	1.4	0		4	13.5
17811	Aerobics	Any	Any	Uniform	3.5	10				
17812	Bike for exercise	Any	Any	Uniform	3.5	14				
17813	Run or jog for exercise	Any	Any	Point	9	0				
17814	Swim for exercise	Any	Any	Uniform	4.8	13.8				
17815	Walk for exercise	Any	Any	Uniform	4.3	9.5				
17820	Strength/stretching	Any	Any	Uniform	2.3	8				
17821	Lift weights	Any	Any	Uniform	3.5	6				
17822	Physical therapy	Any	Any	Point	2.8	0				
17823	Stretching	Any	Any	Uniform	2.3	2.8				
18000	Travel, general	Any	Any	Uniform	1.3	4				
18010	Travel by bus, general	Any	Any	Point	1.3	0				
18020	Travel by foot, general	Any	Any	Uniform	2.5	4				
18030	Travel by motor vehicle, general	Any	Any	Uniform	1.3	3.5				
18031	Drive a motor vehicle, general	Any	Any	Uniform	2	3.5				
18032	Ride in a motor vehicle, general	Any	Any	Point	1.3	0				
18040	Wait, general	Any	Any	Uniform	1.3	1.8				
18100	Travel during work, general	Any	Any	Uniform	1.3	4				

Table 5-1. Activity-specific MET Distributions

Activity Code	Activity Description	Age	Occ	Shape	Par1	Par2	Par3	Par4	LTrunc	UTrunc
18110	Travel during work by bus	Any	Any	Point	1.3	0				
18120	Travel during work by foot	Any	Any	Uniform	2.5	4				
18130	Travel during work by motor vehicle	Any	Any	Uniform	1.3	3.5				
18131	Travel during work, drive a motor vehicle	Any	Any	Uniform	2	3.5				
18132	Travel during work, ride in a motor vehicle	Any	Any	Point	1.3	0				
18140	Travel during work, wait	Any	Any	Uniform	1.3	1.8				
18200	Travel to/from work, general	Any	Any	Uniform	1.3	4				
18210	Travel to/from work by bus	Any	Any	Point	1.3	0				
18220	Travel to/from work by foot	Any	Any	Uniform	2.5	4				
18230	Travel to/from work by motor vehicle	Any	Any	Uniform	1.3	3.5				
18231	Travel to/from work, drive a motor vehicle	Any	Any	Uniform	2	3.5				
18232	Travel to/from work, ride in a motor vehicle	Any	Any	Point	1.3	0				
18240	Travel to/from work, wait	Any	Any	Uniform	1.3	1.8				
18300	Travel for education, general	Any	Any	Uniform	1.3	4				
18310	Travel for education by bus	Any	Any	Point	1.3	0				
18320	Travel for education by foot	Any	Any	Uniform	2.5	4				
18330	Travel for education by motor vehicle	Any	Any	Uniform	1.3	3.5				
18331	Travel for education, drive a motor vehicle	Any	Any	Uniform	2	3.5				
18332	Travel for education, ride in a motor vehicle	Any	Any	Point	1.3	0				
18340	Travel for education, wait	Any	Any	Uniform	1.3	1.8				
U	Uncertain	Any	Any	Point	2	0				
X	Missing	Any	Any	Point	2	0				

Notes: The bolded entries correspond to "Tier 1" activity. Left-justified entries that are not bolded correspond to Tier 2 codes. Single-indented entries correspond to Tier 3 codes. Double-indented entries correspond to the Tier 4 codes. See Table 5-2 for descriptions of the parameters of this table. LTrunc and UTrunc, respectively, are the lower and upper truncation limits of the distributions based on available data and professional judgment.

Table 5-2. Relevant Shapes of Probability Distributions

Distribution	Par1	Par2	Par3	Par4
Exponential	Decay constant, k > 0	Shift (a)		
Lognormal	Geometric mean (gm) of unshifted dist	Geometric standard deviation (gsd) > 1	Shift (a)	
Normal	Mean	Standard deviation		
Point	Point Value			
Triangle	Minimum	Maximum	Peak	
Uniform	Minimum	Maximum		

6. Development of Weather Data for CHAD

Weather data were developed during the studies, or were developed as part of a study's data synthesis after the diaries were collected, for five studies in the current (November 2016) CHAD—DEA, NSA, OAB, SEA, and VAL. Weather data were developed for the purposes of integration into CHAD for at least three other studies— BLS, EPA, and RTP. Details on the weather data produced for the above eight studies, where available from supporting materials, are summarized below in Table 6-1 as well as in the relevant subsections of Appendix A. CHAD contains at least some weather data for the remaining studies, but the origin of those CHAD weather data is not certain based on supporting documentation. Across the whole CHAD (as of November 2016), approximately one-third of diary-days have no weather data, impacting many of the studies in CHAD. Most of these cases of missing weather data correspond to missing or nonspecific location data, although a diary-day having missing or nonspecific location data does not necessarily mean it will have missing weather data. Please refer to Table 6-1 and the study discussions in Appendix A for further details.

Table 6-1. CHAD Weather Data

Study Name	Data Collected During Study?	Study's Data Used in CHAD-Master?	Data Developed Specifically for CHAD-Master?
Baltimore Retirement Home Study (BAL)	No	N/A	No
American Time Use Survey (ATUS), Bureau of Labor Statistics (BLS)	No	N/A	Derived by ICF using primary and secondary NOAA stations (matched to diary counties based on proximity).
California Activity Pattern Studies (CAA, CAC, CAY)	N/A	N/A	N/A
Cincinnati Activity Patterns Study (CIN)	N/A	N/A	N/A
Detroit Exposure and Aerosol Research Study (DEA)	Yes	N/A	No
Denver, Colorado Personal Exposure Study (DEN)	N/A	N/A	N/A
EPA Longitudinal Studies (EPA)	No	N/A	Derived by ICF using primary and secondary NOAA stations (matched to diary counties based on proximity).
Population Study of Income Dynamics (PSID) I, II, III (ISR)	N/A	N/A	N/A
Los Angeles Ozone Exposure Study: Elementary School/High School (LAE/LAH)	N/A	N/A	N/A
National Human Activity Pattern Study (NHAPS): Air/Water (NHA/NHW)	N/A	N/A	N/A
National-scale Activity Study (NSA)	Yes	Yes	No
RTI Ozone Averting Behavior Study (OAB)	Yes	Yes	No
RTP Particulate Matter Panel Study (RTP)	No	N/A	Derived by Alion Science and Technology Corp. from Raleigh-Durham International Airport (RDU).(NOAA ISD)
Seattle Study (SEA)	Yes	Yes	No
Study of Use of Products and Exposure-related Behaviors (SUP)	N/A	N/A	N/A
Valdez Air Health Study (VAL)	Yes[a]	Yes	No
Washington, DC Study (WAS)	N/A	N/A	N/A

Note: NOAA = National Oceanic and Atmospheric Administration; ISD = Integrated Surface Database. "N/A" indicates that information from supporting materials is either not available or sufficiently clear to provide correct responses in this table.

[a]Rainfall was not included in the VAL data collection.

7. Contact Information

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Appendix A: Human-activity Studies in CHAD-Master

A.1. Introduction

Listed below are sources of information, mostly unpublished, that were used to prepare the activity-study summaries in this appendix. Additional study-specific references are included in the References section for each study. These documents are available from the EPA CHAD point of contact (currently Dr. Stephen Graham).

- CHAD_Manual—the CHAD User's Guide prepared for EPA by ManTech Environmental Technology, Inc. in 2000, updated by the Systems Development Center in 2002
- NERL (National Exposure Research Laboratory). 1997. Development of a consistent & consolidated human activity data base. Prepared for U.S. Environmental Protection Agency by ManTech Environmental Technology, Inc.
- MultiCityCoding—Document for the Multicity Activity Data Base; prepared for EPA by International Technology Air Quality Services in 1991
- EPA. 2014. Health risk and exposure assessment for ozone, final report, Chapter 5 appendices. EPA-452/R-14-004c.

A.2. CHAD QA Procedures

Diary QA

For many of the studies in CHAD, SAS® or other code is used to process diary data into CHAD. During this process of importing diary data into CHAD, the data being imported and sometimes all of the CHAD-Master data are subjected to the QA checks listed below.

- Check for events lasting less than 1 minute or more than 60 minutes, based on the start time of the event and the start time of the next event. Can reveal errors in coding times or dates, and can reveal missing event breaks at the top of the hour.
- Check for more than 24 hours in a day. Can reveal further errors in date coding and incorrectly placed hour breaks (hour breaks placed before last event in the hour; for example, if diary had events at 6:45, 6:50, and 7:10, an hour break may have been added for 7:00, but placed incorrectly between the 6:45 and 6:50 event).
- Check that all hour breaks are present and in the correct order. Can identify some errors that for various reasons were not previously identified by the above tests. Such errors in the hour-break events can be due to software (e.g., due to Microsoft® Excel automatically incrementing the values of location and activity codes for adjacent events).

- Check for valid location and activity codes.

- Check for improper activity/location pairs; specifically, travel should not occur at home and outdoor activities should not occur indoors at home. Examples of how such errors originated might include: a coder might have automated the activity "unpack" to be outdoor chores, irrespective of where it occurred; when the diary said "Home" as the location for an outdoor activity (such as unloading a car or doing yard work), the location might have automatically been coded as "indoor your residence" irrespective of activity; or, a coder might link the "outdoor home" location incorrectly to the code for "dining room".

Data-quality Indicators

Data-quality indicators are used to indicate potential problems with data content. Listed below are the two classes of such problems that can arise in CHAD.

- Data are present but outside the allowable range. If "clean" study data sets are incorporated into CHAD, this type of error should rarely occur, but such errors will occasionally be found. When these errors are detected, either they are corrected when the data are incorporated into CHAD (if possible) or the values are deleted.

- Data are present and the values are within allowable range, but are deemed to be of poor quality by a researcher or analyst. This is the most difficult type of problem to resolve when incorporating study data into CHAD.

Some of the problems with data content can be identified by using the descriptive variables and data-quality flags present in CHAD. The descriptive variables RECCOUNT and WRAPTIME are discussed below. Beyond those descriptive variables, CHAD has two main types of quality indicators: variables whose names start with "QF" are binary pass/fail quality flags, and those starting with "QC" indicate how often a condition was met within the diary. Flagged diaries have not been modified. It is left to the CHAD user to correct or otherwise account for flagged records. To resolve the quality issues being flagged, an analyst would examine each flagged diary in detail to determine whether changes should be made. For example, some diaries do not report any sleep time or any meals in a 24-hour period; these can be identified by using the QCSLEEP and QCMEALS flags. It is left to the user to determine which flags are important and whether or not a diary is acceptable.

The data from some studies underwent other or additional QA measures when coded into CHAD, and those study-specific measures are discussed in the individual study sections in this appendix.

Descriptive Variables

There are several descriptive variables that are a part of CHAD and can be used for QA purposes. These include RECCOUNT and WRAPTIME, which are described below.

RECCOUNT. For a given study respondent, RECCOUNT is the number of individual activity records in a diary-day, as mapped into CHAD from the study's original dataset. A small number of reported activities over a 24-hour period may be a sign of poor or unreliable diaries. Some activity databases delete diaries that contain fewer than some specified number of entries

(records), but any specific number of entries would represent an arbitrary standard. Using the RECCOUNT variable as a filter, the CHAD user can select any desired minimum number. Note that all diary-days have at least 24 records because there is one or more for every hour.

WRAPTIME. WRAPTIME is discussed in Section 3.1. It is the time at which a 24-hour diary actually started in the study's original dataset. For consistency, all of the diary-days in CHAD are organized into a midnight-to-midnight form and no CHAD event record crosses the boundary between one clock hour and another. These hour and midnight requirements mean that some original diary records were split at the hour boundary or at midnight, creating two records in CHAD when there originally was one record. The WRAPTIME variable indicates if this has been done, showing the actual start time of the diary using a 24-hour time convention. For wrapped diaries, the date and the weekday given in CHAD represent the day that contained more than 12 hours of time.

Quality-flag (QF) Variables

Variables whose names start with "QF" are binary pass/fail quality flags. The QF variables QFACTLOC, QFTRAVEL, QFINFER, and QFMETAB are discussed below. The flagged diaries have not been modified. It is left to the CHAD user to correct or otherwise account for flagged records. To resolve the quality issues being flagged, an analyst would examine each flagged diary in detail to determine whether changes should be made.

QFACTLOC. QFACTLOC indicates inconsistent activity-location pairs in the diary. Each record in the events portion of CHAD contains both an activity code and a location code. Certain activities are not compatible with certain locations. For example, travel activities (i.e., activity codes 18000 and over) should not take place in one's home (i.e., location codes less than 31000). Since certain activity-location combinations are unlikely but not impossible, the identification of suspect combinations will always be partly subjective. The total amount of time that QFACTLOC is "on" in each diary is summarized in the variable QCACTLOC (see below).

QFTRAVEL. One of the logical constraints on a valid activity diary is that travel to a remote location (such as a workplace) should be roughly matched in duration by a later return trip (i.e., should create a round-trip travel). There are complicating factors such as traffic jams, running errands, and so on which may result in differing travel times. Another difficulty arises from trying to identify each leg of the round-trip travel. Without examining all the diaries individually, an attempt at flagging potential travel inconsistencies was made. The QFTRAVEL variable flags those person-days that meet the four conditions listed below.

- The person is employed outside the home
- The sampled day is a weekday (Monday–Friday)
- The total travel time in the morning rush hours (6–9 AM) differs by more than a factor of 2 from the evening rush hour (4–7 PM) travel time
- Either the morning or evening travel time was at least 30 minutes.

The travel time used is the travel time to/from work (Activity=182* in the current [November 2016] CHAD, if recorded) plus the time for unspecified travel (Activity=180*).

QFINFER. All data in CHAD is faithful to the original raw data. If the original data contained gaps in time, or missing activity or location codes, then these show up as CHAD records with missing codes (Activity="X" and/or Location="X"). At some point, it might be desirable to assign inferred activities in place of the missing data. If this is done, then the QFINFER flag will be set to indicate this, and the user will have the option of "turning off" the changes. Similarly, diaries with no missing time might be altered (to add meals or sleep time, for instance), and the QFINFER flag would then be used to indicate this condition. The cumulative variable QCINFER indicates the total time per diary with QFINFER=1 (see below).

QFMETAB. A distribution of possible values for MET is associated with each activity. The QFMETAB flag indicates those activities for which the median value in the distribution is greater than or equal to 3. These activities will have an effect on the breathing rates of subsequent activities through the process of excess post-exercise oxygen consumption. The total amount of time per diary with QFMETAB set to "on" is recorded in the count variable QCMETAB (see below).

Quality-count Variables

Besides quality flags, the other type of quality indicators use the prefix "QC". These variables are counts (usually of time) indicating how often within a diary some condition was met. For example, the variable QCSLEEP records the number of hours of sleep time in each diary-day and can be used to select diaries that contain sleep durations within a desired range. These indicators are discussed below.

QCSLEEP. The only two activities that are expected in each diary-day are sleeping and eating. For sleeping, the daily total time (rounded to the nearest whole number of hours) is recorded in the variable QCSLEEP, which appears with the questionnaire data. Diary-days with little or no reported sleep time should probably be examined more closely to allow the analyst to decide on their reliability.

QCMISS. CHAD is divided into person-days that contain exactly 24 hours of consecutive diary data. In some cases, the original data did not span a full 24 hours or contained one or more time gaps with no recorded activities. The total amount (in minutes) of such time is recorded in the QCMISS variable, so that the CHAD user can use filtering to eliminate incomplete diaries.

QCMEALS. A meal is defined as one or more consecutive records of eating activity. Two meals must be separated by at least one non-eating activity. Examination of the diaries shows that eating is not reported in some cases because it is subsumed under some other activity (e.g., visiting a friend or relative for a very long period of time). Eating may also take place while watching television or traveling. Excessive eating (more than 6 hours per day) might also occur. The diaries are flagged but are not excluded because of unusual eating patterns. The analyst must decide on the appropriateness of using any of these diaries.

QCLONG. Some diaries report a single activity (meaning that both the activity and location codes do not change) lasting 10 hours or more. The duration in minutes of the longest such activity is recorded in the variable QCLONG for each diary. Diaries with large values (e.g., greater than 600 minutes) for QCLONG could be examined to determine whether or not the diary appears complete.

QF Summaries

The remaining quality variables listed below provide time summaries of other flags. This allows the CHAD user to exclude diaries on the basis of thresholds of time flagged in each category.

QCACTLOC. Total time (minutes) in diary with QFACTLOC flag set to "on"

QCEATIME. Total time (minutes) in diary spent eating

QCINFER. Total time (minutes) in diary with QFINFER set to "on"

QCMETAB. Total time (minutes) in diary with QFMETAB set to "on"

QCHEAVY. Total time (minutes) in diary with HEAVYBR=1 (heavy breathing). The definition of heavy breathing is subjective and not consistent across individuals or across studies. Nevertheless, this flag is provided so that the user can quickly find those diaries that are likely to represent active individuals. The fields QFMETAB and QCMETAB give similar information.

A.3. American Time Use Survey (ATUS), Bureau of Labor Statistics (BLS)

The U.S. Census Bureau (for the Bureau of Labor Statistics (BLS)) conducts the American Time Use Survey (ATUS) on an annual basis for U.S. people aged 15 years or older. ATUS data from 2003 through 2011 are incorporated into CHAD-Master as described in an EPA (2014) internal report, amounting to 124,517 diary-days of human-activity and location data.

Data Transfer

Source of Study Data. The ATUS measures the amount of time respondents spend doing various paid and unpaid activities. ATUS is sponsored by the BLS and conducted by the U.S. Census Bureau. The Census Bureau collects and processes the survey data. ATUS raw data (diary information and demographic information) can be downloaded from the ATUS website (http://www.bls.gov/tus/) (BLS, 2016). The current CHAD-Master uses data from 2003 through 2011.

Format of Data Provided. ATUS multi-year microdata files (both diary information and demographic information) that combine data for 2003 through 2011 were downloaded from the ATUS website (see http://www.bls.gov/tus/datafiles_0311.htm) and processed for use in CHAD-Master. Multi-year ATUS data dictionaries contain more information on the variables included in the Current Population Survey (CPS)[1] and Respondent files and describe differences in content for the multi-year versus single-year files; these data dictionaries can also be accessed at the ATUS website cited above. Multi-year data files are now available for download for years beyond 2011 (see http://www.bls.gov/tus/datafiles_my.htm), but they are not currently included in the CHAD-Master.

Incorporating ATUS (BLS) into CHAD-Master

- **Source—** http://www.bls.gov/tus/ for 2003-2011
- **Data format**—multi-year comma-delimited .dat text files
- **Data gathering**—24-hour recall data collected by telephone interview combining structured questions and conversational interviewing
- **Final CHAD-Master ATUS data set**—ATUS added 124,517 diary-days of human-activity and location data to CHAD-Master

The multi-year files processed for CHAD-Master include the following CSV .dat text files, accompanied by other programs to work with statistics software.

- ATUS Activity file (atusact_0311.dat)
- ATUS CPS file (atuscps_0311.dat)

[1] The Current Population Survey (CPS) is a monthly survey of households conducted by the Census Bureau for the BLS. It provides a comprehensive body of data on the labor force, employment, unemployment, persons not in the labor force, hours of work, earnings, and other demographic and labor force characteristics (http://www.bls.gov/cps/home.htm).

- ATUS Well-being Module file (wbresp_1013.dat)
- ATUS Respondent file (atusresp_0311.dat)

The above files were linked by using TUCASEID (the variable used to identify each household) and TULINENO (the variable used to identify each individual within the household). All coding of the ATUS data into CHAD-Master was performed in SAS®.

Study Details

The major goal of ATUS is to provide nationally representative estimates of how people spend their time, with whom they spend their time, and where they spend their time (BLS, 2014). The geographic coverage of the ATUS is the US, and study respondents must be at least 15 years old. Study dates are January 2003 through December 2013 (as noted above, 2003 through 2011 are incorporated into CHAD-Master). Thus far, ATUS data files have been collected from over 148,000 interviews. ATUS records the amount of time respondents spend doing various paid and unpaid activities. Unpaid activities of individuals might include childcare, housework, volunteering, religious activities, socializing, exercising, and relaxing. Collected demographic information of respondents includes gender, race, age, educational attainment, occupation, income, marital status, and presence of children in the household (BLS, 2014). The ATUS raw data (both diary information and demographic information) for 2003 through 2013 can be downloaded from the ATUS website (http://www.bls.gov/tus/home.htm). Households that have completed their final (eighth) month of the CPS can participate in the ATUS. Households that are selected from this group represent a range of demographic characteristics. One person at least 15 years old is randomly chosen from each selected household to answer questions about time use. This person is interviewed for the ATUS 2 to 5 months after the household's final CPS interview. ATUS respondents are interviewed only one time about how, where, and with whom they spent their time on the day before the interview (diary-day). The "designated person" is interviewed about his or her activities using Computer Assisted Telephone Interviewing (CATI). Active military personnel and people residing in institutions such as nursing homes and prisons are not surveyed (BLS, 2014).

Recall versus Real-time Diary. During the ATUS interview, respondents are asked to recall how they spent the past 24 hours. Specifically, activities starting at 4 AM. the previous day and ending at 4 AM on the interview day are described. For each activity, respondents are asked how long the activity lasted (in minutes), where they were when these activities occurred (except for personal care activities such as sleeping and grooming), and who was in the room with them (if at home) or who accompanied them (if away from home) (except for personal care activities and work). If respondents report doing more than one activity at a time, they are asked to identify which one was the primary activity; if a primary activity cannot be identified, then the first activity mentioned is the activity recorded. After completing the time diary, respondents are asked additional questions to clarify work, volunteering, and secondary childcare activities (i.e., caring for a child under 13 years old while doing another activity) (BLS, 2014).

Limitations of ATUS include the following (BLS, 2014).

- With the exception of childcare, information on secondary activities (activities done at the same time as the primary activity) is not recorded. This might result in underestimates of the amount of time respondents spend doing activities that are frequently done in combination

with other activities (e.g., listening to music).

- Lack of specificity for location data (e.g., distinction between indoor and outdoor locations at home) and lack of consistent commuting information could impact analyses using these data.

- Non-sampling errors that may occur—e.g., inability to obtain information from all sampled households, data entry or coding errors, and misinterpretation of definitions—are not measured as part of ATUS; however, the Census Bureau uses QA procedures to minimize non-sampling data entry and coding errors in survey estimates.

Time Resolution of Questionnaire. For the ATUS interview, respondents are asked to recall how they spent the past 24 hours—specifically, activities starting at 4 AM the previous day and ending at 4 AM on the interview day. This one-time telephone interview lasts approximately 15 to 20 minutes (BLS, 2014). Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. The ATUS interview is conducted using CATI with a combination of structured questions and conversational interviewing. As described in the ATUS User's Guide (BLS, 2014), for all parts of the interview except the collection of the time-use diary data, interviewers read scripted text on the CATI screen and enter the reported responses. For the time-use diary, interviewers use conversational interviewing, a technique that allows respondents to feel more comfortable while reporting on activities and allows interviewers to use methods to guide respondents through memory lapses, to probe respondents in a non-leading way for additional information, and to redirect a respondent's attention to an area more relevant to the activity (BLS, 2014).

ATUS activities are coded using a three-tiered classification system, with 17 major (first-tier) categories and two additional tiers to help define the activity type (BLS, 2014). There are approximately 30 ATUS location codes, some of which indicate unspecified or unknown locations (see below).

Details of the Coding of Study Information

All coding of the ATUS data into CHAD-Master was performed in SAS®. The CHAD questionnaire file variables were determined from the ATUS data as presented in Table A.3-1. Coding of diary (events) file variables is also provided in the table.

The mapping of location and activity variables is described in the following sections (EPA, 2014), leading to 124,517 diary-days of human-activity data added to CHAD-Master.

As discussed below, limitations on the specificity of location data (including no distinction between indoor and outdoor locations at home) and lack of consistent commuting information could impact any analyses using these data. However, in the coding of ATUS for CHAD-Master, attempts were made to infer missing location data from activities and code more specific locations from activities where possible. The mapping of location and activity variables is described in the following section.

Mapping of Locations from ATUS to CHAD-Master. In general, CHAD location variables were assigned from values of the ATUS variable TEWHERE as shown in Table A.3-2.

However, many locations were updated (or inferred, if missing) as described below.

Once the activities were coded, the originally coded locations were updated where possible. If a location was given as in a residence ("Respondent's Residence" or "Other's Residence"), then activities including the following were assumed to occur inside the residence (see codes below): sleeping; grooming; health-related self-care; personal activities; personal care activities; interior housework; interior arrangement and repair; interior maintenance; household/financial management types of activities; and computer activities. Activities including the following were assumed to occur outside the residence (see codes below): exterior cleaning; exterior repair, improvements, & decoration; exterior maintenance, repair & decoration; lawn, garden, and houseplant care; ponds, pools, and hot tubs; vehicle repair and maintenance (by self); playing sports with children; playing baseball; playing basketball; participating in equestrian sports; and playing and watching other sports activities.

- If an activity took place in a residence ("Respondent's Residence" or "Other's Residence"), the initial coding of CHAD location codes 30010 and 30020 were replaced with indoor CHAD Residence location codes (30120 and 30130) for the following ATUS codes: 010101, 010102, 010199, 010201, 010299, 010301, 010399, 010401, 010499, 010501, 010599, 019999, 020101, 020102, 020103, 020104, 020199, 020203, 020299, 020301, 020399, 020901, 020902, 020903, 020904, 020999, 030101, 030201, 030203, 030301, 030401, 030403, 030499, 030502, 040101, 040102, 040108, 040201, 040203, 040301, 040401, 040403, 040499, 040501, 040505, 040506, 050481, 050101, 050102, 060301, 060302, 060399, 060401, 060402, 060499, 069999, 070201, 070299, 079999, 120303, 120304, 120308, 120309, 120310, 120311, 130105, 130128, 150101, 150102, 150103, 150104, 150105, 150106, and 150199.

- If an activity took place in a residence ("Respondent's Residence" or "Other's Residence"), the initial coding of CHAD location codes 30010 and 30020 were replaced with outdoor CHAD Residence location codes (30210 and 30220) for the following ATUS codes, with the exceptions described below: 020401, 020402, 020499, 020501, 020502, 020599, 020701, 020799, 040502, 130102, 130103, 130110, 130113, 130112, 130114, 130117, 130120, 130122, 130123, 130125, 130126, 130127, 130129, 130130, 130132, 130199, 130202, 130203, 130204, 130212, 130213, 130214, 130216, 130218, 130220, 130221, 130223, 130224, 130225, 130227, 130229, and 130299.

As exceptions, work- and income-producing activities performed at "Respondent's Residence" were assumed to occur indoors (these were assumed to be teleworking activities). Work- and income-producing activities performed at "Other's Residence" were not assumed to occur indoors as these activities could reflect respondents having outdoor jobs in fields such as landscaping and construction.

Once the above assumptions were implemented, only 32 percent of the activities coded as being in a residence failed to be categorized as either indoors or outdoors.

Investigators making use of the CHAD-Master data could additionally categorize one or more of these activities (or any others not listed here) as indoor/outdoor to suit their purposes. The following additional reasonable assumptions were made to update a large number of missing locations in ATUS.

- There was a substantial number of missing locations for sleeping events. If the location for sleeping was missing, and the previous activity occurred in a residential location, the sleeping events were assigned the same residential location. This replaced approximately 275,000 missing event locations (about 6 percent of all missing locations).

- All non-missing locations for each activity in the diary (events) file were analyzed. In many cases, greater than 90 percent of the activity events occurred in a single location. For each of these cases, the missing locations for each of these events were replaced with this dominant location. This replaced about 19,500 events (or 0.41 percent of missing locations).

Mapping of Activities from ATUS to CHAD-Master. ATUS activities are coded using a three-tier (six-digit) coding system (ATUS variable: TRCODEP). The first two digits represent the major activity category; the next two digits represent the second-tier level of detail for the activity; and the final two digits represent the third, most-detailed level of activity. The final code in every tier is 99, which represents an activity not elsewhere classified (displayed as "n.e.c.").

The CHAD activity variable was assigned based on the ATUS variable TRCODEP (see Table A.3-3). Note that EPA updated the full set of all CHAD activity codes in 2015, after the ATUS data were incorporated into CHAD-Master.

Mapping of Personal Variables. The mappings of some ATUS personal variable to CHAD-Master—including EDUCATION, OCCUP, RACE, INCOME, and EMPLOYED—are shown below (Tables A.3-4 through A.3-8).

Assumptions. Mapping of CHAD-Master locations from ATUS study data required that many locations be updated (e.g., to categorize them as indoor/outdoor) or inferred, if missing. These coding assumptions have been described above.

References

BLS (Bureau of Labor Statistics). 2016. American Time Use Survey User's Guide: Understanding ATUS 2003 to 2013; Bureau of Labor Statistics, Washington, DC; December 2014. Available at: http://www.bls.gov/tus/atususersguide.pdf.

U.S. EPA (U.S. Environmental Protection Agency). 2014. Coding the American Time Use Survey (ATUS) for Inclusion in EPA's Consolidated Human Activity Database. EPA/600/X-14/298.

Table A.3-1. Assignment of ATUS Data to CHAD-Master

CHAD Variable	CHAD Variable Description	ATUS File	ATUS Variable
Variables in Questionnaire File			
Diary Variables			
CHADID	EPA-assigned ID for this diary-day	N/A[a]	ATUS diaries given the CHAD prefix "BLS" CHADID numbers assigned in order of the raw ATUS respondent ID TUCASID, left-padded with zeros to six digits
rawid	Raw data ID in the current study. May be missing or anonymized based on conditions imposed by the original investigators for inclusion in CHAD.	All files	TUCASEID
daynum	Index of current diary-day for this respondent	N/A	Set to 1 (all diaries are a single day)
totaldays	Number of diary-days in CHAD for this respondent	N/A	Set to 1 (all diaries are a single day)
Location Variables			
county	County of residence	CPS file	GECO, "Federal Processing Information Standards (FIPS) county code"[b]
state	State of residence	CPS file	GESTFIPS, "Federal Processing Information Standards (FIPS) state code" [b]
zipcode	Zip code of residence	N/A	Could not be determined from the ATUS data; set to "X"
Date Variables			
daymonth	Day of the month of diary-day (1–31)	Respondent file	TUDIARYDATE, "Date of diary-day (date about which the respondent was interviewed)". Date value, YYMMDD10
month	Month of diary-day (1–12)		
year	Year of diary-day		
wdwe	Day type of diary-day (WE or WD)		
dayofweek	Day of the week (abbreviation) (SUN, MON, TUE, WED, THU, FRI, SAT)		
Weather Variables			
avgtemp	Average temperature on day of study		

Table A.3-1. Assignment of ATUS Data to CHAD-Master

CHAD Variable	CHAD Variable Description	ATUS File	ATUS Variable
maxtemp	Maximum temperature on day of study	Derived by ICF; primary and secondary NOAA WBAN (weather station) assigned for each location and merged with daily summary weather data for the stations in question; if data for primary met station missing for the diary date, then data for the secondary met station used CPS file	GECMSA, MSA_PMSA, GTCSA, and GTCBSA before 2004; due to changes in the Metropolitan Statistical Area definitions, no corresponding variables after 2004
inchrain	Inches of rainfall on day of study		
hourrain	Hours of rainfall on day of study		
Personal Variables			
age	Age	CPS file	PRTAGE
gender	Gender		from ATUS codebook 1 = male, 2 = female
weight	Weight		EUWGT, converted to kilograms; set to -999 (missing) when not available
education	Level of education		PEEDUCA[c]
occup	U.S. Census Bureau occupation group		PRDTOCC1[c]
race	Racial/Ethnic group		PTDTRACE[c] and PEHSPNON
income	Household income before taxes		HUFAMINC[c] (2003–2009), HEFAMINC (2010+); CHAD INCOME variable set as midpoint of bins (in thousands of dollars), except for the maximum ATUS bins (set to missing = -999)
hrsworked	Hours worked in the last 7 days		PRHRUSL and PEHRUSLT (best as possible via the value; typical hours worked)
housingtype	Best description of living quarters	N/A	Could not be determined from the ATUS data; set to "X"
heatingtype	Type of heating for living quarters		
fueltype	Fuel or energy source used to heat living quarters		
Personal Flags			

Table A.3-1. Assignment of ATUS Data to CHAD-Master

CHAD Variable	CHAD Variable Description	ATUS File	ATUS Variable
aircond	Flag for air conditioning (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
asthma	Flag for having asthma (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
employed	Flag for employed outside home (Y/N)	CPS file	TELFS[c] labor force status)
fulltime	Flag for working full-time (Y/N)		TRDPFTPT (1 = full-time, 2 = part-time)
garage	Flag for attached garage (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
gasstove	Flag for gas stove used in house (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
heartlung	Flag for having a heart or lung condition (Y/N)	Well-being Module file	Initialized to missing ("X") as no general information on heart/lung health provided; however, if the well-being file variable WHBP (in the last 5 years, were you ever told by a doctor or other health professional that you have hypertension, also called high blood pressure, or borderline hypertension) = 1 (Yes), then HEARTLUNG was set = "Y"
pesticides	Flag for pesticide exposure (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
pregnant	Flag for being pregnant (Y/N)	CPS file	Initialized to "N" If EUWGT variable = -5 ("Pregnant"), then PREGNANT = "Y"
student	Flag for attending school (Y/N)	Respondent file	TESCHFT
smoker	Flag for being a smoker (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
nearsmoker	Flag for having been around smoker (Y/N)	N/A	Could not be determined from the ATUS data; set to "X"
Variables in Diary (Events) File			
duration	Duration of event	Activity file	TUSTARTTIM
starttime	Time of start of event		TUSTARTTIM
endtime	Time of end of event		STARTTIME and activity durations/end times
loc	CHAD location code		TEWHERE
act	CHAD activity code		TRCODEP

Note: Variables shown in the above table are only those relevant to the current study. A list of all CHAD-Master variables can be found in Section 4.

[a]N/A = not available or not applicable

[b]Available at: http://quickfacts.census.gov/qfd/meta/long_fips.htm.

[c]Additional information for these parameters provided in Tables A.3-4 through A.3-8.

Table A.3-2. Assignment ATUS Location Codes to CHAD-Master Location Codes

TEWHERE Code (ATUS)	TEWHERE Code Description (ATUS)	LOC Code (CHAD)	LOC Code Description (CHAD)
-1	Blank	X	Missing
-2	Don't Know	X	Missing
-3	Refused	X	Missing
1	Respondent's home or yard	30010	Your Residence
2	Respondent's workplace	33400	At work : no specific location, moving among locations
3	Someone else's home	30020	Other's Residence
4	Restaurant or bar	33600	At Restaurant
5	Place of worship	33700	At Church
6	Grocery store	32300	Grocery store/convenience store
7	Other store/mall	32400	Shopping mall/non-grocery store
8	School	33500	At School
9	Outdoors away from home	35000	Other outdoor, general
10	Library	32920	Library/courtroom/museum/theater
11	Other place	X	Other place
12	Car, truck, or motorcycle (driver)	31100	Motorized travel
13	Car, truck, or motorcycle (passenger)	31100	Motorized travel
14	Walking	31210	Travel by walk
15	Bus	31140	Travel by bus
16	Subway/train	31150	Travel by Train/Subway/rapid transit
17	Bicycle	31220	Travel by bicycle/skateboard/roller-skates
18	Boat/ferry	31170	Travel by boat
19	Taxi/limousine service	31110	Travel by car
20	Airplane	31160	Travel by airplane
21	Other mode of transportation	31900	Other travel
30	Bank	32100	Office building/bank/post office
31	Gym/health club	32700	Indoor gym/sports or health club
32	Post Office	32100	Office building/bank/post office
89	Unspecified place	X	Unspecified place
99	Unspecified mode of transportation	31900	Other travel

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
10101	Sleeping	14500	Sleep or nap
10102	Sleeplessness	17250	Think and relax
10199	Sleeping, n.e.c.	14500	Sleep or nap
10201	Washing, dressing and grooming oneself	14600	Dress, groom
10299	Grooming, n.e.c.	14600	Dress, groom
10301	Health-related self care	14200	Medical care
10399	Self care, n.e.c.	14200	Medical care
10401	Personal/Private activities	14700	Other personal needs
10499	Personal activities, n.e.c.	14700	Other personal needs
10501	Personal emergencies	14700	Other personal needs
10599	Personal care emergencies, n.e.c.	14700	Other personal needs
19999	Personal care, n.e.c.	14700	Other personal needs
20101	Interior cleaning	11220	Clean house
20102	Laundry	11400	Care of clothes
20103	Sewing, repairing, & maintaining textiles	11400	Care of clothes
20104	Storing interior hh items, inc. food	11200	Indoor chores
20199	Housework, n.e.c.	11200	Indoor chores
20201	Food and drink preparation	11100	Prepare food
20202	Food presentation	11100	Prepare food
20203	Kitchen and food clean-up	11210	Clean-up food
20299	Food & drink prep, presentation, & clean-up, n.e.c.	11210	Clean-up food
20301	Interior arrangement, decoration, & repairs	11640	Home repairs
20302	Building and repairing furniture	11640	Home repairs
20303	Heating and cooling	11640	Home repairs
20399	Interior maintenance, repair, & decoration, n.e.c.	11640	Home repairs
20401	Exterior cleaning	11310	Clean outdoors
20402	Exterior repair, improvements, & decoration	11300	Outdoor chores
20499	Exterior maintenance, repair & decoration, n.e.c.	11300	Outdoor chores
20501	Lawn, garden, and houseplant care	11700	Care of plants
20502	Ponds, pools, and hot tubs	11300	Outdoor chores
20599	Lawn and garden, n.e.c.	11300	Outdoor chores
20681	Care for animals and pets (not veterinary care)	11800	Care for pets/animals
20699	Pet and animal care, n.e.c.	11800	Care for pets/animals

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
20701	Vehicle repair and maintenance (by self)	11630	Repair/maintain car
20799	Vehicles, n.e.c.	11630	Repair/maintain car
20801	Appliance, tool, and toy set-up, repair, & maintenance (by self)	11600	Repair, general
20899	Appliances and tools, n.e.c.	11600	Repair, general
20901	Financial management	17242	Write for leisure/pleasure/paperwork
20902	Household & personal organization and planning	17242	Write for leisure/pleasure/paperwork
20903	HH & personal mail & messages (except e-mail)	17242	Write for leisure/pleasure/paperwork
20904	HH & personal e-mail and messages	17160	Use of computers
20905	Home security	11200	Indoor chores
20999	Household management, n.e.c.	11200	Indoor chores
29999	Household activities, n.e.c.	11000	General household activities
30101	Physical care for hh children	12200	Care of child
30102	Reading to/with hh children	12400	Talk/read
30103	Playing with hh children, not sports	12500	Play indoors
30104	Arts and crafts with hh children	17142	Create domestic crafts
30105	Playing sports with hh children	17110	Participate in sports
30186	Talking with/listening to hh children	17241	Converse
30108	Organization & planning for hh children	17242	Write for leisure/pleasure/paperwork
30109	Looking after hh children (as a primary activity)	12200	Care of child
30110	Attending hh children's events	17260	Other passive leisure
30111	Waiting for/with hh children	12800	Other child care
30112	Picking up/dropping off hh children	18300	Travel for child care
30199	Caring for & helping hh children, n.e.c.	12200	Care of child
30201	Homework (hh children)	12300	Help/teach
30202	Meetings and school conferences (hh children)	17240	Converse/write
30203	Home schooling of hh children	12300	Help/teach
30204	Waiting associated with hh children's education	12800	Other child care
30299	Activities related to hh child's education, n.e.c.	12800	Other child care
30301	Providing medical care to hh children	12700	Medical care-child
30302	Obtaining medical care for hh children	13400	Obtain medical service

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
30303	Waiting associated with hh children's health	12200	Care of child
30399	Other child care	12800	
30401	Physical care for hh adults	14300	Help and care
30402	Looking after hh adult (as a primary activity)	14300	Help and care
30403	Providing medical care to hh adult	14200	Medical care
30404	Obtaining medical and care services for hh adult	13400	Obtain medical service
30405	Waiting associated with caring for household adults	17122	Passive, sitting
30499	Caring for household adults, n.e.c.	14300	Help and care
30501	Helping hh adults	14300	Help and care
30502	Organization & planning for hh adults	17240	Converse/write
30503	Picking up/dropping off hh adult	18400	Travel for goods and services
30504	Waiting associated with helping hh adults	17122	Passive, sitting
30599	Helping household adults, n.e.c.	14300	Help and care
39999	Caring for & helping hh members, n.e.c.	14300	Help and care
40101	Physical care for nonhh children	12200	Care of child
40102	Reading to/with nonhh children	12200	Care of child
40103	Playing with nonhh children, not sports	12500	Play indoors
40104	Arts and crafts with nonhh children	17142	Create domestic crafts
40105	Playing sports with nonhh children	17110	Participate in sports
40186	Talking with/listening to nonhh children	17241	Converse
40108	Organization & planning for nonhh children	17242	Write for leisure/pleasure/paperwork
40109	Looking after nonhh children (as primary activity)	12200	Care of child
40110	Attending nonhh children's events	17260	Other passive leisure
40111	Waiting for/with nonhh children	12800	Other child care
40112	Dropping off/picking up nonhh children	18300	Travel for child care
40199	Caring for and helping nonhh children, n.e.c.	12200	Care of child
40201	Homework (nonhh children)	12300	Help/teach
40202	Meetings and school conferences (nonhh children)	17240	Converse/write
40203	Home schooling of nonhh children	12300	Help/teach
40204	Waiting associated with nonhh children's education	12800	Other child care

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
40299	Activities related to nonhh child's educ., n.e.c.	12800	Other child care
40301	Providing medical care to nonhh children	12700	Medical care-child
40302	Obtaining medical care for nonhh children	13400	Obtain medical service
40303	Waiting associated with nonhh children's health	12200	Care of child
40399	Activities related to nonhh child's health, n.e.c.	12800	Other child care
40401	Physical care for nonhh adults	14300	Help and care
40402	Looking after nonhh adult (as a primary activity)	14300	Help and care
40403	Providing medical care to nonhh adult	14200	Medical care
40404	Obtaining medical and care services for nonhh adult	13400	Obtain medical service
40405	Waiting associated with caring for nonhh adults	17122	Passive, sitting
40499	Caring for nonhh adults, n.e.c.	14300	Help and care
40501	Housework, cooking, & shopping assistance for nonhh adults	11200	Indoor chores
40502	House & lawn maintenance & repair assistance for nonhh adults	11300	Outdoor chores
40503	Animal & pet care assistance for nonhh adults	11800	Care for pets/animals
40504	Vehicle & appliance maintenance/repair assistance for nonhh adults	11600	Repair, general
40505	Financial management assistance for nonhh adults	17240	Converse/write
40506	Household management & paperwork assistance for nonhh adults	17240	Converse/write
40507	Picking up/dropping off nonhh adult	18400	Travel for goods and services
40508	Waiting associated with helping nonhh adults	17122	Passive, sitting
40599	Helping nonhh adults, n.e.c.	14300	Help and care
49999	Caring for & helping nonhh members, n.e.c.	14300	Help and care
50101	Work, main job	10100	Work, General
50102	Work, other job(s)	10100	Work, General
50103	Security procedures related to work	10100	Work, General
50189	Working, n.e.c.	10100	Work, General

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
50201	Socializing, relaxing, and leisure as part of job	17200	Participate in passive leisure
50202	Eating and drinking as part of job	14400	Eat
50203	Sports and exercise as part of job	17100	Participate in sports and active leisure
50204	Security procedures as part of job	10100	Work, General
50289	Work-related activities, n.e.c.	10100	Work, General
50301	Income-generating hobbies, crafts, and food	17142	Create domestic crafts
50302	Income-generating performances	17144	Perform music/drama/dance
50303	Income-generating services	10130	Work, secondary (income-related)
50304	Income-generating rental property activities	10130	Work, secondary (income-related)
50389	Other income-generating activities, n.e.c.	10130	Work, secondary (income-related)
50481	Job search activities	17240	Converse/write
50403	Job interviewing	17240	Converse/write
50404	Waiting associated with job search or interview	17122	Passive, sitting
50405	Security procedures rel. to job search/interviewing	17240	Converse/write
50499	Job search and Interviewing, n.e.c.	17240	Converse/write
59999	Work and work-related activities, n.e.c.	10100	Work, General
60101	Taking class for degree, certification, or licensure	15140	Attend adult education and special training
60102	Taking class for personal interest	15140	Attend adult education and special training
60103	Waiting associated with taking classes	17242	Write for leisure/pleasure/paperwork
60104	Security procedures rel. to taking classes	17240	Converse/write
60199	Taking class, n.e.c.	15140	Attend adult education and special training
60201	Extracurricular club activities	17141	Participate in hobbies
60202	Extracurricular music & performance activities	17144	Perform music/drama/dance
60203	Extracurricular student government activities	16200	Participate in social, political, or religious activities
60289	Education-related extracurricular activities, n.e.c.	15500	Other education
60301	Research/homework for class for degree, certification, or licensure	15300	Do homework

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
60302	Research/homework for class for pers. interest	15300	Do homework
60303	Waiting associated with research/homework	17122	Passive, sitting
60399	Research/homework n.e.c.	15300	Do homework
60401	Administrative activities: class for degree, certification, or licensure	17240	Converse/write
60402	Administrative activities: class for personal interest	17240	Converse/write
60403	Waiting associated w/admin. activities (education)	17122	Passive, sitting
60499	Administrative for education, n.e.c.	17240	Converse/write
69999	Education, n.e.c.	15500	Other education
70101	Grocery shopping	13210	Shop for food
70102	Purchasing gas	13600	Obtain car services
70103	Purchasing food (not groceries)	13210	Shop for food
70104	Shopping, except groceries, food and gas	13200	Shop/run errands
70105	Waiting associated with shopping	17122	Passive, sitting
70199	Shopping, n.e.c.	13200	Shop/run errands
70201	Comparison shopping	13200	Shop/run errands
70299	Researching purchases, n.e.c.	17240	Converse/write
70301	Security procedures rel. to consumer purchases	17240	Converse/write
70399	Security procedures rel. to consumer purchases, n.e.c.	17240	Converse/write
79999	Consumer purchases, n.e.c.	13200	Shop/run errands
80101	Using paid childcare services	13800	Other services
80102	Waiting associated w/purchasing childcare svcs	17122	Passive, sitting
80199	Using paid childcare services, n.e.c.	13800	Other services
80201	Banking	13500	Obtain government/financial services
80202	Using other financial services	13500	Obtain government/financial services
80203	Waiting associated w/banking/financial services	17122	Passive, sitting
80299	Using financial services and banking, n.e.c.	13500	Obtain government/financial services
80301	Using legal services	13800	Other services
80302	Waiting associated with legal services	13800	Other services
80399	Using legal services, n.e.c.	13800	Other services

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
80401	Using health and care services outside the home	13400	Obtain medical service
80402	Using in-home health and care services	13400	Obtain medical service
80403	Waiting associated with medical services	17122	Passive, sitting
80499	Using medical services, n.e.c.	13400	Obtain medical service
80501	Using personal care services	13300	Obtain personal care service
80502	Waiting associated w/personal care services	17122	Passive, sitting
80599	Using personal care services, n.e.c.	13300	Obtain personal care service
80601	Activities rel. to purchasing/selling real estate	13800	Other services
80602	Waiting associated w/purchasing/selling real estate	17122	Passive, sitting
80699	Using real estate services, n.e.c.	13800	Other services
80701	Using veterinary services	13800	Other services
80702	Waiting associated with veterinary services	17122	Passive, sitting
80799	Using veterinary services, n.e.c.	13800	Other services
80801	Security procedures rel. to professional/personal svcs.	13800	Other services
80899	Security procedures rel. to professional/personal svcs n.e.c.	13800	Other services
89999	Professional and personal services, n.e.c.	13800	Other services
90101	Using interior cleaning services	11000	General household activities
90102	Using meal preparation services	11000	General household activities
90103	Using clothing repair and cleaning services	11000	General household activities
90104	Waiting associated with using household services	17122	Passive, sitting
90199	Using household services, n.e.c.	11000	General household activities
90201	Using home maint/repair/décor/construction svcs	11000	General household activities
90202	Waiting associated w/ home main/repair/décor/constr	17122	Passive, sitting
90299	Using home maint/repair/décor/constr services, n.e.c.	11000	General household activities
90301	Using pet services	13800	Other services
90302	Waiting associated with pet services	17122	Passive, sitting
90399	Using pet services, n.e.c.	13800	Other services
90401	Using lawn and garden services	11000	General household activities

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
90402	Waiting associated with using lawn & garden services	17122	Passive, sitting
90499	Using lawn and garden services, n.e.c.	11000	General household activities
90501	Using vehicle maintenance or repair services	13600	Obtain car services
90502	Waiting associated with vehicle main. or repair svcs	17122	Passive, sitting
90599	Using vehicle maint. & repair svcs, n.e.c.	13600	Obtain car services
99999	Using household services, n.e.c.	11000	General household activities
100101	Using police and fire services	13500	Obtain government/financial services
100102	Using social services	13500	Obtain government/financial services
100103	Obtaining licenses & paying fines, fees, taxes	13500	Obtain government/financial services
100199	Using government services, n.e.c.	13500	Obtain government/financial services
100201	Civic obligations & participation	16200	Participate in social, political, or religious activities
100299	Civic obligations & participation, n.e.c.	16200	Participate in social, political, or religious activities
100381	Waiting associated with using government services	17122	Passive, sitting
100383	Waiting associated w/civic obligations & participation	17122	Passive, sitting
100399	Waiting assoc. w/govt svcs or civic obligations, n.e.c.	17122	Passive, sitting
100401	Security procedures rel. to govt svcs/civic obligations	17240	Converse/write
100499	Security procedures rel. to govt svcs/civic obligations, n.e.c.	17240	Converse/write
109999	Government services, n.e.c.	13500	Obtain government/financial services
110101	Eating and drinking	14400	Eat
110199	Eating and drinking, n.e.c.	14400	Eat
110281	Waiting associated w/eating & drinking	17122	Passive, sitting
110289	Waiting associated with eating & drinking, n.e.c.	17122	Passive, sitting
119999	Eating and drinking, n.e.c.	14400	Eat
120101	Socializing and communicating with others	16600	Visit
120199	Socializing and communicating, n.e.c.	16600	Visit

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
120201	Attending or hosting parties/receptions/ceremonies	16700	Attend a party
120202	Attending meetings for personal interest (not volunteering)	16200	Participate in social, political, or religious activities
120299	Attending/hosting social events, n.e.c.	16700	Attend a party
120301	Relaxing, thinking	17250	Think and relax
120302	Tobacco and drug use	17200	Participate in passive leisure
120303	Television and movies (not religious)	17223	Watch TV
120304	Television (religious)	17223	Watch TV
120305	Listening to the radio	17221	Listen to radio
120306	Listening to/playing music (not radio)	17140	Create art, music, participate in hobbies
120307	Playing games	17150	Play games
120308	Computer use for leisure (exc. Games)	17160	Use of computers
120309	Arts and crafts as a hobby	17142	Create domestic crafts
120310	Collecting as a hobby	17141	Participate in hobbies
120311	Hobbies, except arts & crafts and collecting	17141	Participate in hobbies
120312	Reading for personal interest	17230	Read, general
120313	Writing for personal interest	17242	Write for leisure/pleasure/paperwork
120399	Relaxing and leisure, n.e.c.	17200	Participate in passive leisure
120401	Attending performing arts	16400	Attend theater
120402	Attending museums	16500	Visit museums
120403	Attending movies/film	16400	Attend theater
120404	Attending gambling establishments	16000	General entertainment/social activities
120405	Security procedures rel. to arts & entertainment	17240	Converse/write
120499	Arts and entertainment, n.e.c.	16000	General entertainment/social activities
120501	Waiting assoc. w/socializing & communicating	17122	Passive, sitting
120502	Waiting assoc. w/attending/hosting social events	17122	Passive, sitting
120503	Waiting associated with relaxing/leisure	17122	Passive, sitting
120504	Waiting associated with arts & entertainment	17122	Passive, sitting
120599	Waiting associated with socializing, n.e.c.	17122	Passive, sitting
129999	Socializing, relaxing, and leisure, n.e.c.	16000	General entertainment/social activities

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
130101	Doing aerobics	17130	Exercise
130102	Playing baseball	17100	Participate in sports and active leisure
130103	Playing basketball	17100	Participate in sports and active leisure
130104	Biking	17131	Walk, bike, or jog (not in transit)
130105	Playing billiards	17113	Bowling/pool/ping pong/pinball
130106	Boating	17100	Participate in sports and active leisure
130107	Bowling	17113	Bowling/pool/ping pong/pinball
130108	Climbing, spelunking, caving	17100	Participate in sports and active leisure
130109	Dancing	17144	Perform music/drama/dance
130110	Participating in equestrian sports	17100	Participate in sports and active leisure
130111	Fencing	17100	Participate in sports and active leisure
130112	Fishing	17111	Hunting, fishing, hiking
130113	Playing football	17100	Participate in sports and active leisure
130114	Golfing	17112	Golf
130115	Doing gymnastics	17100	Participate in sports and active leisure
130116	Hiking	17111	Hunting, fishing, hiking
130117	Playing hockey	17100	Participate in sports and active leisure
130118	Hunting	17111	Hunting, fishing, hiking
130119	Participating in martial arts	17100	Participate in sports and active leisure
130120	Playing racquet sports	17100	Participate in sports and active leisure
130121	Participating in rodeo competitions	17100	Participate in sports and active leisure
130122	Rollerblading	17130	Exercise
130123	Playing rugby	17100	Participate in sports and active leisure
130124	Running	17131	Walk, bike, or jog (not in transit)
130125	Skiing, ice skating, snowboarding	17100	Participate in sports and active leisure
130126	Playing soccer	17100	Participate in sports and active leisure

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
130127	Softball	17100	Participate in sports and active leisure
130128	Using cardiovascular equipment	17130	Exercise
130129	Vehicle touring/racing	17100	Participate in sports and active leisure
130130	Playing volleyball	17100	Participate in sports and active leisure
130131	Walking	17131	Walk, bike, or jog (not in transit)
130132	Participating in water sports	17100	Participate in sports and active leisure
130133	Weightlifting/strength training	17130	Exercise
130134	Working out, unspecified	17130	Exercise
130135	Wrestling	17100	Participate in sports and active leisure
130136	Doing yoga	17114	Yoga
130199	Playing sports n.e.c.	17100	Participate in sports and active leisure
130201	Watching aerobics	16100	Attend sports events
130202	Watching baseball	16100	Attend sports events
130203	Watching basketball	16100	Attend sports events
130204	Watching biking	16100	Attend sports events
130205	Watching billiards	16100	Attend sports events
130206	Watching boating	16100	Attend sports events
130207	Watching bowling	16100	Attend sports events
130208	Watching climbing, spelunking, caving	16100	Attend sports events
130209	Watching dancing	16100	Attend sports events
130210	Watching equestrian sports	16100	Attend sports events
130211	Watching fencing	16100	Attend sports events
130212	Watching fishing	16100	Attend sports events
130213	Watching football	16100	Attend sports events
130214	Watching golfing	16100	Attend sports events
130215	Watching gymnastics	16100	Attend sports events
130216	Watching hockey	16100	Attend sports events
130217	Watching martial arts	16100	Attend sports events
130218	Watching racquet sports	16100	Attend sports events
130219	Watching rodeo competitions	16100	Attend sports events
130220	Watching rollerblading	16100	Attend sports events
130221	Watching rugby	16100	Attend sports events
130222	Watching running	16100	Attend sports events
130223	Watching skiing, ice skating, snowboarding	16100	Attend sports events

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
130224	Watching soccer	16100	Attend sports events
130225	Watching softball	16100	Attend sports events
130226	Watching vehicle touring/racing	16100	Attend sports events
130227	Watching volleyball	16100	Attend sports events
130228	Watching walking	16100	Attend sports events
130229	Watching water sports	16100	Attend sports events
130230	Watching weightlifting/strength training	16100	Attend sports events
130231	Watching people working out, unspecified	16100	Attend sports events
130232	Watching wrestling	16100	Attend sports events
130299	Attending sporting events, n.e.c.	16100	Attend sports events
130301	Waiting related to playing sports or exercising	17122	Passive, sitting
130302	Waiting related to attending sporting events	17122	Passive, sitting
130399	Waiting associated with sports, exercise, & recreation, n.e.c.	17122	Passive, sitting
130401	Security related to playing sports or exercising	17240	Converse/write
130402	Security related to attending sporting events	17240	Converse/write
130499	Security related to sports, exercise, & recreation, n.e.c.	17240	Converse/write
139999	Sports, exercise, & recreation, n.e.c.	17100	Participate in sports and active leisure
140101	Attending religious services	16210	Practice religion
140102	Participation in religious practices	16210	Practice religion
140103	Waiting associated w/religious & spiritual activities	17122	Passive, sitting
140104	Security procedures rel. to religious & spiritual activities	17240	Converse/write
140105	Religious education activities	16210	Practice religion
149999	Religious and spiritual activities, n.e.c.	16210	Practice religion
150101	Computer use	17160	Use of computers
150102	Organizing and preparing	17240	Converse/write
150103	Reading	17230	Read, general
150104	Telephone calls (except hotline counseling)	17241	Converse
150105	Writing	17242	Write for leisure/pleasure/paperwork
150106	Fundraising	17240	Converse/write

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
150199	Administrative & support activities, n.e.c.	17240	Converse/write
150201	Food preparation, presentation, clean-up	11110	Prepare and clean-up food
150202	Collecting & delivering clothing & other goods	13230	Run errands
150203	Providing care	14300	Help and care
150204	Teaching, leading, counseling, mentoring	12300	Help /teach
150299	Social service & care activities, n.e.c.	14300	Help and care
150301	Building houses, wildlife sites, & other structures	11300	Outdoor chores
150302	Indoor & outdoor maintenance, repair, & clean-up	11300	Outdoor chores
150399	Indoor & outdoor maintenance, building & clean-up activities, n.e.c.	11300	Outdoor chores
150401	Performing	17144	Perform music/drama/dance
150402	Serving at volunteer events & cultural activities	16200	Participate in social, political, or religious activities
150499	Participating in performance & cultural activities, n.e.c.	16200	Participate in social, political, or religious activities
150501	Attending meetings, conferences, & training	15140	Attend adult education and special training
150599	Attending meetings, conferences, & training, n.e.c.	15140	Attend adult education and special training
150601	Public health activities	16200	Participate in social, political, or religious activities
150602	Public safety activities	16200	Participate in social, political, or religious activities
150699	Public health & safety activities, n.e.c.	16200	Participate in social, political, or religious activities
159989	Volunteer activities, n.e.c.	16200	Participate in social, political, or religious activities
160101	Telephone calls to/from family members	17241	Converse
160102	Telephone calls to/from friends, neighbors, or acquaintances	17241	Converse
160103	Telephone calls to/from education services providers	17241	Converse
160104	Telephone calls to/from salespeople	17241	Converse
160105	Telephone calls to/from professional or personal care svcs providers	17241	Converse

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
160106	Telephone calls to/from household services providers	17241	Converse
160107	Telephone calls to/from paid child or adult care providers	17241	Converse
160108	Telephone calls to/from government officials	17241	Converse
169989	Telephone calls, n.e.c.	17241	Converse
180101	Travel related to personal care	18400	Travel for goods and services
180199	Travel related to personal care, n.e.c.	18400	Travel for goods and services
180280	Travel related to household activities		
180381	Travel related to caring for and helping hh children	18300	Travel for child care
180382	Travel related to caring for and helping hh adults	18400	Travel for goods and services
180399	Travel rel. to caring for & helping hh members, n.e.c.	18400	Travel for goods and services
180481	Travel related to caring for and helping nonhh children	18300	Travel for child care
180482	Travel related to caring for and helping nonhh adults	18400	Travel for goods and services
180499	Travel rel. to caring for & helping nonhh members, n.e.c.	18400	Travel for goods and services
180501	Travel related to working	18100	Travel during work
180502	Travel related to work-related activities	18100	Travel during work
180589	Travel related to work, n.e.c.	18100	Travel during work
180601	Travel related to taking class	18600	Travel for education
180682	Travel related to education (except taking class)	18600	Travel for education
180699	Travel related to education, n.e.c.	18600	Travel for education
180701	Travel related to grocery shopping	13200	Shop/run errands
180782	Travel related to shopping (except grocery shopping)	13200	Shop/run errands
180801	Travel related to using childcare services	18300	Travel for child care
180802	Travel related to using financial services and banking	18400	Travel for goods and services
180803	Travel related to using legal services	18400	Travel for goods and services
180804	Travel related to using medical services	18400	Travel for goods and services
180805	Travel related to using personal care services	18400	Travel for goods and services
180806	Travel related to using real estate services	18400	Travel for goods and services

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
180807	Travel related to using veterinary services	18400	Travel for goods and services
180899	Travel rel. to using prof. & personal care services, n.e.c.	18400	Travel for goods and services
180901	Travel related to using household services	18400	Travel for goods and services
180902	Travel related to using home main./repair/décor./construction svcs	18400	Travel for goods and services
180903	Travel related to using pet services (not vet)	18400	Travel for goods and services
180904	Travel related to using lawn and garden services	18400	Travel for goods and services
180905	Travel related to using vehicle maintenance & repair services	18400	Travel for goods and services
180999	Travel related to using household services, n.e.c.	18400	Travel for goods and services
181081	Travel related to using government services	18400	Travel for goods and services
181002	Travel related to civic obligations & participation	18800	Travel for event/social activity
181099	Travel rel. to govt svcs & civic obligations, n.e.c.	18400	Travel for goods and services
181101	Travel related to eating and drinking	18800	Travel for event/social activity
181199	Travel related to eating and drinking, n.e.c.	18800	Travel for event/social activity
181201	Travel related to socializing and communicating	18800	Travel for event/social activity
181202	Travel related to attending or hosting social events	18800	Travel for event/social activity
181283	Travel related to relaxing and leisure	18900	Travel for leisure
181204	Travel related to arts and entertainment	18900	Travel for leisure
181299	Travel rel. to socializing, relaxing, & leisure, n.e.c.	18900	Travel for leisure
181301	Travel related to participating in sports/exercise/recreation	18900	Travel for leisure
181302	Travel related to attending sporting/recreational events	18900	Travel for leisure
181399	Travel related to sports, exercise, & recreation, n.e.c.	18900	Travel for leisure
181401	Travel related to religious/spiritual practices	18800	Travel for event/social activity

Table A.3-3. Assignment of ATUS Activity Codes to CHAD-Master Activity Codes

TRCODEP Code (ATUS)	TRCODEP Code Description (ATUS)[a]	ACT Code (CHAD)	ACT Code Description (CHAD)
181499	Travel rel. to religious/spiritual activities, n.e.c.	18800	Travel for event/social activity
181501	Travel related to volunteering	18800	Travel for event/social activity
181599	Travel related to volunteer activities, n.e.c.	18800	Travel for event/social activity
181601	Travel related to phone calls	18000	Travel, general
181699	Travel rel. to phone calls, n.e.c.	18000	Travel, general
181801	Security procedures related to traveling	17240	Converse/write
181899	Security procedures related to traveling, n.e.c.	17240	Converse/write
189999	Traveling, n.e.c.	18000	Travel, general
500101	Insufficient detail in verbatim	X	Missing
500103	Missing travel or destination	X	Missing
500104	Recorded simultaneous activities incorrectly	X	Missing
500105	Respondent refused to provide information/"none of your business"	X	Missing
500106	Gap/can't remember	X	Missing
500107	Unable to code activity at 1st tier	X	Missing
509989	Data codes, n.e.c.	X	Missing

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the ATUS data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

[a]n.e.c = not elsewhere classified; hh = household

Table A.3-4. Assignment of ATUS Education Codes to CHAD-Master Education Codes

PEEDUCA Code (ATUS)	PEEDUCA Code Description (ATUS)	EDUCATION Code (CHAD)
-3	Refused	X
-2	Don't Know	X
-1	Blank	X
31	Less than 1st grade	N
32	1st, 2nd, 3rd, or 4th grade	SE
33	5th or 6th grade	SE
34	7th or 8th grade	E
35	9th grade	SH
36	10th grade	SH
37	11th grade	SH
38	12th grade - no diploma	SH
39	High school graduate - diploma or equivalent (GED)	H
40	Some college but no degree	SC
41	Associate degree - occupational/vocational	C
42	Associate degree - academic program	C
43	Bachelor's degree (BA, AB, BS, etc.)	C
44	Master's degree (MA, MS, MEng, MEd, MSW, etc.)	G
45	Professional school degree (MD, DDS, DVM, etc.)	G
46	Doctoral degree (PhD, EdD, etc.)	G

Table A.3-5. Assignment of ATUS Occupation Codes to CHAD-Master Occupation Codes

PRDTOCC1 Code (ATUS)	PRDTOCC1 Code Description (ATUS)	OCCUP Code (CHAD)
-3	Refused	X
-2	Don't Know	X
-1	Blank	X
1	Management occupations	ADMIN
2	Business and financial operations occupations	ADMIN
3	Computer and mathematical science occupations	PROF
4	Architecture and engineering occupations	PROF
5	Life, physical, and social science occupations	PROF
6	Community and social service occupations	PROF
7	Legal occupations	PROF
8	Education, training, and library occupations	PROF
9	Arts, design, entertainment, sports, and media occupations	PROF
10	Healthcare practitioner and technical occupations	PROF
11	Healthcare support occupations	TECH
12	Protective service occupations	PROTECT
13	Food preparation and serving related occupations	SERV
14	Building and grounds cleaning and maintenance occupations	LABOR
15	Personal care and service occupations	SERV LABOR
16	Sales and related occupations	SALE
17	Office and administrative support occupations	ADMSUP
18	Farming, fishing, and forestry occupations	FARM
19	Construction and extraction occupations	LABOR
20	Installation, maintenance, and repair occupations	PREC
21	Production occupations	MECH
22	Transportation and material moving occupations	TRANS
23	Armed Forces	PROTECT

Table A.3-6. Assignment of ATUS Race Codes to CHAD-Master Race Codes

PTDTRACE Code (ATUS)	PTDTRACE Code Description (ATUS)	RACE Code (CHAD)
-3	Refused	X
-2	Don't Know	X
-1	Blank	X
1	White only	W
2	Black only	B
3	American Indian, Alaskan Native only	O
4	Asian only	A
5	Hawaiian/Pacific Islander only	O
6	White-Black	B
7	White-American Indian	O
8	White-Asian	A
9	White-Hawaiian	O
10	Black-American Indian	B
11	Black-Asian	B
12	Black-Hawaiian	B
13	American Indian-Asian	O
14	Asian-Hawaiian	A
15	White-Black-American Indian	B
16	White-Black-Asian	B
17	White-American Indian-Asian	O
18	White-Asian-Hawaiian	O
19	White-Black-American Indian-Asian	O
20	2 or 3 races	O
21	4 or 5 races	O

Table A.3-7. Values of ATUS Variables HUFAMINC/HEFAMINC for CHAD-Master Income Codes

HUFAMINC (2003-2009)/HEFAMINC (2010-) Code (ATUS)	HUFAMINC (2003-2009)/HEFAMINC (2010-) Code Description (ATUS)
1	Less than $5,000
2	$5,000 to $7,499
3	$7,500 to $9,999
4	$10,000 to $12,499
5	$12,500 to $14,999
6	$15,000 to $19,999
7	$20,000 to $24,999
8	$25,000 to $29,999
9	$30,000 to $34,999
10	$35,000 to $39,999
11	$40,000 to $49,999
12	$50,000 to $59,999
13	$60,000 to $74,999
14	$75,000 to $99,999(2011-); $75,000+ (2003-2009)
15	$100,000 to $149,999 (2011-)
16	$150,000 and over (2011-)

Note: The CHAD-Master INCOME variable set as midpoint of bins (in thousands of dollars), except for the maximum ATUS bins (set to missing = -999).

Table A.3-8. Assignment of ATUS Employed Codes to CHAD-Master Employed Codes

TELFS Code (ATUS)	TELFS Description Code (ATUS)	EMPLOYED Code (CHAD)
-3	Refused	X
-2	Don't Know	X
-1	Blank	X
1	Employed - at work	Y
2	Employed - absent	Y
3	Unemployed - on layoff	N
4	Unemployed - looking	N
5	Not in labor force	N

A.4. Baltimore Retirement Home Study (BAL)

The Baltimore Retirement Home Study (BAL) was conducted with respondents aged 65 years or older in a retirement home in Baltimore County, Maryland during January and February 1997 and July and August 1998. BAL added 391 diary-days of human-activity data to CHAD-Master.

Data Transfer

Source of Study Data. Data were provided in Williams et al. (2000).

Format of Data Provided. No information provided at this time.

Incorporating BAL into CHAD-Master

- **Source**—data provided in Williams et al. (2000)
- **Data format**—not available
- **Data gathering**—daily recall data collected by study staff over a 3-week period
- **Final CHAD-Master BAL data set**—BAL added 391 diary-days of human-activity and location data to CHAD-Master

Study Details

All respondents were Caucasian and at least 65 years of age. No individual was a part of both study periods. In each of 3 consecutive weeks in 1997, five people recorded diaries 5 days per week. Twenty-one people participated in 1998.

Recall versus Real-time Diary. Study staff used recall from each respondent to document personal activity patterns, measured as the amount of time spent in selected activities or scenarios (e.g., sleeping; driving; spending time indoors or outdoors; trips to stores, family outings, or church).

Time Resolution of Questionnaire. Study staff recorded a daily activity log at 15-minute intervals for each respondent.

Structured versus Free-form Entry. No information provided at this time.

Details of the Coding of Study Information

BAL added 391 diary-days of human-activity and location data to CHAD-Master.

Mapping of Locations from BAL to CHAD-Master. No information provided at this time.

Mapping of Activities from BAL to CHAD-Master. No information provided at this time.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Williams, R, Suggs, J, Creason, J, Rodes, C, Lawless, P, Kwok, R, Zweidinger, R, and Sheldon, L. 2000. The 1998 Baltimore Particulate Matter Epidemiology-Exposure Study: Part 2. Personal

exposure associated with an elderly population. J Expo Anal Environ Epidemiol. 10(6): 533–543.

A.5. California Activity Pattern Studies (CAA, CAC, CAY)

Studies of activity patterns of California residents were conducted from 1987 to 1990 by the California Air Resources Board (Wiley et al., 1991a; 1991b). The California Adults Activity Patterns Study (CAA) and California Youth Activity Patterns Study (CAY) were conducted in California from October 1987 through September 1988 (Wiley et al., 1991a). CAA respondents were 18 to 94 years of age, and the CAA added one diary-day to CHAD-Master for each of 1,579 CAA respondents. CAY respondents were 12 to 17 years of age, and the CAY added one diary-day to CHAD-Master for each of 183 CAY respondents. The California Children Activity Patterns Study (CAC) was conducted in California from April 1989 through February 1990 (Wiley et al. 1991b). Its 1,200 respondents were up to 11 years of age and added 1,200 diary-days to CHAD-Master.

Data Transfer

Source of Study Data. James Capel (independent consultant) supplied EPA with the data after receiving a letter from Tom McCurdy (of EPA) requesting the data.

Format of Data Provided. Paper diaries were provided as Microsoft® Excel files.

Study Details

Recall versus Real-time Diary. Retrospective time diaries were collected via telephone for all activities occurring on the previous day. Questionnaire data were also collected on housing and socioeconomic characteristics.

For CAA, one adult aged 18 years or older was interviewed. As part of the adult interview, the presence of youths aged 12 through 17 years living in the household was determined. If one or more youths were present in the household, a shortened version of the interview was administered to a randomly selected youth in the household (as permitted by the youth's parent or guardian) (Wiley et al., 1991a).

Incorporating CAA, CAC, and CAY into CHAD-Master

- **Source**—data from Wiley et al. (1991a; 1991b); James Capel provided database
- **Data format**—paper diaries provided as Microsoft® Excel files; database provided by James Capel
- **Data gathering**—24-hour recall data collected by telephone interviews with structured questions
- **Final CHAD-Master CAA data set**— CAA, CAY, and CAC added 1,579, 183, and 1,200 diary-days of human-activity and location data, respectively, to CHAD-Master

For CAA and CAY, respondents provided location of each activity, an indication of whether they or anyone else nearby was smoking during the activity, and time that the current activity ended and the next activity began. A total of 36,918 (CAA and CAY) records were collected (571 cases missing data) (Wiley et al., 1991a).

For CAC, each respondent (either the child 9 to 11 years old or an adult informant living in the child's household) was asked to recall the child's activities the previous day. For each activity, respondents provided location of the activity, an indication of whether or not tobacco smoke was

present, and the timeframe of the activity. A total of 27,048 records were collected (Wiley et al., 1991b).

Time Resolution of Questionnaire. Using telephone survey, respondents—or adults in the household for some child respondents—were asked to recall activities that occurred the previous day. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. The CAA, CAY, and CAC interviews were conducted using CATI with a set of structured questions (Wiley et al., 1991a; 1991b).

Details of the Coding of Study Information

CAA, CAY, and CAC added 1,579, 183, and 1,200 diary-days of human-activity and location data, respectively, to the CHAD-Master.

For CAA, The table c_tblCali_To_Chad was created to link CAA observations in tblCali_DataSet1 (and others) and tblCHAD_Data. The CHADID was developed from the PID in original data, which was padded with leading zeros as needed until it was five characters long and then was augmented with a trailing "A" and a leading "CAA" (i.e., CHADID = "CAA" & right("00000"&trim([PID],5)&"A").

For CAY, the data were stored in tblCali_DataSet3 and 5. Most item names started with "y". The CHAD IDs for the youth and the IDs in the diary are the corresponding adult's ID plus 2. The CHADID was developed from the adult's PID in the original data, which was incremented by 2 and then padded with leading zeros as needed until it was five characters long, and then it was augmented with a trailing "A" and a leading "CAY" (i.e., CHADID = "CAY" & right("00000"&str(val(trim([PID]))+2),5)&"A"). The table c_tblCHAD_To_CA links the main California data tables with CHAD tables. The diaries use different IDs.

Mapping of Locations from CAA, CAY, and CAC to CHAD-Master. Mapping of CAA, CAY, CAC location variables to CHAD-Master locations is presented in Table A.5-1.

Mapping of Activities from CAA, CAY, and CAC to CHAD-Master. Mapping of CAA, CAY, CAC CHAD activity variables to CHAD-Master activities is presented in Table A.5-2. Note that EPA updated the full set of all CHAD activity codes in 2015, after the CAA data were incorporated into CHAD-Master.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Wiley J, Robinson J, Piazza T, Garrett K, Cirksena K, Cheng Y, and Martin G. 1991a. Activity Patterns of California Residents. Final Report. Prepared for California Air Resources Board, Research Division, Sacramento, CA.

Wiley J, Robinson J, Cheng Y, Piazza T, Stork L, and Pladsen K. 1991b. Study of Children's Activity Patterns. Final Report under contract no A733-149. Prepared for California Air Resources Board, Research Division, Sacramento, CA.

Table A.5-1. Assignment of CAA, CAY, and CAC Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (CAA and CAY)	Location Code (CAC)
30020: other's residence	32	-
30121: kitchen	1	1
30122: living room/family room	2	2
30123: dining room	3	3
30124: bathroom	4	4
30125: bedroom	5	5
30126: study/ office	6	6
30127: basement	8	8
30128: utility room/laundry room	9	9
30131: kitchen	-	3201
30132: living room/family room	-	3202
30133: dining room	-	3203
30134: bathroom	-	3204
30135: bedroom	-	3205
30136: study/office	-	3206
30137: basement	-	3208
30138: utility room/laundry room	-	3209
30211: pool, spa	10	10
30219: other outdoor	11	11
30221: pool, spa	-	3210
30229: other outdoor	-	3211
30330: your garage	7	7
30340: other's garage	-	3207
30400: other, residence	-	13
31110: car	51	51
31121: truck (pick-up or van)	52	52
31122: truck (other than pick-up or van)	57	57
31130: motorcycle/ moped/motorized scooter	60	60
31140: bus	55	55
31150: train/subway/rapid transit	56	56, 69, 70
31160: airplane	58	58
31210: walk	53	53
31220: bicycle/ skateboard/roller- skates	59	59
31230: in a stroller or carried by an adult	-	63
31310: wait for bus, train, ride (at stop)	54	54
31900: travel, other	61	-
32100: office building/ bank/ post office	21	21
32200: industrial plant/ factory/warehouse	22	22
32300: grocery store/convenience store	23	23
32400: shopping mall non-grocery store	24	24
32510: bar/night club	29	29

Table A.5-1. Assignment of CAA, CAY, and CAC Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (CAA and CAY)	Location Code (CAC)
32610: auto repair shop/gas station	33	33
32700: indoor gym, sports or health club	31	31
32810: childcare facility, house	-	253
32820: childcare facility, commercial	-	255
32900: public building/library/ museum/theater	26	26
33200: hospital/health care facility/doctor's office	27	27
33300: beauty parlor/ barber shop/hair dresser's	37	37
33400: at work: no specific location, moving among locations	38	-
33500: school	25	251
33600: restaurant	28	28
33700: church	30	30
33800: hotel/ motel	35	35
33900: dry cleaners	36	36
34200: other, indoor (specify)	39	39
35000: other outdoor, general	34, 11	-
35500: amusement park	-	38
35620: playground	-	34
36300: other outdoor (specify)	40	40

Table A.5-2. Assignment of CAA, CAY, and CAC Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (CAA and CAY)	Activity Code (CAC)
10110: work, general, for organizational activities	-	60
10111: work for professional/union organizations	60	-
10112: work for special interest identity organizations	61	-
10113: work for political party and civic participation	62	-
10114: work for volunteer/helping organizations	63	-
10115: work of/for religious groups	64	-
10116: work for fraternal organizations	66	-
10117: work for child/youth/family organizations	67	-
10118: work for other organizations	68	-
10120: work, income-related only	1	5
10130: work, secondary (income-related)	5	-
10200: unemployment	2	2
10300: breaks	8	-
11100: prepare food	10	10
11210: clean-up food	11	11
11220: clean house	12	12
11310: clean outdoors	13	13
11400: care of clothes	14	14
11410: wash clothes	-	149
11500: build a fire	169	169
11610: repair of boat	166	166
11620: paint home/room	167	167
11630: repair/maintain car	15	15
11640: home repairs	-	16
11650: other repairs	16	-
11700: care for plants	17	17
11800: care for pets/animals	18	19
11900: other household	19	18
12100: care of baby	20	20
12200: care of child	21	21
12300: help/teach	22	22
12400: talk/read	23	23
12500: play indoors	24	24
12600: play outdoors	25	25
12700: medical care-child	26	26
12800: other child care	27	27
13100: dry clean	28	-
13200: shop/run errands, general	-	301
13210: shop for food	30	30
13220: shop for clothes or household goods	31	31

Table A.5-2. Assignment of CAA, CAY, and CAC Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (CAA and CAY)	Activity Code (CAC)
13230: run errands	38	38
13300: obtain personal care service	32	32
13400: obtain medical service	33	33
13500: obtain government/financial services	34	34
13600: obtain car service	35	35
13700: other repairs	36	36
13800: other services	37	37
14100: shower, bathe, personal hygiene	40	40
14200: medical care	41	41
14300: help and care	42	42
14400: eat	43, 44, 6	43, 44, 6, 711
14500: sleep or nap	45, 46	45, 46
14600: dress, groom	47	47
15100: attend full-time school	50	50
15110: attend day-care	-	52
15200: attend other classes	51	51
15300: do homework	54	54, 549
15400: use library	55	55
15500: other education	56	56
16100: attend sports events	70	70
16210: practice religion	65	-
16300: view movie	72	72
16400: attend theater	73	73
16500: visit museums	74	74
16600: visit	75	75
16700: attend a party	76	76
16800: go to bar/lounge	77	77
16900: other entertainment/social events	78, 71	71, 78
17110: participate in sports	80	80
17111: hunting, fishing, hiking	-	-
17112: golf	801	801
17113: bowling/pool/ping pong/pinball	802	802
17114: yoga	803	803
17120: participate in outdoor leisure	-	81
17121: play, unspecified	-	811
17131: walk, bike, or jog (not in transit)	82	82
17141: participate in hobbies	83	83
17142: create domestic crafts	84	84
17143: create art	85	85
17144: perform music/drama/dance	86	86
17150: play games	87	87

Table A.5-2. Assignment of CAA, CAY, and CAC Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (CAA and CAY)	Activity Code (CAC)
17160: use of computer	88	-
17211: watch adult at work	-	8
17212: watch someone provide childcare	-	28
17213: watch personal care	-	48
17214: watch education	-	58
17215: watch organizational activities	-	68
17216: watch recreation	-	88
17221: listen to radio	90	90
17222: listen to recorded music	92	92
17223: watch TV	91, 914	91, 914, 915
17231: read books	93, 939	93, 934, 937, 938
17232: read magazine/not ascertained	94	94, 944
17233: read newspaper	95, 954	95, 954
17241: converse	96	96
17242: write for leisure/pleasure/paperwork	97, 971	97, 971
17250: think and relax	98	-
17300: other leisure	-	98, 875, 877, 879
18100: travel during work	3	3
18200: travel to/from work	9	9
18300: travel for child care	29	29
18400: travel for goods and services	39	39
18500: travel for personal care	49	49
18600: travel for education	59	59
18700: travel for organizational activity	69	69
18800: travel for event/social activity	79	79
18900: travel for leisure	-	-
18910: travel for active leisure	89	89
18920: travel for passive leisure	99	99

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the CAA, CAC, and CAY data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

A.6. Cincinnati Activity Patterns Study (CIN)

The Cincinnati Activity Patterns Study (CIN) was conducted in March and April or August and September of 1985 in the Cincinnati, Ohio metropolitan area and included respondents aged less than 1 to 86 years (Johnson, 1989). With 973 respondents, CIN provided 2,614 diary-days of human activity to CHAD-Master.

Data Transfer

Source of Study Data. The data were from Johnson (1989), and the electronic data were provided by James Capel (independent consultant).

Format of Data Provided. No information provided at this time.

Incorporating CIN into CHAD-Master

- **Source**— data from Johnson (1989); James Capel provided database
- **Data format**—electronic data provided (format unspecified)
- **Data gathering**—activity diary and background questionnaire
- **Final CHAD-Master CIN data set**—CIN added 2,614 diary-days of human-activity and location data to CHAD-Master

Study Details

The study was funded by the Electric Power Research Institute and was conducted in 1985 (Johnson, 1989). Using a screening questionnaire administered to several thousand households in the study area, 973 respondents were randomly selected. The respondent questionnaire included detailed questions about the respondent's home, age, gender, education environment, work environment, commuting habits, occupation, leisure-time activities, socioeconomic status, indoor pollution sources, time spent indoors and outdoors, time spent in strenuous activities, and number of children in household. Respondents kept activity diaries for 3 consecutive 24-hour periods. In 1991, EPA's Office of Air Quality Planning and Standards (OAQPS) combined data from the Cincinnati, Denver, and Washington, DC studies into a "Multicity Activity Data Base" (Paul et al., 1991).

Recall versus Real-time Diary. Each respondent was asked to carry an activity diary for 3 consecutive 24-hour sampling periods in either March/April or August/September of 1985. These months were chosen to represent seasons with differing activity patterns. Each respondent was also requested to complete a detailed background questionnaire. The questionnaire responses and approximately 2,800 respondent-days of activity diary data were collected, validated, and entered into an activity-pattern data base; 2,614 of these diary-days were incorporated into CHAD-Master.

Time Resolution of Questionnaire. The start and end times were not consistent from person to person, and activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. A questionnaire was administered with a set of structured questions.

Details of the Coding of Study Information

CIN added 2,614 diary-days of human-activity and location data to CHAD-Master.

Mapping of Locations from CIN to CHAD-Master. Mapping of CIN location variables to CHAD-Master locations is presented in Table A.6-1.

Mapping of Activities from CIN to CHAD-Master. The CIN activity diary page includes the following data items. Note that EPA updated the full set of all CHAD activity codes in 2015, after the CIN data were incorporated into CHAD-Master.

- Time activity started (TIME)
- Activity (A)
- Location (B)
- Breathing rate (C)
- Smoking (D)
- Fireplace use (E1)
- Woodstove use (E2)
- Window status (E3)

Mapping of CIN activity variables to CHAD-Master activities is presented in Table A.6-2.

Assumptions. The table c_tblCHAD_ToCinByPerson links summaries made by person to CHAD-Master. CHAD values for SMOKER were set based on diary entries. If a person had smoked at all during any diary-day, then SMOKER="Y" was assigned for all of his diary-days. If he never smoked then SMOKER="N" was set. Values for passive smoke exposure, SMOKER2, were set for a diary-day (not an individual) to "Y" if any passive smoke exposure was recorded in the diary. Otherwise, the value was set to "N".

Quality Flags/Quality Assurance Checks. CIN asked the respondents to identify those activities accompanied by heavy breathing. The definition of heavy breathing is therefore subjective and not consistent across individuals or across studies.

Additional Data. No information provided at this time.

References

Johnson, T. 1989. Human Activity Patterns in Cincinnati, Ohio. Final Report. Prepared for Electric Power Research Institute, Health Studies Program, Palo Alto, CA.

Paul RA, Yoder JM, Johnson T, and Capel J. 1991. Documentation for the Multicity Activity Data Base. Report for International Technology Air Quality Services, Durham, NC.

Table A.6-1. Assignment of CIN Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (CIN)
30120: your residence, indoor	3
30130: other's residence, indoor	4
30200: residence, outdoor	60
30310: indoor garage	38
30320: outdoor garage	55
31110: car	1
31120: truck	28
31121: truck (pick-up or van)	30
31130: motorcycle/ moped/motorized scooter	31
31140: bus	29
31150: train/subway/rapid transit	32
31160: airplane	33
31171: motorized boat	34
31172: unmotorized boat	35
31910: other vehicle	36
32100: office building/ bank/ post office	5
32200: industrial plant/ factory/warehouse	6
32300: grocery store/convenience store	8
32400: shopping mall non-grocery store	48
32510: bar/night club	52
32520: bowling alley	51
32610: auto repair shop/gas station	40
32620: other repair shop	41
32700: indoor gym, sports or health club	42
32910: auditorium, sport's arena, concert hall	43
32920: library, courtroom, museum, theater	44, 50, 45
33200: hospital/health care facility/doctor's office	49
33500: school	7
33600: restaurant	46
33700: church	47
34100: parking garage	39
34200: other, indoor (specify)	53, 9
35110: within 10 yards of street	10
35210: public garage	56
35220: parking lot	57
35300: service station/gas station	58
35400: construction site	59
35610: school grounds	61
35620: playground	62
35700: sports stadium and amphitheater	63
35800: park/golf course	64

Table A.6-1. Assignment of CIN Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (CIN)
36300: other outdoor (specify)	67, 11

Table A.6-2. Assignment of CIN Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (CIN)
10110: work, general, for organizational activities	19
10120: work, income-related only	2
11110: prepare and clean-up food	8
11300: outdoor chores	11
11400: care of clothes	9
11900: other household	10
12000: child care, general	12
13200: shop/run errands, general	13
14400: eat	15
14500: sleep or nap	16
14700: other personal needs	17
15110: attend day-care	3
15120: attend K-12	4
15130: attend college or trade school	5
15140: attend adult education and special training	6
15300: do homework	7
16100: attend sports events	21
16210: practice religion	18
16500: visit museums	24
16600: visit	26
16700: attend a party	25
16800: go to bar/lounge	23
16900: other entertainment/social events	22
17110: participate in sports	28
17111: hunting, fishing, hiking	29
17131: walk, bike, or jog (not in transit)	30, 31
17140: create art, music, participate in hobbies	32
17170: participate in recess and physical education	27
17180: other sports and active leisure	33
17220: listen to radio/listen to recorded music/watch TV	35
17230: read, general	34
17240: converse/write	36
17250: think and relax	37
17260: other passive leisure	38
18000: travel, general	1

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the CIN data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

A.7. Detroit Exposure and Aerosol Research Study (DEA)

The Detroit Exposure and Aerosol Research Study (DEA) was a particulate matter study conducted by the EPA from June 2004 through October 2007 in the Detroit, Michigan area. Over 100 respondents aged 18 years or more in the Detroit area kept daily activity diaries during several seasons, leading to 340 diary-days entered into CHAD-Master.

Data Transfer

Source of Study Data. Data were provided by Ron Williams of EPA.

Format of Data Provided. No information provided at this time.

Incorporating DEA into CHAD-Master

- **Source**—Ron Williams of EPA
- **Data format**—no information provided at this time
- **Data gathering**—activities recorded via free-form entry, while location data were structured
- **Final CHAD-Master DEA data set**—DEA added 340 diary-days of human-activity and location data to CHAD-Master

Study Details

A randomized recruitment strategy recruited 137 respondents from the Wayne County/Detroit area of Michigan to participate in a two-season (summer and winter) monitoring program for 5 days per season. Respondents were nonsmokers, lived in nonsmoking households, were ambulatory, were expected to live in the same dwelling for 9 consecutive months, lived in a detached home, were 18 years of age or older, and were able to understand English or Spanish. Daily activity diaries indicating location, activity, and level of exertion were kept (Williams et al., 2008).

Recall versus Real-time Diary. No information provided at this time.

Time Resolution of Questionnaire. Diaries contained entries for every 15-minute segment of the day. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. Activities were recorded via free-form entry while location data were structured.

Details of the Coding of Study Information

Activity diaries were hand-coded into CHAD-Master by EPA staff (Tom McCurdy and Kristin Isaacs), leading to 340 diary-days of human-activity data added to CHAD-Master. Table A.7-1 provides information on the presence and absence of available diary variables from DEA.

Mapping of Locations from DEA to CHAD-Master. No information provided at this time.

Mapping of Activities from DEA to CHAD-Master. No information provided at this time.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Williams R, Rea A, Vette A, Croghan C, Whitaker D, Stevens C, McDow S, Fortmann R, Sheldon L, Wilson H, Thornburg J, Phillips M, Lawless P, Rodes C, and Daughtrey H. 2008. The design and field implementation of the Detroit Exposure and Aerosol Research Study. Journal of Exposure Science and Environmental Epidemiology 19: 643–659.

Table A.7-1. CHAD-Master Variables with Corresponding Data from DEA

CHAD Variable	CHAD Variable Description
Event Variables	
actdesc	Original activity description from survey
Location Variables	
state	State of residence
Weather Variables	
Weather data were collected from the Detroit airport weather station for the day of the diary collection; however, information is not currently available on which variables were present.	
Personal Variables	
fueltype	Fuel or energy source used to heat living quarters
heatingtype	Type of heating for living quarters
housingtype	Best description of living quarters
race	Racial/Ethnic group
weight	Weight
Personal Flags	
aircond	Flag for air conditioning (Yes/No)
employed	Flag for employed outside home (Yes/No)
garage	Flag for attached garage (Yes/No)
gasstove	Flag for gas stove used in house (Yes/No)
nearsmoker	Flag for having been around smoker (Yes/No)
smoker	Flag for being a smoker (Yes/No)
student	Flag for being a student (Yes/No)

Note: Variables shown in the above table are only those relevant to the current study. A list of all CHAD-Master variables can be found in Section 4.

A.8. Denver, Colorado Personal Exposure Study (DEN)

The Denver, Colorado Carbon Monoxide (CO) Personal Exposure Study (DEN) was conducted in November 1982 through February 1983 in the Denver metropolitan area. A total of 454 study respondents aged 18 to 70 years provided data from CO personal exposure monitors (PEMs) and activity diary data for 2 consecutive 24-hour sampling periods, leading to 805 diary-days of human-activity and location data added to CHAD-Master.

Data Transfer

Source of Study Data. The electronic data were provided by James Capel (independent consultant), and was found to have an incomplete questionnaire. So far, a complete version of that questionnaire has not been found.

Format of Data Provided. No information provided at this time.

Incorporating DEN into CHAD-Master

- **Source**—data from Johnson (1984) and Johnson et al. (1986); James Capel provided database
- **Data format**—electronic data provided (format unspecified)
- **Data gathering**—activity diary and background questionnaire
- **Final CHAD-Master DEN data set**—DEN added 805 diary-days of human-activity and location data to CHAD-Master

Study Details

The target population for DEN included all non-institutionalized, non-smoking residents of the urbanized portion of the metropolitan area who were 18 to 70 years of age. The study was sponsored by the Environmental Monitoring Systems Laboratory (EMSL) of EPA. DEN was conducted concurrently with a similar study in Washington, DC (WAS; see Section A.19). DEN and WAS were carried out as part of studies of personal exposure to CO using PEMs. A total of 454 study respondents were identified through the use of a screening questionnaire administered by telephone or in person to 1,404 households in the study area. Each person carried a PEM (breath samples) and an activity diary for 2 consecutive 24-hour sampling periods. Approximately 900 person-days of PEM and activity data were collected in DEN, with 805 going into CHAD-Master. Detailed background questionnaire data was also collected. In 1991, EPA/OAQPS combined data from the Cincinnati, Denver, and Washington, DC studies into a "Multicity Activity Data Base" (Paul et al., 1991).

Recall versus Real-time Diary. Each respondent carried a PEM and an activity diary for 2 consecutive 24-hour sampling periods; that is, 48 continuous hours. Detailed background questionnaire data were also collected. The 2 diary-days from each respondent were first recombined into one 48-hour diary. If data were available for less than 45 hours, then only 1 diary-day was retained.

Time Resolution of Questionnaire. The start and end times were not consistent from person to person, and activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. A diary of activities was recorded via free-form entry. A background questionnaire was administered with a set of structured questions.

Details of the Coding of Study Information

Coding of CHAD-Master variables was carried out for DEN using SAS® programs. Approximately 900 person-days of PEM and activity data were collected, with 805 going into CHAD-Master.

The number of consecutive diary-days from the same respondent is indicated by the variable NDAYS. In most cases in the original data, there was some time overlap between the first and second days. This was due to the extending or adding of records, often with missing activity codes, so that the diary-days either started or ended on an hour. These records were removed from the data, and a stop time was set exactly 24 hours after the first record started. The second diary-day then starts immediately and continues another 24 hours. If the second day was too short, then additional records were added with the activity and location codes set to missing (i.e., "X"). The different diary-days from the same individual are indicated in two ways: (1) The leftmost eight characters in the CHADID are the same, and the ninth (rightmost) is "A" for the first diary-day, "B" for the second, and so on; and (2) the DAYNUM variable on the personal summary screen indicates the day number numerically.

Mapping of Locations from DEN to CHAD-Master. Mapping of DEN location variables to CHAD-Master is presented in Table A.8-1.

Mapping of Activities from DEN to CHAD-Master. Mapping of DEN activity variables to CHAD-Master is presented in Table A.8-2. Note that EPA updated the full set of all CHAD activity codes in 2015, after the DEN data were incorporated into CHAD-Master.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Johnson, T. 1984. Study of Personal Exposure to Carbon Monoxide in Denver, Colorado. Prepared for U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

Johnson, T, Capel J, and Wijnberg L. 1986. Selected Data Analyses Relating to Studies of Personal Carbon Monoxide Exposure in Denver and Washington, D.C. Prepared for U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

Paul RA, Yoder JM, Johnson T, and Capel J. 1991. Documentation for the Multicity Activity Data Base. Report for International Technology Air Quality Services, Durham, NC.

Table A.8-1. Assignment of DEN Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (DEN)
30100: residence, indoor	2
30200: residence, outdoor	76
30331: indoor garage	51
30332: outdoor garage	71
31000: travel, general	1
32000: other indoor, general	6, 50
32100: office building/ bank/ post office	3
32200: industrial plant/ factory/warehouse	53
32300: grocery store/convenience store	4
32400: shopping mall non-grocery store	58
32610: auto repair shop/gas station	54
32620: other repair shop	55
32910: auditorium, sport's arena, concert hall	56
32920: library, courtroom, museum, theater	61
33200: hospital/health care facility/doctor's office	59
33500: school	60
33600: restaurant	5
33700: church	57
34100: parking garage	52
34200: other, indoor (specify)	62
35000: other outdoor, general	8, 70
35110: within 10 yards of street	7
35210: public garage	72
35220: parking lot	73
35300: service station/gas station	74
35400: construction site	75
35610: school grounds	77
35700: sports stadium and amphitheater	78
35800: park/golf course	79

Table A.8-2. Assignment of DEN Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (DEN)
10120: work, income-related only	2
11100: prepare food	3
11300: outdoor chores	6
11400: care of clothes	4
13200: shop/run errands, general	7
14400: eat	8
14500: sleep or nap	9
14700: other personal needs	10
16200: participate in social, political, or religious activities	11
17131: walk, bike, or jog (not in transit)	13
17300: other leisure	14
18000: travel, general	1

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the DEN data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

A.9. EPA Longitudinal Studies (EPA)

The EPA diaries were daily diaries kept by EPA researchers familiar with CHAD, and their family members in some cases, in the Raleigh-Durham-Chapel Hill, North Carolina area. The diaries were kept for various periods in 1999–2000, 2002, 2006–2008, and 2012–2013. The EPA data have provided 1,786 diary-days of human activity to CHAD-Master.

Data Transfer

Source of Study Data. Data were provided from the diaries of EPA staff and some of their family members for various periods in 1999 through 2000, 2002, 2006 through 2008, and 2012 through 2013.

Format of Data Provided. Paper diaries were hand-coded into electronic records (typically in Microsoft® Excel) of the natural language descriptions and corresponding CHAD activity and location codes by Alion Science and Technology and Tom McCurdy (of EPA).

Study Details

Other than an infant aged "zero" years, all respondents were adults between 35 and 72 years old in central North Carolina. Activities and locations were coded directly from general, shorthand, activity descriptions into CHAD codes (typically in Microsoft® Excel). These coded diaries were then typically read into SAS® and given a variety of QA tests.

Incorporating EPA into CHAD-Master

- **Source**—data from diaries of EPA staff and some family members for various periods in 1999–2000, 2002, 2006–2008, and 2012–2013 (Isaacs et al., 2012)
- **Data format**—paper diaries hand-coded into electronic records
- **Data gathering**—paper diary; free-form questionnaire
- **Final CHAD-Master EPA data set**—EPA added 1,786 diary-days of human-activity and location data to CHAD-Master

Recall versus Real-time Diary. Real-time data were collected by study respondents using a standard paper diary format.

Time Resolution of Questionnaire. Respondents were instructed to record any unique activity/location pair that was longer than 1 minute in duration, and activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. Demographic CHAD variables were collected via questionnaire at the start of the study. These data were translated to electronic records by Alion Science and Technology. The answers were free-form; respondents described their activities using natural language.

Details of the Coding of Study Information

EPA added 1,786 diary-days of human-activity data to CHAD-Master. All coding of the 2012–2013 EPA data into CHAD-Master was performed in SAS®.

Weather Variables. In 2015, ICF derived the weather variables for the 2012–2013 records of the EPA study, using methods very similar to those used for the ATUS (BLS) study. U.S. Census population-weighted county centroids (using 2010 Census data) were used for county centroids. Hourly data were obtained from the National Oceanic and Atmospheric Administration (NOAA) Quality-controlled Local Climatological Dataset (QCLCD), and in a few cases those data were supplemented with daily QCLCD data and/or hourly data from NOAA's Integrated Surface Database. Each county in the EPA 2012–2013 records were matched with a primary weather station (the closest station based on proximity to the population-weighted county centroid) and a secondary weather station (the closest major-airport station; is allowed to be the same as the primary station). After numerous processing and quality-assessment evaluations (including checks on missing data, handling of sub-hourly data, and logic and value-bounds checks), each day in the diary was matched with the best available data from either the primary station, the secondary station, or a mix of both stations. Data from the primary station were used in most cases.

Mapping of Locations from EPA to CHAD-Master. No information provided at this time. Location-code mapping for the 2012–2013 data was conducted by ICF for EPA.

Mapping of Activities from EPA to CHAD-Master. No information provided at this time. Activity-code mapping for the 2012–2013 data was conducted by ICF for EPA.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Isaacs K, McCurdy T, Glen G, Nysewander M, Errickson A, Forbes S, Graham S, McCurdy L, Smith L, Tulve N, and Vallero, D. 2012. Statistical properties of longitudinal time-activity data for use in human exposure modeling. Journal of Exposure Science and Environmental Epidemiology 23(3): 328-336.

A.10. Population Study of Income Dynamics (PSID) I, II, III (ISR)

The Population Study of Income Dynamics (PSID) began in 1968 using a nationally-representative sample of more than 18,000 respondents living in 5,000 families in the US. PSID I was conducted February through December 1997 on children aged 0 to 12 years (2,300 families). Information was collected again in 2002 through 2003 (PSID II) and September 2007 through May 2008 (PSID III) for children in this cohort who remained under 18 years old. Collectively called "ISR" in CHAD-Master, these studies added 13,354 diary-days of human activity to CHAD-Master.

Data Transfer

Source of Study Data. Data collection efforts were performed by University of Michigan faculty. Alion Science and Technology provided the SAS® data set.

Format of Data Provided. All coding of the ISR data into CHAD-Master was performed in SAS®.

SAS® files included ReadDiaries2002.sas, ReadDiaries2007.sas, ReadIndividuals2002.sas, and ReadIndividuals2007.sas). Data were processed as Process_PSID_2002_2011Dec02.sas, Process_PSID_2007_2011Dec02.sas, and ChadCorrectAndMerge2011Oct.sas.

Incorporating ISR into CHAD-Master

- **Source**—University of Michigan (2004); source of SAS® data sets was Alion Science and Technology
- **Data format**—provided as SAS® data sets
- **Data gathering**—interviews ; time diaries
- **Final CHAD-Master ISR data set**—ISR added 5,616 (PSID I), 4,997 (PSID II), and 2,741 (PSID III) diary-days of human-activity and location data to CHAD-Master

Study Details

PSID is directed by faculty members at the University of Michigan who have performed various data collection efforts (University of Michigan, 2014). PSID I, II, and III were conducted as part of the Child Development Supplement of PSID. Information on PSID children was obtained through extensive interviews with the child, their primary caregiver, secondary caregiver, absent parent, teacher, and school administrator. Information was collected on physical health, emotional well-being, intellectual and academic achievement, cognitive ability, social relationships with family and peers, and time use (University of Michigan, 2014).

Recall versus Real-time Diary. For each diary-day (1 weekday and 1 weekend day), the primary caregiver of the child respondent was asked to recall the child's activities during the 24-hour period beginning at midnight on the specified day. For each activity, caregivers of the respondents provided location of the activity, time that each activity began and ended, who else was present during the activity (except for personal care activities and sleeping), and what else the child was doing at the time of the activity (except for personal care activities and sleeping). If the child was watching television or playing a video or computer game, the name of the program or game must also be indicated (University of Michigan, undated).

Time Resolution of Questionnaire. The diary lists the child's activities during 1 weekday and 1 weekend day. A diary is kept for an entire 24-hour time period, starting with midnight on the specified day and running until midnight on the next day (University of Michigan, undated). Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. Interviews were conducted using structured sets of questions (University of Michigan, 2014). Time diaries for 1 weekday and 1 weekend day were also collected using a structured form requiring the following information: activity description, time the activity began, time the activity ended, location of the child at the time of the activity, who was with the child during the activity, and other activities the child was doing at the same time (University of Michigan, undated).

Details of the Coding of Study Information

All coding of the ISR data into CHAD-Master was performed in SAS®. ISR added 5,616 (PSID I), 4,997 (PSID II), and 2,741 (PSID III) diary-days of human-activity and location data to the CHAD-Master. The 2002 diaries were reprocessed, starting with the raw data, to ensure consistency with the 2007–2008 data. The 1997 CHADID prefixes were updated from "UMC" to "ISR" to match the other two ISR study entries (Alion Science and Technology, 2012).

Mapping of Locations from ISR to CHAD-Master. Mapping of ISR location variables to CHAD-Master is presented in Table A.10-1.

Mapping of Activities from ISR to CHAD-Master. Mapping of ISR activity variables to CHAD-Master is presented in in Table A.10-2. Note that EPA updated the full set of all CHAD activity codes in 2015, after the ISR data were incorporated into CHAD-Master.

Assumptions. No information provided at this time.

Quality Flags/Quality Assurance Checks. As part of the integration into CHAD-Master conducted by Alion Science and Technology, a set of new QA tests were created and collected into a single SAS® program: ChadUtilities_2011Dec02. The tests focused on data transformations and mapping to ensure that the information was processed correctly (Alion Science and Technology, 2012).

Additional Data. No information provided at this time.

References

Alion Science and Technology. 2012. PSID Integration into CHAD (a description from Alion on integrating ISR into CHAD).

University of Michigan. 2016. PSID. A national study of socioeconomics and health over lifetimes and across generations. http://psidonline.isr.umich.edu/Studies.aspx.

University of Michigan. 1997. Child Development Supplement; Time Diary. https://psidonline.isr.umich.edu/CDS/questionnaires/cds-i/english/Tdiary.pdf.

Table A.10-1. Assignment of ISR Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (ISR)
31000: Travel, general	20
32000: Other, indoor general	30, 35
33600: At Restaurant	50
33500: At School	80
33700: At Church	81
32400: Shopping mall / non-grocery store	82
32900: Public building / library / museum /theater	83
32820: Childcare facility, commercial	84
Multiple CHADIDs: Various	10
Multiple CHADIDs: Various	40, 45, 60, 70, 89

Table A.10-2. Assignment of ISR Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (ISR)
10120: Work, income-related only	110, 120
10130: Work, secondary (income-related)	590
10200: Unemployment	220
10300: Breaks	890
11100: Prepare food	1080
11200: Indoor chores	1090, 1290
11210: Clean-up food	1180, 1190
11300: Outdoor chores	1390, 1920, 1680, 1710
11400: Care of clothes	1490
11410: Wash clothes	1480
11600: Repair, general	1610, 1620
11610: Repair of boat	8330
11630: Repair / maintain car	1630, 1670, 8320
11640: Home repairs	1640
11650: Other repairs	3530, 1650, 1660
11700: Care of plants	1730
11800: Care for pets/animals	1890, 8440
11900: Other household	1280, 1910
12000: Child care, general	4870, 4880, 2780, 2790
12100: Care of baby	2090, 2480
12200: Care of child	2180, 2190, 2490, 2590
12300: Help / teach	2210, 2220, 2360
12400: Talk /read	2380
12700: Medical care-child	2690
12800: Other child care	2770
13000: Obtain goods and services, general	3120
13100: Dry clean	3520
13210: Shop for food	3010
13220: Shop for clothes or household goods	3020, 3110
13230: Run errands	3780, 3890
13300: Obtain personal care service	3290
13400: Obtain medical service	3390, 3772, 3773
13500: Obtain government / financial services	3771, 3410, 3420
13600: Obtain car services	3510
13800: Other services	3790
14000: Personal needs and care, general	3690, 4070, 4820
14110: Shower, bathe	4080
14200: Medical care	4110, 4120
14300: Help and care	4210, 4220, 4230, 4240
14400: Eat	690, 4390, 4480, 4490, 4495

Table A.10-2. Assignment of ISR Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (ISR)
14500: Sleep or nap	4590, 4690
14600: Dress, groom	4090
14700: Other personal needs	4840, 4850, 4860
15100: Attend full-time school	5092
15110: Attend day-care	5091, 5680
15140: Attend adult education and special training	5691
15200: Attend other classes	5093, 5190, 5191, 5192, 5193, 6130, 6131, 6134, 6136, 6138, 8880
15300: Do homework	5490, 5491, 5492, 5493, 5494
15500: Other education	5690
16100: Attend sports events	7090, 7091, 7092, 7093, 7094, 7095, 7096, 7098
16200: Participate in social, political, or religious activities	6110, 6210, 6310, 6311, 6313, 6322, 6330, 6340, 6341, 6342, 6350, 6620, 6710, 6720
16210: Practice religion	6410, 6420, 6430, 6440, 6510, 6520
16300: Watch movie	7290
16400: Attend theater	7390
16500: Visit museums	7490
16600: Visit	7520
16700: Attend a party	7690
16800: Go to bar / lounge	7710, 7730
16900: Other entertainment / social events	6890, 7890
17000: Leisure, general	8890
17100: Participate in sports and active leisure	8032, 8040, 8041, 8042, 8050, 8051, 8052, 8053, 8054, 8055, 8070, 8160, 8850, 8851, 8865
17110: Participate in sports	8010, 8011, 8012, 8013, 8014, 8015, 8016, 8017, 8020, 8021, 8023, 8091, 8092
17111: Hunting, fishing, hiking	8110, 8120, 8130, 8220
17112: Golf	8030
17113: Bowling / pool / ping pong / pinball	8060, 8061, 8062
17114: Yoga	8080, 8864
17120: Participate in outdoor leisure	7190, 8180
17121: Play, unspecified	8760, 9090
17130: Exercise	8100, 8860, 8861, 8863
17131: Walk, bike, or jog (not in transit)	8210, 8230, 8240, 8241, 8260
17140: Create art, music, participate in hobbies	8871, 8872
17141: Participate in hobbies	8310, 8340
17142: Create domestic crafts	8350, 8420, 8430
17143: Create art	8510, 8511, 8512, 8513
17144: Perform music / drama / dance	6132, 6133, 8610, 8611, 8612, 8620, 8630, 8640, 8870
17150: Play games	8730

Table A.10-2. Assignment of ISR Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (ISR)
17160: Use of computers	5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5110, 5120, 5121, 5122, 5123, 5130, 8790
17180: Other sports and active leisure	8140, 8242, 8660, 8750, 8830, 8831, 8832, 8833, 8834, 8835, 8836, 8837, 8838, 8839, 8840, 8841, 8843, 8844, 8846, 8847, 8854
17211: Watch adult at work	1940, 1950, 1960
17213: Watch personal care	4890
17216: Watch recreation	8820
17222: Listen to recorded music	9290
17223: Watch TV	9190
17230: Read, general	5100, 9420, 9790
17231: Read books	9390
17232: Read magazines / not ascertained	9410
17233: Read newspaper	9590
17241: Converse	780, 6135, 9610, 9620, 9630, 9640, 9650, 9660, 9661
17242: Write for leisure / pleasure / paperwork	1930, 8521, 8523
17250: Think and relax	9810, 9820, 9830
17260: Other passive leisure	8710, 8720, 8740, 9430, 9890
17300: Other leisure	8650, 8770, 8780
18000: Travel, general	970
18200: Travel to/from work	980, 990
18300: Travel for child care	2980, 2990
18400: Travel for goods and services	1990, 3990
18500: Travel for personal care	4980, 4990
18600: Travel for education	5390, 5970, 5980, 5990
18700: Travel for organizational activity	6980, 6990
18800: Travel for event / social activity	7990
18900: Travel for leisure	8250
18910: Travel for active leisure	8150, 8990
18920: Travel for passive leisure	8170, 9970, 9970, 9980, 9990
U: Uncertain	4810, 5790

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the ISR data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

A.11. Los Angeles Ozone Exposure Study: Elementary School/High School (LAE/LAH)

The Los Angeles Ozone Exposure Study: Elementary School/High School (LAE/LAH) was conducted between 1989 and 1992 and examined the exposure of outdoor workers and students to ozone pollution in the Los Angeles, California area. For students aged 10 to 17 years, data from Fall 1989 and Fall 1990 added 94 diary-days of human-activity data to CHAD-Master.

Data Transfer

Source of Study Data. Data were provided in Spier et al. (2012) and were obtained from Kenneth Clark.

Format of Data Provided. All survey instruments consisted of a background questionnaire and a real-time 3-day diary.

Study Details

The study assessed outdoor workers exposed to oxidant pollution, elementary and high school students exposed to oxidant pollution, and construction workers exposed to ozone. The activity records from these studies cover only 1 work day or school day period of time, as the purpose of these studies was to focus on exposures in specific microenvironments. Only diary data from students were incorporated into CHAD-Master.

Incorporating LAE/LAH into CHAD-Master

- **Source**—data provided in Spier et al. (2012) and obtained from Kenneth Clark
- **Data format**— no information provided at this time
- **Data gathering**—real-time diaries
- **Final CHAD-Master LAE/LAH data set**— LAE/LAH added 94 diary-days of human-activity and location data to CHAD-Master

Recall versus Real-time Diary. Respondents were asked to record diary entries every hour in real time.

Time Resolution of Questionnaire. The activity records cover only 1 work day or school day (typically 8 hours). Respondents were asked to fill out the diary every hour. In addition, respondents provided a daily summary that evaluated the activity level and symptoms that day relative to other days. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. The hourly form contained eight questions for each of up to three activities per hour, plus 15 general questions.

Details of the Coding of Study Information

LEA/LAH added 94 diary-days of human-activity data to CHAD-Master.

Mapping of Locations from LAE/LAH to CHAD-Master. No information provided at this time.

Mapping of Activities from LAE/LAH to CHAD-Master. No information provided at this time.

Assumptions. Since the respondents of this survey were self-selected volunteers, the extent to which they are representative of asthmatics is not known; for that reason, it is not clear how well the estimates given here will characterize other groups of asthmatics.

Additional Data. Because of the limited study sizes and the difficulty of extending the diaries to a standard 24-hour period, the construction and outdoor workers studies were not incorporated into the CHAD database.

Of the 52 survey respondents in this sample, 29 had been previously classified as either "minimal/mild" or "moderate/severe" asthmatics by investigators at Rancho Los Amigos Medical Center. All of the additional 23 respondents would have fallen into one of these two categories and were later classified into one of the categories by the original investigation of the human clinical studies to yield a total of 26 minimal/mild to 26 moderate/severe asthmatics.

References

Roth Associates. 1988. LA_part1 and LA_part2 (A Study of Activity Patterns Among a Group of Los Angeles Asthmatics). Electric Power Research Institute

Spier C, Little D, Trim S, Johnson T, Linn W, and Hackney J. 1992. Activity Patterns in Elementary and High School Students Exposed to Oxidant Pollution. Journal of Exposure Analysis and Environmental Epidemiology 2: 277–293.

A.12. National Human Activity Pattern Study (NHAPS): Air/Water (NHA/NHW)

The National Human Activity Pattern Studies (NHAPS) for air (NHA) and water (NWA) were conducted September 1992 through October 1994 (Klepeis et al., 1995; Tsang and Klepeis, 1996), during which 24-hour activity diaries were collected from 9,386 respondents aged less than 1 to 93 years—4,723 for NHA and 4,663 for NHW, all of which were added to CHAD-Master.

Data Transfer

Source of Study Data. The original data for this study were obtained from William Nelson of EPA's National Exposure Research Laboratory (NERL).

Format of Data Provided. No information provided at this time.

Incorporating NHA/NHW into CHAD-Master

- **Source**—data provided by William Nelson of EPA/NERL
- **Data format**—electronic data provided (format unspecified)
- **Data gathering**—telephone interview and questionnaire
- **Final CHAD-Master NHA/NHW data set**—NHA/NHW added 9,386 diary-days of human-activity and location data to CHAD-Master

Study Details

Recall versus Real-time Diary. NHA and NHW were conducted using a next-day telephone interview.

Time Resolution of Questionnaire. Twenty-four-hour diaries were collected from 9,386 respondents that were interviewed September 1992 through October 1994. It was conducted as a next-day telephone interview. Questionnaire data was also collected. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. The interviews were conducted by telephone. This method had the advantage that an interviewer could insist on filling in gaps in a diary, but was limited by a respondent's memory regarding the exact time and duration of activities.

Details of the Coding of Study Information

This survey was one of the largest and most geographically diverse (data from 48 states) of the studies that went into CHAD-Master. Coding of CHAD-Master variables was carried out for NHA/NHW using SAS® programs. The NHA/NHW location and activity coding system was selected as the foundation for the CHAD system. The NHA/NHW system of nesting digits so that the leftmost digit describes the most general (broadest) category, both for activities and for locations, was extended to a five-digit system in CHAD-Master. This provided enough flexibility to allow new codes to be added as needed. Some of the other activity studies used coarser or finer subdivisions of activities than NHA/NHW used; therefore, CHAD-Master codes were created or modified for these cases. Note that EPA updated the full set of all CHAD activity codes in 2015, after the NHA/NHW data were incorporated into CHAD-Master.

NHA/NHW codes were modified in CHAD-Master to address the following issues.

- In some cases, there were new categories that were not mentioned in NHA/NHW.
- There were situations in which the code from one study could fit under more than one category in the NHA/NHW coding system.
- Other codes did not properly fit anywhere within the NHA/NHW coding system.

NHA/NHW added 9,386 diary-days of human-activity and location data to the CHAD-Master.

Mapping of Locations from NHA/NHW to CHAD-Master. Mapping of NHA/NHW location variables to CHAD-Master is presented in Table A.12-1.

Mapping of Activities from NHA/NHW to CHAD-Master. Mapping of NHA/NHW activity variables to CHAD-Master is presented in Table A.12-2. Note that EPA updated the full set of all CHAD activity codes in 2015, after the NHA/NHW data were incorporated into CHAD-Master.

Assumptions. NHA/NHW contains 9,386 diary-days total. The RESPIDS field only contained about 9,088 unique values. In order to uniquely identify an individual, the RESPIDS and QUARTER fields were linked together to form a unique identifier.

The table c_tblCHAD_To_NHAPS was used to link the raw tables with the consolidated database.

The NHA/NHW data contained a set of primary and secondary tables. The primary tables created by reading the NHA/NHW data were named tblNHAPS_DatasetXX where XX=1, 2, 3, ..., 20. A set of update queries (e.g., qupd_ExpToSmoke) created respondent-specific tables (tbl_ExpToSmoke) from the somewhat randomly organized data set tables. Once created, these respondent-specific tables, with matching select queries to transform some of the coding, were used to display values in the forms. There are values in the data set tables that are not represented in the respondent-specific tables.

The individual's exposure to second hand smoke (SMOKER2) was re-coded in CHAD-Master for NHA/NHW with the following logic.

- Start with all SMOKER2 = "X" or missing.
    - If "Someone else smoked at house" (WHOSMHM), OR ("Was at Bar/Night Club/Or Bowling is True AND environmental tobacco smoke (ETS) is unknown") then SMOKER2 ="Y".
    - If the respondent was a non-smoker AND the diary indicated that someone was smoking, then SMOKER2 ="Y"
    - If the respondent was a smoker
        - AND other smokers lived in the house
        - AND someone smoked at the house then SMOKER2 ="Y"

- If NOT someone smoked at their house (No one smoked in house.) AND NOT someone smoked in their diaries (No smoking in diary.)
  - then SMOKER2 =“N”
- Otherwise, SMOKER2 =“N/A”

- All children 0 through 9 years old with an “X” for SMOKER were set to “N” for SMOKER.

Additional Data. No information provided at this time.

References

Klepeis N, Tsang A, and Behar J. 1995. Analysis of the National Human Activity Pattern Survey (NHAPS) Respondents from a Standpoint of Exposure Assessment. Final Report. Prepared for U.S. Environmental Protection Agency, National Exposure Research Laboratory, Las Vegas, NV.

Tsang AM and Klepeis NE. 1996. Descriptive Statistics Tables from a Detailed Analysis of the National Human Activity Pattern Survey (NHAPS) Data, U.S. Environmental Protection Agency, Washington, D.C.

Table A.12-1. Assignment of NHAPS (NHA, NHW) Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (NHAPS (NHA, NHW))
30121: kitchen	101
30122: living room/family room	102
30123: dining room	103
30124: bathroom	104
30125: bedroom	105
30126: study/ office	106
30127: basement	108
30128: utility room/laundry room	110
30131: kitchen	201
30132: living room/family room	202
30133: dining room	203
30134: bathroom	204
30135: bedroom	205
30136: study/office	206
30137: basement	208
30138: utility room/laundry room	210
30211: pool, spa	111
30219: other outdoor	112
30221: pool, spa	211
30229: other outdoor	212
30310: indoor garage	38
30320: outdoor garage	55
30330: your garage	107
30340: other's garage	207
31110: car	301
31121: truck (pick-up or van)	302
31122: truck (other than pick-up or van)	303
31130: motorcycle/ moped/motorized scooter	304
31140: bus	305
31150: train/subway/rapid transit	310
31160: airplane	311
31170: boat	312
31210: walk	306
31220: bicycle/ skateboard/roller- skates	307
31230: in a stroller or carried by an adult	308
31310: wait for bus, train, ride (at stop)	313
31320: wait for travel, indoors	314
31900: travel, other	300, 320
31910: other vehicle	36
32100: office building/ bank/ post office	401

Table A.12-1. Assignment of NHAPS (NHA, NHW) Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (NHAPS (NHA, NHW))
32200: industrial plant/ factory/warehouse	402
32300: grocery store/convenience store	403
32400: shopping mall non-grocery store	404
32500: bar/night club/bowling alley	405
32610: auto repair shop/gas station	406
32620: other repair shop	418
32700: indoor gym, sports or health club	407
32900: public building/library/ museum/theater	408
33100: laundromat	409
33200: hospital/health care facility/doctor's office	410
33300: beauty parlor/ barber shop/hair dresser's	411
33400: at work: no specific location, moving among locations	412
33500: school	413
33600: restaurant	414
33700: church	415
33800: hotel/ motel	416
33900: dry cleaners	417
34100: parking garage	419
34200: other, indoor (specify)	400, 420
35100: sidewalk/street/neighborhood	501
35220: parking lot	502
35300: service station/gas station	503
35400: construction site	504
35600: school grounds/playground	505
35700: sports stadium and amphitheater	506
35800: park/golf course	507
35900: pool, river, lake	508
36100: restaurant, picnic	510
36200: farm	511
36300: other outdoor (specify)	500, 520

Table A.12-2. Assignment of NHAPS (NHA, NHW) Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (NHAPS (NHA, NHW))
10111: work for professional/union organizations	60
10112: work for special interest identity organizations	61
10113: work for political party and civic participation	62
10114: work for volunteer/helping organizations	63
10115: work of/for religious groups	64
10116: work for fraternal organizations	66
10117: work for child/youth/family organizations	67
10118: work for other organizations	68
10120: work, income-related only	01
10130: work, secondary (income-related)	05
10200: unemployment	02
10300: breaks	08
11100: prepare food	10
11210: clean-up food	11
11220: clean house	12
11300: outdoor chores	13
11400: care of clothes	14
11630: repair/maintain car	15
11650: other repairs	16
11700: care for plants	17
11800: care for pets/animals	18
11900: other household	19
12100: care of baby	20
12200: care of child	21
12300: help/teach	22
12400: talk/read	23
12500: play indoors	24
12600: play outdoors	25
12700: medical care-child	26
12800: other child care	27
13100: dry clean	28
13210: shop for food	30
13220: shop for clothes or household goods	31
13230: run errands	38
13300: obtain personal care service	32
13400: obtain medical service	33
13500: obtain government/financial services	34
13600: obtain car service	35
13700: other repairs	36
13800: other services	37
14110: shower, bathe	40

Table A.12-2. Assignment of NHAPS (NHA, NHW) Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (NHAPS (NHA, NHW))
14120: personal hygiene	44
14200: medical care	41
14300: help and care	42
14400: eat	43
14500: sleep or nap	45
14600: dress, groom	47
14700: other personal needs	48
15100: attend full-time school	50
15200: attend other classes	51
15300: do homework	54
15400: use library	55
15500: other education	56
16100: attend sports events	70
16210: practice religion	65
16300: view movie	72
16400: attend theater	73
16500: visit museums	74
16600: visit	75
16700: attend a party	76
16800: go to bar/lounge	77
16900: other entertainment/social events	71, 78
17110: participate in sports	80
17122: passive, sitting	81
17130: exercise	82
17141: participate in hobbies	83
17142: create domestic crafts	84
17143: create art	85
17144: perform music/drama/dance	86
17150: play games	87
17160: use of computer	88
17221: listen to radio	90
17222: listen to recorded music	92
17223: watch TV	91
17231: read books	93
17232: read magazine/not ascertained	94
17233: read newspaper	95
17241: converse	96
17242: write for leisure/pleasure/paperwork	97
17250: think and relax	98
18100: travel during work	03
18200: travel to/from work	09

Table A.12-2. Assignment of NHAPS (NHA, NHW) Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (NHAPS (NHA, NHW))
18300: travel for child care	29
18400: travel for goods and services	39
18500: travel for personal care	49
18600: travel for education	59
18700: travel for organizational activity	69
18800: travel for event/social activity	79
18910: travel for active leisure	89
18920: travel for passive leisure	99

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the NHA/NHW data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

A.13. National-scale Activity Study (NSA)

The National-scale Activity Study (NSA) was conducted from June through September 2009 by a team consisting of EPA staff and private consulting firms. The study collected activity data for respondents aged 35 through 92 years in seven U.S. metropolitan areas. In total, 6,862 diary-days of data were collected and later coded into CHAD-Master.

Data Transfer

Source of Study Data. Data files were provided by Carol Mansfield of RTI International. Details regarding the survey structure and generation of the NSA data sets are found in Knowledge Networks (2009).

Format of Data Provided. Two useable file types were provided, both in the form of SAS® data sets. The first file was the Rti_NSAS_baseline_main_client data set (dated April 15, 2011), which contained demographic and other person-level attributes for each respondent. The second type of file(s) was the rti_NSAS_diaryX_main_client files (dated October 9, 2009), where X ranged from 1 to 16 and contained the time-location-activity-pattern data for the study respondents.

Incorporating NSA into CHAD-Master

- **Source**—data provided by Carol Mansfield (of RTI International)
- **Data format**—two file types: one containing demographic and person-level attributes and another containing time, location, and activity patterns data
- **Data gathering**—recall activity diary questionnaire
- **Final CHAD-Master NSA data set**—NSA added 6,862 diary-days of human-activity and location data to CHAD-Master

Study Details

Recall versus Real-time Diary. The NSA diary data were collected based on the responses of each of the respondents to a recall activity diary questionnaire.

Time Resolution of Questionnaire. Diaries contained entries for every 15-minute segment of the day, with some intervals down to 5 minutes as coded in CHAD-Master.

Structured versus Free-form Entry. The NSA study was conducted using a structured format with eight location codes and 13 activity codes (see Table A.13-1 and Table A.13-2 respectively).

Details of the Coding of Study Information

All coding of the NSA data into CHAD-Master was performed in SAS®. The CHAD-Master variables derived from the NSA data are presented in see Table A.13-3. NSA added 6,862 diary-days of human-activity data to CHAD-Master.

Weather Variables. Meteorological data were downloaded from NOAA. Meteorological data are available from ftp://ftp.ncdc.noaa.gov/pub/data/gsod/. Meteorological sites were first

identified using Integrated Surface Database stations listed in the ish-history.txt file (dated April 6, 2011). With the exception of the Sacramento area, the major airport meteorology station within each study area was selected to represent the local meteorology (see Table A.13-4). The Sacramento area included a range counties north of and within the San Joaquin Valley that were assumed to have unique meteorology. For each county in California, the primary meteorological station closest in distance to each California county in the study was selected for use (see Table A.13-4). Data were summarized for the year 2009 (files dated June 16, 2010) when the NSA study was conducted. After processing the raw data files, four meteorological variables were retained for use in the NSA questionnaire file: daily-mean temperature (degrees F), maximum hourly temperature (degrees F), precipitation (inches of water), and precipitation duration (hours). There were no missing values for either temperature or precipitation. These meteorological data were included within the NSAS_quest_final.sas7bdat file.

Mapping of Locations from NSA to CHAD-Master. Automated location responses were given both an indoor and outdoor CHAD-Master location code; a later question asked the respondent to identify the proportion of their time they were indoors or outdoors. These events were subdivided as necessary. Additionally, respondents could type in custom answers to their location if the given selections did not suffice. These locations and activities were hand-coded according to their best CHAD-Master code match. Assignments of CHAD-Master location codes from NSA data are presented in Table A.13-1.

If the activity recorded was "Travel to another destination" then no location was provided by the respondent. However, the CHAD location codes for these activities were derived from the NSA mode of travel variable Q_travel (see Table A.13-5).

Mapping of Activities from NSA to CHAD-Master. A large number of the NSA diary entries corresponded to fixed (predetermined) survey responses for activity. The CHAD-Master activity code was assigned based on the NSA variable Q_activity (see Table A.13-2). A general education and professional training activity code of 15000 was used because all persons in the study were adults. Note that EPA updated the full set of all CHAD activity codes in 2015, after the NSA data were incorporated into CHAD-Master.

Assumptions.

Missing Locations: One of the options for location was "Other Location". If the respondents designated this location for an event, they were supposed to type in a description (hand-coded by author). However, in a number of cases, the description was missing, although indoor/outdoor information was included. The portion of these events that were designated as occurring indoors was set to location code 32000 (other indoor, general). The portion of these events that was designated outdoors was set to location code 35000 (other outdoor, general).

Missing INDOOR/OUTDOOR Designations: For events that have locations but are missing the indoor/outdoor designation (NSA variable Q10_2_L8F), the following assumptions were made: for home, school, work, and vehicle locations, the event was assumed to be all indoors (see the indoor CHAD-Master codes above); and for parking lot/garage or park (natural area) locations, the event was assumed to be all outdoors. These assumptions were made 16,747 times in 106,000 events.

Missing Date Variables: If an xdiary variable was missing, the date of the diary was

assumed to be the day prior to the day given by the baseline NSA variable TM_START (which contained the day and time that the questionnaire was started). This occurred on 1,019 days out of a total of 7,881 days, spread out across respondents. This was a good assumption, as the xdiary variables indicated the day prior to TM_START in 5,661 cases out of 6,862. In the other cases, there was a lag of 2 days.

Meteorological Data: For each county in California, the primary meteorological station closest in distance to each California county in the study was selected for use (see Table A.13-4).

Subdivision of Events: Each event was given a location based on the response to the survey. However, there was an additional question that indicated the proportion of time in the location that was spent indoors/outdoors. Each NSA location was given an "indoor" and an "outdoor" location code (see above). The event was subdivided into two events if time was spent both indoors and outdoors according to the survey response, using the following methods:

- All indoors: 100 percent of time indoors (event not subdivided)
- Mostly indoors: 66.7 percent of time indoors, balance outdoors, new event created
- Mostly outdoors: 66.7 percent of time outdoors, balance indoors, new event created
- Equally indoors and outdoors: 50 percent of time in each location, new event created
- All outdoors: 100 percent of time outdoors (event not subdivided)

New start times and event durations were calculated when each activity was subdivided.

Insertion of Travel Events: In addition to the main activity/location questions, for each event on the recall diary, the respondent was asked "How did you get from PREV LOCATION to CURRENT LOCATION?" A response may or may not have indicated the need to insert a travel event. This occurred when a response was provided for means of transportation AND a travel time was given as greater than 0 minutes (as indicated by the NSA Q_8_1A_MIN_L and Q_8_1A_HRS_L variables). There were 4,715 events (out of an initial count of 89,918 events) where the insertion of a travel event was required, with these events being distributed across respondents. The time required for travel was subtracted from the time of the previous activity, and new event start times and durations were calculated. In only 250 of these events did this result in a 0 or negative duration for the previous event. In the majority of these instances, we judged that the respondent used the question to provide additional information for a previous event, which was itself often a travel event. In these cases, the easiest solution was to not insert a travel event.

Events of 0-minute Duration: There were 895 events that had 0-minute durations scattered across the respondents. These events arose when two concurrent activities on the raw diaries had the same start time. In a majority of cases, it was assumed that these were events that may have been noted as occurring but lasted less than 1 minute (e.g., "fed dog"). It is also possible that some of these events are miscoded, but to recode them would be an intractable undertaking at this time. The simplest solution was to delete these events from the diaries.

Event Duration: After all the above processing was complete, the required CHAD-Master clock-hour sequencing was added to the data set. That is to say, at a minimum, there were 24 events per diary-day, none of which was longer than 60 minutes in duration, with start and end times for events occurring at each clock hour. As a result, the final event start/end times and durations were recalculated.

HEAVYBREATHING: If the activity level was 5 or 6 (indicating heavy/vigorous or maximal exertion levels, respectively), then the CHAD-Master event variable "HEAVYBREATHING" was set to "Y".

GASSTOVE, SMOKING, COOKINGSELF, COOKINGOTHER, SMOKINGMON, VOCS, WINDOWSOPEN, and **COMBUSTION:** There were no other data provided on the NSA questionnaires that would allow the setting of these additional CHAD-Master event file variables. Therefore, the CHAD-Master default of missing ("X") was used.

Quality Flags/Quality Assurance Checks. Additional QA/quality-control (QC) steps were taken to ensure the accuracy of the NSA data being imported into CHAD-Master. The following QA tests were performed on the final NSA events file.

- Check for incompatible start times and event durations (i.e., next event start time not equal to previous event start time plus event duration)
- Check for 24 hours in each day
- Check for invalid activity and location codes

Additional Data. An additional data set, NSAS_quest_additional, was generated from a number of NSA questionnaire responses that are not normally included in CHAD-Master. This includes variables obtained from files rti_NSAS_baseline_main_client.sas7bdat and NSAS_merge_baseline_debrief_v8.sas7bdat. Also included in the data set are the corresponding CHADIDs, raw NSA case IDs, and a number of demographic variables from the NSAS_quest_final data set that may be useful. Note that the additional data set contains 1,019 more respondents than NSAS_quest_final because it includes respondents who did not complete the diary survey.

References

Knowledge Networks. 2009. Field Report: National Scale Activity Survey (NSAS). Conducted for Research Triangle Institute. Submitted to Carol Mansfield November 13, 2009.

Table A.13-1. Assignment of NSA Location Codes to CHAD-Master Location Codes

Q_location Code(NSA)	Q_location Code Description (NSA)	LOC Code (CHAD)	LOC Code Description (CHAD)
-1	Refused	--	--
1	Home or near school	Indoor: 30120 Outdoor: 30210	Indoor: Your residence Outdoor: Your residence
2	Work or school	Indoor: 33400 Outdoor: 35000	Indoor: At work, no specific location Outdoor: Other outdoor, general
3	Other's home	Indoor: 30130 Outdoor: 30220	Indoor: Other's residence Outdoor: Other's residence
4	A parking lot/garage	Indoor: 30300 Outdoor: 35220	Indoor: Garage Outdoor: Parking lot
5	An outdoor park or natural area	Indoor: 32000 Outdoor: 35810	Indoor: Other, general Outdoor: Park
6	A private vehicle	Indoor: 31110 Outdoor: 35000	Indoor: Travel by car Outdoor: Other, general
7	A public vehicle	Indoor: 31100 Outdoor: 35000	Indoor: Motorized travel Outdoor: Other, general
8	Other (please specify)	--	--

Table A.13-2. Assignment of NSA Activity Codes to CHAD-Master Activity Codes

Q_activity Code (NSA)	Q_activity Code Description (NSA)	ACT Code (CHAD)	ACT Code Description (CHAD)
-1	Refused	X	Missing
1	Shower, bathe, personal hygiene	14120	Personal hygiene
2	Eat	14400	Eat
3	Sleep/nap	14500	Sleep or nap
4	Work (any paid work)	10000	Work and other income producing activities, general
5	Childcare	12000	Child care, general
6	Caregiving for an adult	14300	Help and care
7	General household activities	11000	General household activities
8	Shop, run errands	13200	Shop/run errands
9	Attend classes	15000	General education and professional training
10	Exercise, participate in sports	17130	Exercise
11	General leisure activities	17000	Leisure, general
12	Travel to another destination	18000	Travel, general
13	Other (please specify)	--	--

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the NSA data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

Table A.13-3. Assignment of NSA Variables to CHAD-Master Variables

CHAD Variable	CHAD Variable Description	NSA Variable
Diary Variables		
CHADID	EPA-assigned ID for this diary-day	CHADIDs were created as the text string "NSA" plus the RAWID (2 to 2,287, front 0-padded as necessary to five digits), plus a letter A through P indicating the multiple days for each person.
rawid	Raw data ID in the current study. May be missing or anonymized based on conditions imposed by the original investigators for inclusion in CHAD.	Raw NSA respondent ID number, as given in "Rti_NSAS_baseline_main_client"
starttime	Time of start of event	Q_start_time: Contains the index (1 through 96) of the 15-minute period of the day for the activity, starting at midnight such that the time = 0000
Location Variables		
county	County of residence	The county names were assigned using the FIPS codes provided by RTI International (filename FIPS.SAS7bdat).
state	State of residence	PPSTATEN where: if PPSTATEN = 54 then state = "Virginia" if PPSTATEN = 22 then state = "New Jersey" if PPSTATEN = 33 then state = "Illinois" if PPSTATEN = 43 then state = "Missouri" if PPSTATEN = 52 then state = "Maryland" if PPSTATEN = 53 then state = "District of Columbia" if PPSTATEN = 58 then state = "Georgia" if PPSTATEN = 93 then state = "California" if PPSTATEN = 74 then state = "Texas" if PPSTATEN = 23 then state = "Pennsylvania" There were no missing values.
Date Variables		
daymonth	Day of the month of diary-day (1–31)	The date of the diary in question is given in the baseline variables xdiary1 through xdiary16. These dates were used to obtain all the date-related variables. If an xdiary variable was missing, the date of the diary was assumed to be the day prior to the day given by the baseline NSA variable TM_START (which contained the day and time that the questionnaire was started).
dayofweek	Day of the week (abbreviation) (SUN, MON, TUE, WED, THU, FRI, SAT)	
month	Month of diary-day (1–12)	
year	Year of diary-day	
weekend	Flag for weekend of current diary-day (0 or 1)	

Table A.13-3. Assignment of NSA Variables to CHAD-Master Variables

CHAD Variable	CHAD Variable Description	NSA Variable
wdwe	Day type of diary-day (WE or WD)	
Personal Variables		
age	Age	PPAge There were no missing values.
education	Level of education	PPEDUC where: if PPEDUC = 1 then education = "N" if PPEDUC in (2 3) then education = "SE" if PPEDUC = 4 then education = "E" if PPEDUC in (5 6 7 8) then education = "SH" if PPEDUC = 9 then education = "HS" if PPEDUC = 10 then education = "SC" if PPEDUC in (11 12) then education = "C" if PPEDUC in (13 14) then education = "G" if PPEDUC in (-1 -2) then education = "X" There were no missing values.
gender	Gender	PPgender where: if PPgender = 1 then gender = "M" if PPgender = 2 then gender = "F" if PPgender in (-1 -2) then gender = "X" There were no missing values.
housingtype	Best description of living quarters	PPHOUSE where: if PPHOUSE = 1 then housingtype = "SF" if PPHOUSE = 2 then housingtype = "MF" if PPHOUSE = 3 then housingtype = "AP" if PPHOUSE = 4 then housingtype = "MH" if PPHOUSE = 5 then housingtype = "O" if PPHOUSE in (-1 -2) then housingtype = "X" *or missing There were no missing values.
income	Household income before taxes	PPINCIMP as a range of incomes: INCOME was assigned to the midpoint of the range. There were 563 person-days with missing values.

Table A.13-3. Assignment of NSA Variables to CHAD-Master Variables

CHAD Variable	CHAD Variable Description	NSA Variable
race	Racial/Ethnic group	PPETHM where: if PPETHM = 1 then race = "W" if PPETHM = 2 then race = "B" if PPETHM = 3 then race = "X" if PPETHM = 4 then race ="H" if PPETHM = 5 then race ="O" if PPETHM in (.-1 -2) then race = "X" PPHETHM = 3 (other, non-Hispanic) was assigned to "missing" in CHAD-Master to avoid confusion because it included Asians, which in CHAD-Master has its own category. However, biracial persons were categorized as "other" in CHAD-Master. There were 210 person-days with missing values.
Personal Flags		
asthma	Flag for having asthma (Yes/No)	if Q23 = 1 (Y) AND Q24 =1 (Y) then asthma = "Y" if Q23 = 2 (N) OR Q24 = 2 (N) then asthma = "N" There were 569 person-days with missing values.
employed	Flag for employed outside home (Yes/No)	Q32 (are you currently employed?) where: if Q32 = "Yes" then employed = "Y" if Q32 = "No" then employed = "N" There were 412 person-days with missing values.
fulltime	Flag for working full-time (Yes/No)	Q34 (In an average week how many hours do you work in total for all paid jobs?) where: if employed = "N" then fulltime = "N" if employed = "Y" and Q34 in (4 5 6 7) then fulltime = "Y" if employed = "Y" and Q34 in (1 2 3) then fulltime = "N" There were 412 person-days with missing values
heartlung	Flag for having a heart or lung condition (Yes/No)	if Q20 = 1 (Y) or Q21 = 1 (Y) or Q25 = 1 (Y) then heartlung = "Y" if Q20 = 2 (N) and Q21 = 2 (N) and Q25 = 2 (N) then heartlung ="N" There were 531 person-days with missing values.

Note: Variables shown in the above table are only those relevant to the current study. A list of all CHAD-Master variables can be found in Section 4.

Table A.13-4. Meteorological Stations Associated with the NSA Study Person-days

STN	WBAN	Station Name	Call	Latitude	Longitude	Elevation	State	Combined Statistical Area
724050	13743	WASHINGTON/NATIONAL	KDCA	38.865	-77.034	198	DC	DC
722190	13874	ATLANTA MUNICICPAL	KATL	33.64	-84.427	3127	GA	ATL
724395	3958	ST LOUIS RGNL	KALN	38.89	-90.046	1658	IL	STL
724080	13739	PHILADELPHIA INTL	KPHL	39.868	-75.231	85	PA	PHI
722430	12960	HOUSTON/INTERCONTIN	KIAH	29.993	-95.364	320	TX	HOU
722590	3927	DALLAS-FORT WORTH/F	KDFW	32.896	-97.041	1817	TX	DAL
724839	93225	SACRAMENTO INTL	KSMF	38.696	-121.59	101	CA	SAC – Yolo County
723840	23155	BAKERSFIELD/MEADOWS	KBFL	35.43	-119.06	150	CA	SAC-Kern County
725845	23225	BLUE CANYON (AMOS)	KBLU	39.29	-120.71	1610.3	CA	SAC-Placer County
723890	93193	FRESNO AIR TERMINAL	KFAT	36.78	-119.72	99.7	CA	SAC-Fresno County
N/A	53119	HANFORD MUNI ARPT	KHJO	36.32	-119.63	73.8	CA	SAC-Kings County
725847	93230	LAKE TAHOE	KTVL	38.89	-120.00	1912	CA	SAC-El Dorado County
N/A	93242	MADERA	KMAE	36.99	-120.11	77.1	CA	SAC-Madera County
724815	23257	MERCED/MACREADY FLD	KMCE	37.29	-120.51	47.5	CA	SAC-Merced County
724926	23258	MODESTO CITY CO HAR	MOD	37.63	-120.95	29.6	CA	SAC-Stanislaus County
724830	23232	SACRAMENTO/EXECUTIV	KSAC	38.51	-121.49	7.6	CA	SAC-Sacramento County
724920	23237	STOCKTON/METROPOLIT	KSCK	37.89	-121.24	8.2	CA	SAC-San Joaquin County
N/A	93241	VACAVILLE NUT TREE	KVCB	38.38	-121.96	34.7	CA	SAC-Solano County

Note: STN = Air Force Datsav3 station number; WBAN = NCDC Weather-Bureau-Army-Navy (WBAN) number; Call = International Civil Aviation Organization (ICAO) call sign; elevation = elevation in tenths of meters

Table A.13-5. Assignment to CHAD-Master Locations for NSA Activities Recorded as "Travel to another destination"

Q_travel Code (NSA)	Q-travel Code Description (NSA)	LOC Code (CHAD)	LOC Code Description (CHAD)
-1	Refused	31000	*travel general
1	Car	31110	*travel by car
2	Hybrid car	31110	*travel by car
3	Minivan	31121	*travel by van/truck
4	Full-size passenger van	31121	*travel by van/truck
5	SUV	31121	*travel by van/truck
6	Motorcycle	31130	*travel by motorcycle
7	Pickup truck	31121	*travel by van/truck
8	Walking/running to destination	31210	*travel by walk
9	Riding on a bus	31140	*travel by bus
10	Riding on a train, subway, or light rail	31150	*travel by train
11	Commercial vehicle	31100	*motorized travel
12	Bicycle, skate etc. to destination	31220	*bike or skate
13	Airplane	31160	*airplane
14	Boat	31170	*boat
15	Other method (please specify)	31000	*travel general

A.14. RTI Ozone Averting Behavior Study (OAB)

The RTI Ozone Averting Behavior (OAB) study collected activity diaries of children's activities on high and low ozone days during July through September 2002 and August 2003 (Mansfield et al., 2009). Asthmatic and non-asthmatic children ages 2 to 12 years were studied in 35 U.S. metropolitan areas having the worst ozone pollution. A total of 2,907 diary-days were added to CHAD-Master.

Data Transfer

Source of Study Data. Data were provided by Carol Mansfield of RTI International.

Format of Data Provided. No information provided at this time.

Study Details

Approximately half of the respondents studied were asthmatics. Activity data were collected from each respondent on a maximum of 6 non-consecutive days.

Recall versus Real-time Diary. No information provided at this time.

Time Resolution of Questionnaire. No information provided at this time. Activity event intervals coded into CHAD-Master were as small as 15 minutes.

Incorporating OAB into CHAD-Master

- **Source**—data provided by Carol Mansfield of RTI International
- **Data format**—no information provided at this time
- **Data gathering**—no information provided at this time
- **Final CHAD-Master OAB data set**—OAB added 2,907 diary-days of human-activity and location data to CHAD-Master

Structured versus Free-form Entry. No information provided at this time.

Details of the Coding of Study Information

Table A.14-1 provides information on the diary variables from OAB that are relevant for CHAD-Master. OAB added 2,907 diary-days of human-activity data to CHAD-Master.

Mapping of Locations from OAB to CHAD-Master. No information provided at this time.

Mapping of Activities from OAB to CHAD-Master. No information provided at this time.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Mansfield C, Houtven GV, Johnson F R, and Yang J-C. 2009. Environmental Risks and Behavior: Do children spend less time outdoors when ozone pollution is high? ASSA annual

meeting, January 5, 2009. Update of Houtven et al. (2003) using the OAB CHAD data set, and related to Mansfield et al. (2006).

Table A.14-1. CHAD-Master Variables with Corresponding Data from OAB

CHAD Variable	Description
Event Variables	
actdesc	Original activity description from survey
Location Variables	
state	State of residence
zipcode	Zip code of residence
Weather Variables	
Weather data was present for diary entries.	
Personal Variables	
race	Ethnic group
Personal Flags	
asthma	Flag of having asthma (Yes/No)
employed	Flag for employed outside home (Yes/No)
heartlung	Flag for having a heart or lung condition (Yes/No)
nearsmoker	Flag for having been around smoker (Yes/No)
smoker	Flag for being a smoker (Yes/No)

A.15. RTP Particulate Matter Panel Study (RTP)

The Research Triangle Park (RTP) Particulate Matter Panel Study was conducted by the EPA from June through November 2000 and January through May 2001 (Williams et al., 2003a,b). A total of 38 respondents aged 55 to 85 years in Wake and Orange Counties, North Carolina were monitored for exposure to $PM_{2.5}$ (particulate matter with diameters no larger than 2.5 microns) and filled out daily questionnaires and activity diaries (Williams et al., 2001). This information provided 998 diary-days of human-activity data to CHAD-Master.

Data Transfer

Source of Study Data. Data were provided in Williams et al. (2003a,b).

Format of Data Provided. Data on study activities were provided in the form of Microsoft® Excel files and processed into separate events and questionnaire files.

Incorporating RTP into CHAD-Master

- **Source**—data provided in Williams et al. (2003a,b)
- **Data format**—provided as Microsoft® Excel files
- **Data gathering**—diaries recorded in real time
- **Final CHAD-Master RTP data set**—RTP added 998 diary-days of human-activity and location data to CHAD-Master

Study Details

Over the course of the year, a total of 38 respondents living in 37 homes in Wake and Orange Counties, North Carolina were involved in personal, residential indoor, residential outdoor, and ambient $PM_{2.5}$ exposure monitoring (Williams et al., 2003a,b). Each respondent was monitored for 7 consecutive days in each of the four seasons. Respondents included 30 nonsmoking, hypertensive African-Americans from low to moderate socioeconomic status areas in southeast Raleigh, North Carolina, and eight nonsmoking individuals with implanted cardiac defibrillators from Chapel Hill, North Carolina. In addition to a number of PM measures, each respondent filled out daily questionnaires and activity diaries in relation to information on locations, activities, and potential sources of PM exposure (Williams et al., 2001).

Recall versus Real-time Diary. Diaries were recorded in real time.

Time Resolution of Questionnaire. Diaries contained entries for every 15-minute segment of the day and were entered into CHAD-Master at that resolution.

Structured versus Free-form Entry. Activities were free-form records and were coded by hand directly into CHAD-Master codes.

Details of the Coding of Study Information

Location and activity codes were determined from the coded values in the Microsoft® Excel files. Some values had been mistyped by Tom McCurdy or his students, and these were hand-corrected. The CHAD-Master variables derived from the RTP data are presented in Table A.15-1. All other questionnaire variables not listed were set to “X” (missing). RTP added 998 diary-

days of human-activity data to CHAD-Master.

Mapping of Locations from RTP to CHAD-Master. Approximately 12 location codes from the RTP data set were coded in CHAD-Master. Additional information is not provided at this time.

Mapping of Activities from RTP to CHAD-Master. No information provided at this time.

Assumptions.

- If "at store" was listed with no specific activity, the activity was assumed to be "shop".
- If "get up", "awaken", etc. were listed with no activity, the activity was assumed to be "personal care".
- If "bathroom" was given as a location with no other information, the activity was assumed to be "personal care".
- If the location was "bus", "cab ride", or "riding in car with other person driving", "sit" was used instead of "travel by bus" due to considerations around MET distributions for travel. If it was unknown whether a respondent was driving, the code was kept as "travel by car".
- For respondents who were obviously nurses, activities such as "pulling charts", "check on patients", or were locations such as "nurses station" were all coded as "work".
- For respondents who were obviously teachers, activities such as "in classroom" or "classroom/teaching" were coded as "work".
- One respondent restocked vending machines. This and other potentially vague activities were coded as "work".
- If location was "in restaurant" with no activity code, the activity was coded as "eat".
- Activities listed as "in route to X" were coded "travel" with "car" as the location unless otherwise noted (bus, etc.).
- Activities listed as "in transit" were coded "travel" with "car" as the location unless otherwise noted (bus, etc.).
- Records listed as "inside at work" etc. were all coded as "work".
- There were a number of notes regarding whether cooking was occurring. Professional judgment was used to determine whether the respondents themselves or another individual was doing the cooking.
- Activities described as "depart for X" were coded as "travel".
- If a record referenced a residential indoor location, such as "dining room" or "den", or if the location was "indoor at home" but no activity was listed, then the activity was coded as

"general household activities".

- Multiple diary entries noted PM sources, such as "wife cooking", "daughter vacuuming", "dryer running", etc. without any information on the diary respondent. If these activities happened at a residential indoor location, they were coded as "general household activities" where no other activity listed for the respondent would carry over into these entries.

- If a diary indicated "parking lot" then the activity was coded as "walk" unless another activity, such as "chat" or "sit in car", was noted.

- Any interactions between RTI International and the respondent were coded as "talk/converse".

- For multiple activities listed in the same diary event, the first activity was typically used. However, if one activity would likely have taken much longer than the others, the entry was coded as the longer activity. For example, "make coffee, clean house, eat" would be coded "clean house".

- For events that listed the name of a meal, such as "lunch" or "dinner", without indicating whether it was being prepared or eaten, professional judgment was used to code the event. In general, if a food was listed with the name of the meal, such as "lunch-soup", then it was assumed the lunch was being prepared. If no food was listed, then it was assumed the meal was being eaten.

- Nursing homes were coded as the location "health care facility".

- If another activity was listed on the same line as "TV" then the more active activity was coded.

- A number of times, after a respondent had gone to bed they entered their last activity of the day (such as "eat dinner") multiple times until the end of the diary, as opposed to coding "sleep". In these cases, it was assumed that all activities except the first instance should be coded as "sleep".

- Missing activities in locations other than in a residential indoor location were either discerned from surrounding entries using professional judgment or were listed as unknown ("U").

- If a respondent left the personal monitoring vest at home, then location was coded as "indoors at home" even if the person was not home. These activities and locations were coded as "U" if the diary did not note the individual's location.

Quality Flags/Quality Assurance Checks. In addition to the standard CHAD-Master QA/QC variables and steps (see Section A.2), other QA/QC steps were taken to ensure the accuracy of the RTP data being imported into CHAD-Master. The following QA tests were performed on the final RTP diaries.

QFinfer: Set to 1 when changes were made by Tom McCurdy or his students

WRAP: Set to "Y" when changes made to first day of diary by Tom McCurdy or his students

WRAPTIME: Set based on the "wrapping" changes to the first day in the simulation (by Tom McCurdy or his students); # minutes where wrap = "Y"

References

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Williams R, Suggs J, Rea A, Leovic K, Vette A, Croghan C, Sheldon L, Rodes C, Thornburg J, Ejire A, Herbst M, and Sanders W. 2003a. The Research Triangle Park particulate matter panel study: PM mass concentration relationships. Atmospheric Environment 37 (38): 5349–5363.

Williams R, Suggs J, Rea A, Sheldon L, Rodes C, and Thornburg J. 2003b. The Research Triangle Park particulate matter panel study: Modeling ambient source contribution to personal and residential PM mass concentrations. Atmospheric Environment 37 (36): 5365–5378.

Table A.15-1. Assignment of RTP Data to CHAD-Master

CHAD Variable	Description	RTP Variable
Diary Variables		
CHADID	EPA-assigned ID for this diary-day	The prefix for the CHADID was "RTP". The next four digits were the respondent number (e.g., "0001" through "0038"). The final two digits were the day ID, assigned a letter 0A through 0Z for days 1 to 26 and AA through GG for days 27 to 33.
Location Variables		
county	County of residence	Respondents 16 through 24 lived in Chapel Hill, NC so COUNTY was set to "Orange". All other respondents resided in southeast Raleigh, NC, so COUNTY was set to "Wake".
state	State of residence	"North Carolina" for all respondents.
Date Variables		
dayofweek	Day of the week (abbreviation) (SUN, MON, TUE, WED, THU, FRI, SAT)	Both date-related variables were set based on the date listed in the diary entry.
wdwe	Day type of diary-day (WE or WD, for weekend or weekday, respectively)	
Weather Variables		
avgtemp	Average temperature on day of study	Set based on the data at the Raleigh-Durham International Airport (RDU) NOAA weather station for the dates in question. (Calculated by Alion Science and Technology Corp. from NOAA's Integrated Surface Hourly Data files).
hourrain	Hours of rainfall on day of study	
inchrain	Inches of rainfall on day of study	
maxtemp	Maximum temperature on day of study	
Personal Variables		
housingtype	Best description of living quarters	TYPE where: if TYPE = 1 then housingtype = "SF"; *detached if TYPE = 2 then housingtype = "MF"; *duplex if TYPE = 4 then housingtype = "AP"; *apartment if TYPE = 6 then housingtype = "MA"; *trailer
race	Ethnic group	RACE was unknown for respondents 16 through 24. All other respondents were African-American.
Personal Flags		
garage	Flag for attached garage (Yes/No)	GARAGE where: if garage = 1 then garage = "Y"
gasstove	Flag for gas stove used in house (Yes/No)	C_FUEL where: if (C_FUEL = 1) then gasstove = "Y"; *these residences have a gas stove

Table A.15-1. Assignment of RTP Data to CHAD-Master

CHAD Variable	Description	RTP Variable
heartung	Flag for having a heart or lung condition (Yes/No)	All respondents were either hypertensive or had implanted defibrillators. HEARTLUNG was set to "Y" for all.

Note: Variables shown in the above table are only those relevant to the current study. A list of all CHAD-Master variables can be found in Section 4.

A.16. Seattle Study (SEA)

The Seattle (SEA) study was a PM exposure study of susceptible study groups living in Seattle, Washington between October 1999 and May 2001 (Liu et al., 2003), though the data coded into CHAD-Master stops after March 2002. Respondents ranging in age from 6 to 91 years and were monitored for PM exposure and kept diaries of time, activity, and location. Of the 1,872 diary-days of human-activity data in the study, 1,692 were coded into CHAD-Master.

Data Transfer

Source of Study Data. Source of the data was Liu et al. 2003.

Format of Data Provided. Final questionnaire and events files were provided in SAS® data set and CSV formats. The CSV events file was split into 3 files (parts I to III) so it could be opened in Microsoft® Excel. The questionnaire file contained entries for all fields that could be exported from the Microsoft® Access version of CHAD, although several were set to missing. Several other fields (for example, housing characteristics and health status) could be filled in using the data in the raw SEA data files Health2 and House2.

Incorporating SEA into CHAD-Master

- **Source**—Liu et al. 2003
- **Data format**—provided as SAS® data set and CSV formats
- **Data gathering**—diaries recorded in real time
- **Final CHAD-Master SEA data set**—SEA added 1,692 diary-days of human-activity and location data to CHAD-Master

Study Details

Two cohorts were studied with respondents ranging in age from 6 to 91 years: an older adult group of 89 people with chronic obstructive pulmonary disease, coronary heart disease, or without any signs or symptoms of cardiorespiratory disease, and a group of 19 children ages 6 to 13 years old with asthma (Liu et al., 2003).

The study included 26 monitoring sessions over the 2-year period, and up to nine respondents were evaluated per session. During each session, activity data were collected on 10 consecutive days from each respondent, with some respondents providing fewer days. For each session, information was gathered on each respondent's housing type, parking garage type, heating type, and proximity to a busy roadway for the purpose of assessing PM exposure. Respondent's also kept diaries of time, activity, and location (Liu et al., 2003).

Recall versus Real-time Diary. Diaries were recorded in real time.

Time Resolution of Questionnaire. Diaries contained entries for every 15-minute segment of the day, though activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. Activities were recorded via free-form entry. Respondents used time-activity diaries to record the amount of time spent in different microenvironments over each 24-hour monitoring day.

Details of the Coding of Study Information

The SEA activity diaries contained activity and location data for 15-minute blocks. About 89 percent of these blocks contained a single activity code and a single location, while the remaining blocks can contain up to three activities and/or locations. The data were coded using a custom SAS® program (process_seattle.sas and seattle_questionnaire.sas). SEA added 1,692 diary-days of human-activity data to CHAD-Master.

Mapping of Activities and Locations from SEA to CHAD-Master. For the blocks with a single activity/location code, decisions were made as to which CHAD codes were most appropriate for mapping to the SEA activity codes. These mappings are given in Table A.16-1. Note that EPA updated the full set of all CHAD activity codes in 2015, after the SEA data were incorporated into CHAD-Master.

The six SEA locations were home; yard; work; in transit; outdoor other; and indoor other. These codes were respectively assigned to the CHAD codes 30010 Your Residence; 30210 Your residence, Outdoor; 33400 At work: no specific location; 31000 Travel, general; 35000 Other outdoor, general; and 34300 Other, indoor. In some cases, more specific location mappings could be made based on the SEA activity codes. These mappings override the above mappings, and are also given in Table A.16-1.

For blocks having multiple (up to three, but usually two) locations and activities, assigning CHAD codes was more difficult. This was because there was no information in the SEA diaries as to which activities correspond to which locations within each block. The following general "rules" were developed for assigning codes.

- The order of the activities in time was determined by the activity number (activity 1, 2, or 3). The amount of time spent in each activity was determined by the minutes spent in the location ultimately assigned to that activity. For blocks with multiple locations but single activities, order does not matter. The block was split into two (or three) events with the same activity but different locations, and no consideration was made about order. Because the MET should be close for these identical activities, the location order should be insignificant for exposure modeling purposes.

- If the number of activities was greater than one, but only one location (number of minutes) was given, the time in the 15-minute block was split as evenly as possible between the activities (8/7 minutes or 5/5/5 minutes depending on number of activities). The order was dictated by the order of the activity codes (1, 2, or 3).

- If one of the locations was "home" AND one of the activities listed was code 1–9 or 14–17 (likely home activities) and the other is not THEN the "home" location was assigned to the "home" activity.

- If one of the locations was "in transit" AND one of the activities was code 31–38 (transit activities) and the other was not THEN the "transit" location was assigned to the "transit" activity.

- If one of the locations was "indoor other" AND one of the activities was code 22–31 (likely indoor other activities) and the other was not THEN the "indoor other" location was assigned

to the “indoor other” activity.

- If one of the locations was “yard” AND one of the activities was code 41, 44, 46, or 47 (likely yard activities) and the other was not THEN the “yard” location was assigned to the “yard” activity.

- After each of the four preceding rules was applied, one of the first two rules above were applied, if appropriate, to the block (either the “one location and multiple acts” or “one activity and multiple locs” situation remaining). If only one activity and one location remained, these locations/activities were paired.

- Any blocks that were not resolved by the above rules were handled individually. There were 174 blocks that had to be processed by hand.

The rules for assigning housing characteristics were as follows:

Housing type
if hbtype = “detached house” then housingtype = “SF”
if hbtypeo = “townhouse” then housingtype = “MF”
if hbtypeo = “fourplex” then housingtype = “MF”
if hbtype = “duplex/triplex” then housingtype = “MF”
if hbtype = “low rise apt” then housingtype = “AP”
if hbtype = “high rise apt” then housingtype = “AP”
if hbtype = “other” then housingtype = “O”
if hbtypeo = “townhouse” then housingtype = “MF”
if hbtypeo = “fourplex” then housingtype = “MF”

Heating type
if hvfair = -1 then heatingtype = “VB”
if hvradi = -1 then heatingtype = “S”
if hvoth = -1 then heatingtype = “O”
if hvothsp = “3 electric heaters” then heatingtype = “UV”; fueltype = “ES”
if hvothsp = “BASEBOARDCHEATER” then heatingtype = “E”; fueltype = “ES”
if hvothsp = “GRAVITY FLON, FUEL OIL” then heatingtype = “O”; fueltype = “OK”
if hvothsp = “HEAT PANELS IN CEILING” then heatingtype = “O”
if hvothsp = “RADIATING HEAT IN CELING” then heatingtype = “O”
if hvothsp = “baseboard” then heatingtype = “E”; fueltype = “ES”
if hvothsp = “central heater” then heatingtype = “VB”
if hvothsp = “central heating” then heatingtype = “VB”
if hvothsp = “elec wall ht (fan)” then heatingtype = “E”; fueltype = “ES”
if hvothsp = “electric heating” then heatingtype = “E”; fueltype = “ES”
if hvothsp = “electric, baseboard” then heatingtype = “E”; fueltype = “ES”
if hvothsp = “floor heated” then heatingtype = “O”
if hvothsp = “floor heater” then heatingtype = “O”
if hvothsp = “gas” then do; heatingtype = “VB”; fueltype = “OK”
if hvothsp = “gas furnace” then heatingtype = “VB”; fueltype = “OK”
if hvothsp = “heat pump-electric” then heatingtype = “VB”
if hvothsp = “oil” then do; heatingtype = “VB”; fueltype = “OK”

if hvothsp = “oil furnace” then heatingtype = “VB”; fueltype = “OK”
if hvothsp = “radiant heat in floor” then heatingtype = “O”
if hvothsp = “through floor” then heatingtype = “O”
if hvothsp = “wall/floor heater” then heatingtype = “E”; fueltype = “ES”
if (heatingtype =“X” and hvfirepl = -1) then heatingtype = “UV”
if (heatingtype =“X” and hvgspcht = -1) then heatingtype = “UV”
if (heatingtype =“X” and hvkspcht = -1) then heatingtype = “UV”
if (heatingtype =“X” and hvespcht = -1) then heatingtype = “UV”
if (heatingtype = “X“ and hvwstove = -1) then heatingtype = “UV”

Gas stove
if (hcpilgr = “Y” or hcpilov = “Y”) then gasstove = “Y”
if (hcpilgr = “N” and hcpilov = “N”) then gasstove = “N”

Attached garage
if (hbgarage = “attached” or hbgarage = “underneath”) then garage = “Y”
if (hbgarage = “none detached or separate carport”) then garage = “N”

AC
if (hvcentac > 0) then aircond = “Y”
if (hvcentac = 0) then aircond = “N”

Health status
if hstatus = “Healthy” then heartlung = “N”
if hstatus = “Healthy” then asthma = “N”
if hstatus = “COPD” then heartlung = “Y”
if hstatus = “AST” then asthma = “Y”
if hstatus = “CHD” then heartlung = “Y”

Other variables
state = “Washington”
avgtemp and maxtemp set based on the daily average and max temperatures at the SEA-TAC airport NOAA weather station for the days in question; calculated by Alion from NOAA’s Integrated Surface Hourly Data files

Assumptions

“Blank” SEA Codes. There were 6 blocks assigned a “blank” code (code 40 and 49); it was assumed that these were typos and were set to “missing”.

“Missing monitoring data” in block. There were 186 blocks that had used code 91–93 (missing monitor data indicators). These codes were set to the previous activity if the location did not change. Otherwise, these activity data were set to missing if no other activity info was available for the block.

Bad time values in block. There were 171 15-minute blocks where the time spent in different locations summed to a value other than 15. Usually these blocks were off by a single minute. These were corrected in processing by removing a minute from the final event in the block.

10-minute blocks. There were several respondents whose diaries utilized 10-minute blocks instead of 15-minute blocks. This was not a problem from a coding standpoint, but it should be noted.

Wrapping of first and last day. On the first and last day of each person's diary, a full 24 hours' worth of data was not collected. The data from the last day of the study was "wrapped" to the first day of the study to create as full a day of data as possible, and the last day was deleted. The "properties" of the first day (the date, daytype) of the first day was not changed. Events that were wrapped from the last day to the first contain the flag WRAP="Y".

Missing Blocks. There were missing 15-minute (or 10-minute) blocks in 14 diary-days. Usually either a section of early morning or late evening was missing. These blocks were added to the diaries and the data were set as "missing".

Quality Flags/Quality Assurance Checks. In addition to the standard CHAD-Master QA/QC variables and steps (see Section A.2), other QA/QC steps were taken to ensure the accuracy of the SEA data being imported into CHAD-Master. The following QA tests were performed on the final SEA diaries.

QA Flags. Some illogical entries existed. For example, several blocks were observed with the single activity "transit by car/taxi", but with significant minutes in both home and transit locations. The extent of such entries is unknown; a further canvass of the data would be necessary. These anomalies in the raw data were flagged where possible. The variable QFACTLOC (the CHAD quality flag for such as case) was set to "1" on the events file when the following were true:

- Activity is an "in vehicle" activity, time is in location other than transit
- Activity is outdoor activity, location is not outdoor
- Activity is indoor activity, location is outdoor
- **QFTravel** could not be set because the employment status of the respondents was unknown. Because the respondents were either elderly or children, it was assumed that matching travel times was unimportant.

There were 1,939 events out of a total of 178,168 where QFACTLOC was 1.

References

Liu L-JS, Box M, Kalman D, Kaufman J, Koenig J, Larson T, Lumley T, Sheppard L, and Wallace L. 2003. Exposure assessment of particulate matter for susceptible populations in Seattle. Environ Health Perspect 111: 909–918.

Table A.16-1. Assignment of SEA Data to CHAD-Master

SEA Code	SEA Code Description	CHAD Code and Description	CHAD Location (overwrites generic SEA location, see text)
Personal Activities (at home/away from home)			
01	Sleeping	14500 Sleep or nap	
02	Laying down	17250 Think and relax	
03	Personal needs: shower, bathroom, getting dressed, etc. (incl. meds, AW)	14000 Personal needs and care, general	
04	Sitting-down activities–very passive: TV, crossword, phone, reading	17122 Passive, sitting	
05	Sitting-down activities–not as passive: doing paperwork, reading newspaper, playing quietly/homework	17230 Read, general	
06	Other activities not sitting– medium level of effort: feeding animals, babysitting, playing more actively	11000 General household activities	
07	Exercise–indoor; playing actively indoors	17130 Exercise	
08	Putting on nail polish/hair spray	14120 Personal hygiene	
09	At home–activity unknown	11000 General household activities	
10	At work	10000 Work and other income-producing activities, general	
Eating/Cooking/Cleaning/Chores (at home/away from home)			
11	Eating	14400 Eat	
12	Real cooking (except microwave)	11100 Prepare food	
13	Preparing food/using microwave/no cooking	11100 Prepare food	
14	Doing dishes/washing stuff in sink/cleaning, wiping surfaces	11210 Clean up food	
15	Ironing	11400 Care of clothes	
16	Laundry	11400 Care of clothes	
17	Dusting, vacuuming, sweeping	11220 Clean house	
18	Tidying up/putting away clothes or groceries/making bed, general housekeeping	11200 Indoor chores	
19	Washing windows, floors, mopping	11220 Clean house	
20	Errands, grocery shopping, other chores	13200 Shop/run errands (for SEA code not "home") 11200 Indoor chores (for SEA code "home")	
Social Events/Miscellaneous Locations			

Table A.16-1. Assignment of SEA Data to CHAD-Master

SEA Code	SEA Code Description	CHAD Code and Description	CHAD Location (overwrites generic SEA location, see text)
21	Socializing: with 1–3 friends, visitors, family (incl. playing cards w/ friends)	16600 Visit	
22	Social/religious/political gathering (over 3 people)	16200 Participate in social, political, or religious activities	
23	Theater, movies, concert, music festival, other leisure	16400 Attend theater	32900 Public building/library/ museum/theater (unless SEA code is "outdoors")
24	Doctor's visit, phlebotomist	14200 Medical care	Doctor's office (unless SEA code is "home")
25	Hair dresser	13300 Obtain personal care service	33300 Beauty parlor/barber shop/ hair dresser's
26	Miscellaneous appointments	13200 Run errands	
27	At school in class/library	15100 Attend full-time school	33500 At school
28	Recess (with 47, 05, 06 or 07)	17170 Participate in recess and physical education	35600 School grounds/playgrounds (if SEA code "outdoors") 33500 At school (if SEA code "indoors")
29	Sports/martial arts/dance class (more active)	17100 Participate in sports and active leisure	
30	Music/theater/other lesson (less active)	17140 Create art, music, participate in hobbies	
In Transit			
31	Walking in hallways/waiting in building	17131 Walk, bike, or jog (not in transit)	
32	Transport–walking or biking outside	17131 Walk, bike, or jog (not in transit)	
33	Transport–car, taxi	18000 Travel, general	31110 Travel by car
34	Transport–bus or shuttle	18000 Travel, general	31140 Travel by bus
35	In car when car is not running	17122 Passive, sitting	31110 Travel by car
36	Waiting outside for car/bus/taxi/etc.	17122 Passive, sitting	31310 Wait for bus, train, ride (at stop) (if SEA code "outdoors") 31320 Wait for travel, indoors (if SEA code "indoors")
37	Transport–unknown type	18000 Travel, general	

Table A.16-1. Assignment of SEA Data to CHAD-Master

SEA Code	SEA Code Description	CHAD Code and Description	CHAD Location (overwrites generic SEA location, see text)
38	Transport–airplane/helicopter/ultralight	18000 Travel, general	31160 Travel by airplane
40		U Unknown	
Outside activities/Home Improvements			
41	Yard work–removing leaves/cutting grass/outdoor burning	11300 Outdoor chores	
42	Having workers at home/repair crew/cleaning person in home	11000 General household activities	
43	Painting/wall papering	11620 Paint home/room	
44	Shoveling snow/snow blower	11300 Outdoor chores	
45	Sanding/carpentry	11650 Other repairs	
46	In yard outside–inactive	17200 Participate in passive leisure	
47	Exercise–outdoor; playing actively outdoors	17100 Participate in sports and active leisure	
49		U Unknown	
Miscellaneous			
51	Other	11000 General household activities	
52	Uncertain	U Unknown	
53	No entry–location and activity unknown	X Missing	
54	Respondent with field team while in house visit	17241 Converse	
55	Burning candles/incense	11000 General household activities	
56	Wood fire in stove	11500 Build a fire	
57	Using air freshener	11200 Indoor chores	
58	Pumping gas	11630 Repair/maintain car	
59	Birthday party	16700 Attend a party	
60			
Problems in Field			
91	Monitor not worn but working	X Missing	
92	Monitor worn but not working	X Missing	
93	Monitor not worn and not working	X Missing	

Note: Variables shown in the above table are only those relevant to the current study. A list of all CHAD-Master variables can be found in Section 4. EPA updated and expanded the full set of all CHAD activity codes in 2015, after the SEA data were incorporated into CHAD-Master. The CHAD activity codes shown here do not reflect the updated activity codes.

A.17. Study of Use of Products and Exposure-related Behaviors (SUP)

As part of the SUPERB Project (Study of Use of Products and Exposure-related Behaviors, coded as "SUP" in CHAD-Master), bar codes were used to quickly and reliably determine what household and personal care products people have in their homes and determine the amount used over a 1-week period. The study included 47 California households, 30 with young children and 17 with an older adult (cumulatively covering ages up to 88 years), studied across June 2006 through March 2010. SUP added 9,446 diary-days of human-activity data to CHAD-Master.

Data Transfer

Source of Study Data. The SUP diaries were provided to EPA (Kristin Isaacs) by the study's principal investigator (Deborah Bennett of the University of California-Davis [UC-Davis]).

Format of Data Provided. The data provided by Deborah Bennett of UC-Davis was in the form of a SAS® data set.

Incorporating SUP into CHAD-Master

- **Source**—data provided by Deborah Bennett of UC-Davis
- **Data format**—provided as SAS® dataset
- **Data gathering**—24-hour recall data, collected by phone interview
- **Final CHAD-Master SUP data set**— SUP added 9,446 diary-days of human-activity and location data to CHAD-Master

Study Details

Traditionally, use of household and personal care products has been collected through questionnaires, which is very time consuming, a burden on respondents, and prone to recall bias. As part of the SUP, a novel platform was developed using bar codes to quickly and reliably determine what household and personal care products people have in their homes and determine the amount used over a 1-week period. The acceptability and feasibility of that methodology was evaluated in a longitudinal field study that included 47 California households, 30 with young children and 17 with an older adult. The dataset provided for CHAD incorporation by UC-Davis had already been coded for CHAD.

Recall versus Real-time Diary. Retrospective diaries were collected via interview for all activities that occurred the previous day. Each respondent was asked to recall their activities during the previous day, from midnight to midnight. Two separate forms were used, one for weekdays and one for weeknights. For respondents less than 8 years of age, the parent responded in place of the child. For children older than 8 years of age, the children responded. For each activity, respondents were asked the location of the activity, the duration, and whether the activity was indoor, outdoor, or in a car. Questionnaire data were also collected on general activities.

Time Resolution of Questionnaire. Respondents were asked to recall activities that occurred on the previous day. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. Activity questionnaires were free form, followed by structured questionnaires about various activities and the relative intensity of those activities.

Details of the Coding of Study Information

SUP added 9,446 diary-days of human-activity data to CHAD-Master.

Mapping of Locations from SUP to CHAD-Master. Mapping of location codes at two tiers are provided Table A.17-1 and Table A.17-3. UC-Davis had already coded their electronic diaries in terms of CHAD codes.

Mapping of Activities from SUP to CHAD-Master. Mapping of activity codes at two tiers are provided in Table A.17-2 and Table A.17-4. UC-Davis had already coded their electronic diaries in terms of CHAD codes. Note that EPA updated the full set of all CHAD activity codes in 2015, after the SEA data were incorporated into CHAD-Master.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Bennett DH, Wu XM, Teague CH, Lee K, Cassady DL, Ritz B, and Hertz-Picciotto I. 2012. Passive sampling methods to determine household and personal care product use. Journal of Exposure Science and Environmental Epidemiology 22(2): 148–160.

Table A.17-1. Tier 1 Assignment of SUP Location Codes to CHAD-Master Location Codes

Tier 1 Location Code (SUP)	Tier 1 Location Code Description (SUP)	LOC Code (CHAD)	LOC Code Description (CHAD)
R-B	basement -- own	30127	basement
R-G	garage -- own	30330	your garage
R-H	own home	30010	your residence
R-HI	own home, indoor	30120	your residence, indoor
R-HO	own home, outdoor	30210	your residence, outdoor
R-O	someone else's home	30020	other's residence
R-OI	someone else's home, indoor	30130	other's residence, indoor
R-OO	someone else's home, outdoor	30220	other's residence, outdoor
S-C	childcare at a bldg	32820	childcare facility, commercial
S-D	school, pre-school, or daycare	32800	childcare facility
S-DC	"school"/daycare (commercial bldg, includes churches)	32820	childcare facility, commercial
S-H	childcare at a house	32810	childcare facility, house
S-HC	home daycare (child care at a house)	32810	childcare facility, house
S-K	k - 12 school	33500	at school
S-KO	k - 12 outside + outside preschool/daycare facility	35600	school grounds/ playgrounds
S-O	other school or childcare location	32800	childcare facility
S-U	child care facility - unknown	32800	childcare facility
T-A	airplane	31160	travel by airplane
T-B	riding on a bus	31140	travel by bus
T-BO	boat	31170	travel by boat
T-C	in stroller or carried	31230	travel in a stroller or carried by an adult
T-M	motorcycle, etc.	31130	travel by motorcycle/moped motorized scooter
T-O	other method	31910	other travel
T-O	other method	31900	other travel
T-P	personal vehicle	31180	personal vehicle
T-R	bicycle/skate/etc.--with destination	31220	travel by bicycle/ skateboard/ roller-skates
T-RN	bicycle/skate/etc--no destination	31220	travel by bicycle/ skateboard/ roller-skates
T-S	bus/train stop	31310	wait for bus, train, ride
T-T	riding on train or light rail	31150	travel by train/subway/ rapid transit
T-V	commercial vehicle	31190	commercial vehicle
T-W	walk/run--with destination	31210	travel by walk
T-WN	walk/run--no destination	31210	travel by walk
V-B	public park, beach, golf course	35800	park/ golf course

Table A.17-1. Tier 1 Assignment of SUP Location Codes to CHAD-Master Location Codes

Tier 1 Location Code (SUP)	Tier 1 Location Code Description (SUP)	LOC Code (CHAD)	LOC Code Description (CHAD)
V-C	construction site	35400	construction site
V-DK	don't know	U	uncertain
V-F	farm	36200	farm
V-G	gym, health club	32700	indoor gym, sports or health club
V-H	hotel or motel	33800	at hotel/motel
V-L	library	32920	library / courtroom / museum / theater
V-NR	not recorded	X	missing
V-O	other indoor general	32000	other, indoor general
V-OG	other outdoor general	36300	other outdoor
V-P	public bldg/museum/theatre/arena	32900	public bldg/museum/ theatre/arena
V-PG	parking garage	34100	parking garage
V-R	religious institution	33700	at church
V-S	swimming pool	35900	pool, river, lake
V-Z	amusement park or zoo	35500	amusement park
W-A	auto related repair shop	32630	auto related repair shop
W-B	beauty salon	33300	beauty parlor/barber shop/ hair dresser
W-BP	bank / post office	33300 or 32120	beauty parlor/barber shop/ hair dresser or bank/post office
W-CS	convenience store	32320	convenience store
W-D	dry cleaners	33900	at dry cleaners
W-G	grocery store	32310	grocery store
W-GA	gas station	32640	gas station
W-H	medical facility	33200	hospital/ health care facility /doctor's office
W-I	Industrial facility	32200	Industrial plant/factory/warehouse
W-M	other store / shopping mall	32400	shopping mall/ non-grocery store
W-N	bar or nightclub	32510	bar/night club
W-O	office building	32110	office building
W-R	restaurant	33600	at restaurant
W-S	multipurpose store	32410	multipurpose store

Table A.17-2. Tier 1 Assignment of SUP Activity Codes to CHAD-Master Activity Codes

Tier 1 Activity Code (SUP)	Tier 1 Activity Code Description (SUP)	ACT Code (CHAD)	ACT Code Description (CHAD)
WS-A	very active activities	17130	exercise
		17132	highly active social/leisure activity
		17133	highly active social/leisure activity
		17134	highly active social/leisure activity
		17135	highly active social/leisure activity
		17138	highly active social/leisure activity
		17600	highly active social/leisure activity
WS-C	attend daycare	15110	Attend day-care
		15120	Attend K-12
		18300	Travel for child care
WS-D	don't know	U	Unknown
WS-E	activities requiring walking	13000	obtain goods and services, general
		13100	dry clean
		13210	shop for food
		13400	obtain medical service
		17500	active social/leisure activity
WS-F	eat	14400	eat
WS-G	outdoor chores	11200	indoor chores
		11300	outdoor chores
WS-H	hpcc	13000	obtain goods and services, general
		13500	obtain government / financial services
		16000	general entertainment / social activities
		19000	household/personal and child care
WS-I	repair	11600	repair, general
WS-J	taking a walk	16800	go to bar / lounge
		17500	active social/leisure activity
WS-K	attend k - 12	15120	attend k-12
		18600	travel for education
WS-M	play - moderate	12510	play, moderate, indoor
		12610	play, moderate, outdoor
		U	unknown
		X	missing
WS-N	sleep/nap	14500	sleep or nap
WS-O	other	13000	obtain goods and services, general
		13100	dry clean
		13210	shop for food
		13500	obtain government / financial services

Table A.17-2. Tier 1 Assignment of SUP Activity Codes to CHAD-Master Activity Codes

Tier 1 Activity Code (SUP)	Tier 1 Activity Code Description (SUP)	ACT Code (CHAD)	ACT Code Description (CHAD)
		13600	obtain car services
		14400	eat
		15000	general education and professional training
		15110	Attend day-care
		15120	attend K-12
		16000	general entertainment / social activities
		16800	go to bar/ lounge
		17131	walk, bike or job (not in transit)
		17500	active social/leisure activity
		17600	highly active social/leisure activity
		U	unknown
WS-P	play - not specified	17121	play, unspecified
WS-Q	play - quiet/non-specified	17121	play, unspecified
WS-R	not recorded	X	missing
WS-S	school	15000	general education and professional training
		15110	Attend day-care
		15120	attend K-12
		18600	travel for education
WS-T	transit	17134	travel, general
		17135	travel, general
		18000	travel, general
		18200	travel to/from work
		18400	travel for goods and services
		18500	travel for personal care
		18600	travel for education
		18800	travel for event / social activity
		18900	travel for leisure
WS-U	unknown	U	unknown
WS-V	play - vigorous	12520	play, vigorous, indoor
		12620	play, vigorous, outdoor
		17600	highly active social/leisure activity
WS-W	work	10100	work, general
WS-X	errands	13000	obtain goods and services, general
		13100	dry clean
		13230	run errands
		13600	obtain car services
		14400	eat
		16000	general entertainment / social activities
		16210	practice religion

Table A.17-2. Tier 1 Assignment of SUP Activity Codes to CHAD-Master Activity Codes

Tier 1 Activity Code (SUP)	Tier 1 Activity Code Description (SUP)	ACT Code (CHAD)	ACT Code Description (CHAD)
		16800	go to bar/ lounge
		17000	leisure, general
		17130	exercise
		18000	travel, general
		18400	travel for goods and services
		U	unknown
WS-Y	standing	17400	quiet social/leisure activity
WS-Z	sitting	17200	passive social/leisure activity

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the SUP data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs. Repeated entries for the SUP code correspond to diary events where the location code helped dictate the most appropriate ACT.

Table A.17-3. Tier 2 Assignment of SUP Location Codes to CHAD-Master Location Codes

Tier 2 Location Code (SUP)	Tier 2 Location Code Description (SUP)	LOC Code (CHAD)	LOC Code Description (CHAD)
R-B	basement -- own	30127	basement
R-G	garage -- own	30330	your garage
R-H	own home	30010	your residence
		30120	your residence, indoor
		30210	your residence, outdoor
R-O	someone else's home	30020	other's residence
		30130	other's residence, indoor
		30220	other's residence, outdoor
S-C	childcare at a commercial or community bldg (e.g., church)	32820	childcare facility, commercial
S-D	school, pre-school, or daycare	32800	childcare facility
S-H	childcare at a house	32810	childcare facility, house
S-O	other school or childcare location	32800	childcare facility
T-A	airplane	31160	travel by airplane
T-B	riding on a bus	31140	travel by bus
T-C	in stroller or carried by adult	31230	travel in a stroller or carried by an adult
T-M	motorcycle, motor scooter, or moped	31130	travel by motorcycle/moped motorized scooter
T-O	other transit method (not otherwise specified)	31900	other travel
T-P	car, pickup truck, or personal van	31180	personal vehicle
T-R	bicycle, skateboard, roller skates, etc.	31220	travel by bicycle/ skateboard/ roller-skates
T-S	waiting at bus stop or train/rail station	31310	wait for bus, train, ride
T-T	riding on train or light rail	31150	travel by train/subway/ rapid transit
T-V	commercial truck or commercial van	31190	commercial vehicle
T-W	walk/run--with destination	31210	travel by walk
V-B	public park, beach, playground or other outdoor rec fac	35800	park/ golf course
V-C	construction site (commercial, not home maintenance)	35400	construction site
V-F	farm (commercial, not home gardening)	36200	farm
V-G	gym, health club, or other indoor recreation facility	32700	indoor gym, sports or health club
V-H	hotel or motel	33800	at hotel/motel
V-O	other indoor general	32000	other, indoor general
V-P	public building (museum, theatre, library)	32900	public bldg/museum/ theatre/arena

Table A.17-3. Tier 2 Assignment of SUP Location Codes to CHAD-Master Location Codes

Tier 2 Location Code (SUP)	Tier 2 Location Code Description (SUP)	LOC Code (CHAD)	LOC Code Description (CHAD)
V-R	religious institution (church, temple, mosque, synagogue)	33700	at church
V-Z	amusement park or zoo	35500	amusement park
W-A	auto repair shop, gas station, indoor parking area, car wash	32610	auto repair shop / gas station
W-B	beauty parlor, barbershop, hairdresser, nail salon	33300	beauty parlor/barber shop/ hair dresser
W-D	dry cleaners	33900	at dry cleaners
W-G	grocery store	32310	grocery store
W-H	hospital, medical office, or other healthcare facility	33200	hospital/ health care facility /doctor's office
W-I	industrial plant, factory or warehouse	32200	industrial plant/factory/ warehouse
W-M	shopping mall or other non-grocery store	32400	shopping mall/ non-grocery store
W-N	bar or nightclub	32510	bar/night club
W-O	office building (e.g., bank, post office)	32100	office building / bank / post office
W-R	restaurant	33600	at restaurant
W-S	multipurpose store	32410	multipurpose store

Note: Repeated entries for the SUP code correspond to diary events where the additional aspects of the diary entry helped dictate the most appropriate LOC.

Table A.17-4. Tier 2 Assignment of SUP Activity Codes to CHAD-Master Activity Codes

Tier 2 Activity Code (SUP)	Tier 2 Activity Code Description (SUP)	ACT Code (CHAD)	ACT Code Description (CHAD)
WS-N	sleep/nap	14500	sleep or nap
WS-O	other	13000	obtain goods and services, general
		13100	dry clean
		13200	shop/ run errands
		13300	obtain personal care service
		13400	obtain medical service
		13600	obtain car services
		13800	other service
		14400	eat
		16210	practice religion
		16800	go to bar/ lounge
		16900	other entertainment /social events
		17130	exercise
		u	unknown
		x	missing
WS-P	play (moderate play)	12510	play, moderate, indoor
		12610	play, moderate, outdoor
WS-S	school/daycare	15000	general education and professional training
		15110	attend day-care
		18300	travel for child care
WS-T	travel time	18000	travel, general
		18300	travel for child care
WS-V	play (vigorous play)	12520	play, vigorous, indoor
		12620	play, vigorous, outdoor
WS-W	work (paid work only)	10100	work, general
WS-WV	work (volunteer)	10119	volunteer work / non-income related

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the SUP data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs. Repeated entries for the SUP code correspond to diary events where the location code helped dictate the most appropriate ACT.

A.18. Valdez Air Health Study (VAL)

This Valdez Air Health Study (VAL) study was conducted during April, May, and August of 1990 and February and March of 1991 (Goldstein et al., 1992). A total of 289 individuals from different households were interviewed as part of a continuous monitoring program that also measured criteria pollutants, volatile organic compounds, and weather conditions. This sample covered 23 percent of the residences in the Valdez area and added 397 diary-days of human-activity data to CHAD-Master.

Data Transfer

Source of Study Data. The data for this study were provided by Ted Johnson (of TRJ Environmental).

Format of Data Provided. No information provided at this time.

Study Details

Recall versus Real-time Diary. No information provided at this time.

Time Resolution of Questionnaire. No information provided at this time. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. No information provided at this time.

Incorporating VAL into CHAD-Master

- **Source**—data provided by Ted Johnson (of TRJ Environmental)
- **Data format**—not provided
- **Data gathering**—information not provided
- **Final CHAD-Master VAL data set**—VAL added 397 diary-days of human-activity and location data to CHAD-Master

Details of the Coding of Study Information

VAL added 397 diary-days of human-activity and location data to the CHAD-Master. The CHAD questionnaire file variables were determined from the VAL data as presented in Table A.18-1.

Mapping of Locations from VAL to CHAD-Master. No information provided at this time.

Mapping of Activities from VAL to CHAD-Master. No information provided at this time.

Assumptions. No information provided at this time.

Additional Data. No information provided at this time.

References

Goldstein B, Tardiff R, Hoffnagle G, and Kester R. 1992. Valdez Air Health Study: Summary

Report. Prepared for Alyeska Pipeline Service Company, Anchorage, AK.

Table A.18-1. Assignment of VAL Data to CHAD-Master

CHAD Variable	CHAD Variable Description
Location Variables	
county	County of residence
state	State of residence
Weather Variables	
Weather data were present for diary entries.	
Personal Variables	
fueltype	Fuel or energy source used to heat living quarters
heatingtype	Type of heating for living quarters
occup	U.S. Census Bureau occupation group
weight	Weight
Personal Flags	
aircond	Flag for air conditioning (Yes/No)
employed	Flag for employed outside home (Yes/No)
garage	Flag for attached garage (Yes/No)
heartlung	Flag for having a heart or lung condition (Yes/No)

Note: Variables shown in the above table are only those relevant to the current study. A list of all CHAD-Master variables can be found in Section 4.

A.19. Washington, DC Study (WAS)

The Washington, DC Study (WAS) was a CO exposure study conducted November 1982 through February 1983 in the Washington, DC metropolitan area using 705 respondents between 18 and 71 years of age (Settergren et al., 1984; Hartwell et al., 1984; Johnson et al., 1986). WAS added 699 diary-days of human-activity data to CHAD-Master.

Data Transfer

Source of Study Data. The electronic data were provided by James Capel, and were found to have incomplete questionnaire data. This caused many variables to contain missing data. So far, a source for the remaining questionnaire has not been found.

Format of Data Provided. No information provided at this time.

Incorporating WAS into CHAD-Master

- **Source**—data provided in Johnson et al. (1986), Hartwell et al. (1984), Settergren et al. (1984); James Capel provided database
- **Data format**—electronic data provided (format unspecified)
- **Data gathering**—activity diary and background questionnaire
- **Final CHAD-Master WAS data set**—WAS added 699 diary-days of human-activity and location data to CHAD-Master

Study Details

The study was sponsored by the EMSL of EPA. WAS was conducted concurrently with DEN (see Section A.8) and covered each of the 705 respondents for 1 day (Settergren et al., 1984). DEN and WAS were carried out as part of studies of personal exposure to CO. In 1991, EPA/OAQPS combined data from the CIN, DEN, and WAS studies into a "Multicity Activity Data Base" (Paul et al., 1991).

WAS was performed by RTI International, and has been described in detail by Hartwell et al. (1984), Settergren et al. (1984), and Johnson et al. (1986). It differs from DEN in two ways: (1) twice as many respondents were used in WAS and (2) each WAS respondent carried a PEM and a diary for a single 24-hour period. The CIN, DEN, and WAS studies were similar in that each used an activity diary and a background questionnaire as data collection instruments.

Recall versus Real-time Diary. An activity diary was also provided to each respondent. Each respondent was asked to carry an activity diary for a single 24-hour sampling period. Each respondent was also requested to complete a detailed background questionnaire. WAS added 699 diary-days of human-activity and location data to CHAD-Master.

Time Resolution of Questionnaire. The start and end times were not consistent from person to person. No other information is provided at this time. Activity event intervals coded into CHAD-Master were as small as 1 minute.

Structured versus Free-form Entry. A questionnaire was administered with a set of structured

questions.

Details of the Coding of Study Information

WAS added 699 diary-days of human-activity and location data to the CHAD-Master.

Mapping of Locations from WAS to CHAD-Master. The list of potential location codes is fairly short, limiting the resolution in location description that is possible in this study. Mapping of CHAD-Master locations to WAS location variables is presented in Table A.19-1.

Mapping of Activities from WAS to CHAD-Master. The list of potential activity codes is fairly short, limiting the resolution in activity description that is possible in this study. Mapping of CHAD-Master activities to WAS activity variables is presented in Table A.19-2. Note that EPA updated the full set of all CHAD activity codes in 2015, after the WAS data were incorporated into CHAD-Master.

Assumptions. The activity data in each study should reflect activities for a 24-hour period. However, it was found that records may have missing activity data such that a complete 24-hour period was not represented. Also, the start and end times were not consistent from person to person. In CHAD, all diaries are exactly 24-hours long and start at midnight. The variable WRAPTIME indicates the true diary starting time. Two sequencing numbers are provided: RECNUM indicates the new midnight-to-midnight order, while SEQ indicates the original chronological sequence.

Additional Data. No information provided at this time.

References

Hartwell TD, Clayton CA, Richie RM, Whitmore RW, Zelon HS, Jones SM, and Whitehurst DA. 1984. Study of Carbon Monoxide Exposure of Residents of Washington, D.C. and Denver, Colorado. Prepared for the U.S. Environmental Protection Agency. Research Triangle Park, NC.

Johnson, T, Capel J, and Wijnberg L. 1986. Selected Data Analyses Relating to Studies of Personal Carbon Monoxide Exposure in Denver and Washington, DC. Prepared for U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

Paul RA, Yoder JM, Johnson T, and Capel J. 1991. Documentation for the Multicity Activity Data Base. Report for International Technology Air Quality Services, Durham, NC.

Settergren SK, Hartwell TD, and Clayton CA. 1984. Study of Carbon Monoxide Exposure of Residents of Washington, DC.: Additional Analyses. Prepared for U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Research Triangle Park, NC.

Table A.19-1. Assignment of WAS Location Codes to CHAD-Master Location Codes

LOC Code and Description (CHAD)	Location Code (WAS)
30100: residence, indoor	0200
30200: residence, outdoor	0883
30331: indoor garage	0661
30332: outdoor garage	0881
31000: travel, general	0100
32100: office building/ bank/ post office	0300
32300: grocery store/convenience store	0400
32400: shopping mall non-grocery store	0664
32910: auditorium, sport's arena, concert hall	0662
33200: hospital/health care facility/doctor's office	0666
33500: school	0665
33600: restaurant	0500
33700: church	0663
34100: parking garage	0661
34200: laboratory	0667
34200: other, indoor (specify)	0669
35200: public garage/parking lot	0881
35300: service station/gas station	0885
35400: construction site	0882
35800: park/golf course	0884
36300: other outdoor (specify)	0889

Table A.19-2. Assignment of WAS Activity Codes to CHAD-Master Activity Codes

ACT Code and Description (CHAD)	Activity Code (WAS)
10100: work, general	2, 22
11100: prepare food	3, 23
11200: indoor chores	5, 25
11300: outdoor chores	6, 26
11400: care of clothes	4, 24
13200: shop/run errands, general	7, 27
14000: personal needs and care, general	8, 28
14400: eat	13, 33
14500: sleep or nap	11, 31
15000: general education and professional training	12, 32
16200: participate in social, political, or religious activities	15
17000: leisure, general	9, 29
17100: participate in sports and active leisure	14, 34
18000: travel, general	1, 21

Note: EPA updated and expanded the full set of all CHAD ACTs in 2015, after the WAS data were incorporated into CHAD-Master. The ACTs shown here do not reflect the updated ACTs.

Appendix B: Crosswalk between Previous and Current CHAD Activity Codes

In early 2015, EPA updated the set of activity codes used in CHAD so that some specific activities undertaken by study respondents now have correspondingly specific activity codes, whereas they previously were grouped with similar activities into broader, less-specific activity codes. For example, the previous "Participate in sports" activity code included four specific sub-categories of activities (Hunting, fishing, hiking; Golf; Bowling / pool / ping pong / pinball; and Yoga), and those not fitting into those four sub-categories were allocated to the broad "Participate in sports" code. In early 2015, the broad "Participate in sports, general" activity still exists, but there are now more than 30 sub-categories spanning combat sports, racquet sports, team sports, water sports, and winter sports. A crosswalk between previous and current CHAD activity codes is provided below. The third column of the table indicates if the activity code number was changed during the development of the new activity codes so that the coding sequence and relationships between adjacent codes were logical, and the fourth column indicates if the August 15, 2014, activity code was among the subset of codes assessed for activity-code revision (not all activity codes were assessed this way).

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
10000	Work and other income producing activities, general	NO	NO	10000	Work and other income producing activities, general
10100	Work, general	NO	NO	10100	Work, general
10110	Work, general, for organizational activities	NO	NO	10110	Work, general, for organizational activities
10111	Work for professional/union organizations	NO	NO	10111	Work for professional/union organizations
10112	Work for special interest identity organizations	NO	NO	10112	Work for special interest identity organizations
10113	Work for political party and civic participation	NO	NO	10113	Work for political party and civic participation
10114	Work for volunteer/ helping organizations	NO	NO	10114	Work for volunteer/ helping organizations
10115	Work of/for religious groups	NO	NO	10115	Work of/for religious groups
10116	Work for fraternal organizations	NO	NO	10116	Work for fraternal organizations
10117	Work for child / youth / family organizations	NO	NO	10117	Work for child / youth / family organizations
10118	Work for other organizations	NO	NO	10118	Work for other organizations
10120	Work, income-related only	NO	NO	10120	Work, income-related only
10130	Work, secondary (income-related)	NO	NO	10130	Work, secondary (income-related)
10200	Unemployment	NO	NO	10200	Unemployment
10300	Breaks	NO	NO	10300	Breaks

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
11000	General household activities	NO	YES	11000	Household activities, general
11900	Other household	YES	NO	11001	Other household
11100	Prepare food	NO	YES	11100	Prepare food, general
11100	Prepare food	NO	YES	11101	Washing
11110	Prepare and clean-up food	NO	NO	11110	Prepare and clean-up food
11100	Prepare food	NO	YES	11120	Cooking
11100	Prepare food	NO	YES	11121	Baking
11100	Prepare food	NO	YES	11122	Fry, grill, sautee
11100	Prepare food	NO	YES	11130	Simple food preparation
11100	Prepare food	NO	YES	11131	Cutting/chopping
11200	Indoor chores	NO	YES	11200	Indoor chores, general
11200	Indoor chores	NO	YES	11210	Move things
11200	Indoor chores	NO	YES	11220	Put things away
11200	Indoor chores	NO	YES	11230	Straighten up
11200	Indoor chores	NO	YES	11231	Make bed
11210	Clean-up food	YES	YES	11240	Clean-up food
11300	Outdoor chores	NO	YES	11300	Outdoor chores, general
11300	Outdoor chores	NO	YES	11301	Shoveling
11300	Outdoor chores	NO	YES	11310	Clean outdoors
11300	Outdoor chores	NO	YES	11320	Chop wood
11300	Outdoor chores	NO	YES	11330	Garden

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
11300	Outdoor chores	NO	YES	11331	Harvest
11300	Outdoor chores	NO	YES	11332	Watering
11300	Outdoor chores	NO	YES	11333	Weeding
11300	Outdoor chores	NO	YES	11340	Lawn/grass
11300	Outdoor chores	NO	YES	11341	Lawn watering
11300	Outdoor chores	NO	YES	11342	Lawn weeding
11300	Outdoor chores	NO	YES	11343	Mowing
11300	Outdoor chores	NO	YES	11344	Pruning
11300	Outdoor chores	NO	YES	11345	Use rake/leaf blower
11300	Outdoor chores	NO	YES	11350	Load/unload
11300	Outdoor chores	NO	YES	11360	Mechanical chores
11300	Outdoor chores	NO	YES	11370	Move objects
11400	Care of clothes	NO	YES	11400	Care of clothes, general
11400	Care of clothes	NO	YES	11401	Fold/sort
11410	Wash clothes	NO	NO	11410	Wash clothes
11400	Care of clothes	NO	YES	11411	Hand wash/dry
11400	Care of clothes	NO	YES	11412	Laundry
11400	Care of clothes	NO	YES	11420	Maintain clothes
11400	Care of clothes	NO	YES	11421	Mend/sew
11400	Care of clothes	NO	YES	11422	Press/iron/steam
11500	Build a fire	NO	NO	11500	Build a fire

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
11600	Repair, general	NO	NO	11600	Repair, general
11610	Repair of boat	NO	NO	11610	Repair of boat
11620	Paint home / room	NO	NO	11620	Paint home / room
11630	Repair / maintain car	NO	NO	11630	Repair / maintain car
11640	Home repairs	NO	YES	11640	Home repairs, general
11640	Home repairs	NO	YES	11641	Home improvement/construction, moderate level
11640	Home repairs	NO	YES	11642	Home maintenance, low level
11650	Other repairs	NO	NO	11650	Other repairs
11700	Care of plants	NO	YES	11700	Care of plants, general
11700	Care of plants	NO	YES	11710	Care of plants, low level
11700	Care of plants	NO	YES	11720	Care of plants, moderate level
11800	Care for pets/animals	NO	NO	11800	Care for pets/animals
11220	Clean house	YES	YES	11900	Clean house, general
11220	Clean house	NO	YES	11901	Collect/empty trash
11220	Clean house	NO	YES	11902	Mop
11220	Clean house	NO	YES	11903	Sweep
11220	Clean house	NO	YES	11904	Vacuum
11220	Clean house	NO	YES	11910	Clean house, heavy
11220	Clean house	NO	YES	11911	Clean bathroom
11220	Clean house	NO	YES	11912	Clean carpet

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
11220	Clean house	NO	YES	11913	Clean floors
11220	Clean house	NO	YES	11914	Clean kitchen
11220	Clean house	NO	YES	11915	Wash windows
11220	Clean house	NO	YES	11920	Clean house, light
11220	Clean house	NO	YES	11921	Dust
11220	Clean house	NO	YES	11922	Use aerosol cleaner/freshener
12000	Child care, general	NO	YES	12000	Child care, general
12100	Care of baby	NO	NO	12100	Care of baby
12200	Care of child	NO	NO	12200	Care of child
12300	Help / teach	NO	NO	12300	Help / teach
12400	Talk /read	NO	NO	12400	Talk /read
12500	Play indoors	NO	NO	12500	Play indoors
12600	Play outdoors	NO	NO	12600	Play outdoors
12700	Medical care-child	NO	NO	12700	Medical care-child
12800	Other child care	NO	NO	12800	Other child care
13000	Obtain goods and services, general	NO	NO	13000	Obtain goods and services, general
13100	Dry clean	NO	NO	13100	Dry clean
13200	Shop / run errands	NO	YES	13200	Shop/run errands, general
13200	Shop / run errands	NO	YES	13201	Errands for children or pets
13200	Shop / run errands	NO	YES	13202	Shopping, general

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
13200	Shop / run errands	NO	YES	13203	Shop at mall or superstore
13210	Shop for food	NO	YES	13210	Shop for food, general
13210	Shop for food	NO	YES	13211	Grocery shopping
13210	Shop for food	NO	YES	13212	Shop for meals/snacks
13220	Shop for clothes or household goods	NO	NO	13220	Shop for clothes or household goods
13230	Run errands	NO	NO	13230	Run errands
13300	Obtain personal care service	NO	NO	13300	Obtain personal care service
13400	Obtain medical service	NO	NO	13400	Obtain medical service
13500	Obtain government / financial services	NO	NO	13500	Obtain government / financial services
13600	Obtain car services	NO	NO	13600	Obtain car services
13700	Other repairs	NO	NO	13700	Other repairs
13800	Other services	NO	NO	13800	Other services
14000	Personal needs and care, general	NO	YES	14000	Personal needs and care, general
14000	Personal needs and care, general	NO	YES	14001	Wake up
14100	Shower, bathe, personal hygiene	NO	NO	14100	Shower, bathe, personal hygiene
14110	Shower, bathe	NO	YES	14110	Shower, bathe, general
14110	Shower, bathe	NO	YES	14111	Bathe
14110	Shower, bathe	NO	YES	14112	Shower
14120	Personal hygiene	NO	YES	14120	Personal hygiene, general
14120	Personal hygiene	NO	YES	14121	Use restroom

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
14120	Personal hygiene	NO	YES	14122	Wash hands/teeth/face
14200	Medical care	NO	YES	14200	Medical care, general
14200	Medical care	NO	YES	14201	Use nebulizer/oxygen machine
14200	Medical care	NO	YES	14210	Feel sick
14300	Help and care	NO	NO	14300	Help and care
14400	Eat	NO	NO	14400	Eat
14500	Sleep or nap	NO	NO	14500	Sleep or nap
14600	Dress, groom	NO	NO	14600	Dress, groom
14700	Other personal needs	NO	NO	14700	Other personal needs
15000	General education and professional training	NO	NO	15000	General education and professional training
15100	Attend full-time school	NO	NO	15100	Attend full-time school
15110	Attend day-care	NO	NO	15110	Attend day-care
15120	Attend K-12	NO	YES	15120	Attend K-12
15130	Attend college or trade school	NO	NO	15130	Attend college or trade school
15140	Attend adult education and special training	NO	NO	15140	Attend adult education and special training
15200	Attend other classes	NO	NO	15200	Attend other classes
15300	Do homework	NO	NO	15300	Do homework
15400	Use library	NO	NO	15400	Use library
15500	Other education	NO	NO	15500	Other education

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
16000	General entertainment / social activities	NO	YES	16000	Social activities, general
16000	General entertainment / social activities	NO	YES	16001	Gamble
16000	General entertainment / social activities	NO	YES	16002	Go to park or festival
16100	Attend sports events	NO	NO	16100	Attend sports events
16200	Participate in social, political, or religious activities	NO	NO	16200	Participate in social, political, or religious activities
16210	Practice religion	NO	NO	16210	Practice religion
16300	Watch movie	NO	NO	16300	Watch movie
16400	Attend theater	NO	NO	16400	Attend theater
16500	Visit museums	NO	NO	16500	Visit museums
16600	Visit	NO	NO	16600	Visit
16700	Attend a party	NO	YES	16700	Attend a party, general
16700	Attend a party	NO	YES	16701	Attend a party, dance
16700	Attend a party	NO	YES	16702	Attend a party, eat/drink
16700	Attend a party	NO	YES	16703	Attend a party, sit/stand
16700	Attend a party	NO	YES	16704	Attend a party, talk
16700	Attend a party	NO	YES	16705	Attend a party, walk
16800	Go to bar / lounge	NO	NO	16800	Go to bar / lounge

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
16900	Other entertainment / social events	NO	NO	16900	Other entertainment / social events
17000	Leisure, general	NO	YES	17000	Leisure, general
17000	Leisure, general	NO	YES	17010	Indoor leisure
17111	Hunting, fishing, hiking	NO	NO	17111	Hunting, fishing, hiking
17112	Golf	NO	NO	17112	Golf
17113	Bowling / pool / ping pong / pinball	NO	NO	17113	Bowling / pool / ping pong / pinball
17114	Yoga	NO	NO	17114	Yoga
17120	Participate in outdoor leisure	NO	NO	17120	Participate in outdoor leisure
17122	Passive, sitting	YES	NO	17121	Passive, sitting
17140	Create art, music, participate in hobbies	NO	NO	17140	Create art, music, participate in hobbies
17141	Participate in hobbies	NO	NO	17141	Participate in hobbies
17142	Create domestic crafts	NO	NO	17142	Create domestic crafts
17143	Create art	NO	NO	17143	Create art
17144	Perform music / drama / dance	NO	NO	17144	Perform music / drama / dance
17121	Play, unspecified	YES	YES	17150	Play, unspecified, general
17121	Play, unspecified	YES	YES	17151	Play, unspecified, low level
17121	Play, unspecified	YES	YES	17152	Play, unspecified, moderate level
17160	Use of computers	NO	NO	17160	Use of computers

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17170	Participate in recess and physical education	NO	NO	17170	Participate in recess and physical education
17180	Other sports and active leisure	NO	YES	17180	Other sports and active leisure, general
17200	Participate in passive leisure	NO	YES	17200	Passive leisure, general
17200	Participate in passive leisure	NO	YES	17201	Indoor passive leisure
17210	Watch	NO	NO	17210	Watch
17211	Watch adult at work	NO	NO	17211	Watch adult at work
17212	Watch someone provide childcare	NO	NO	17212	Watch someone provide childcare
17213	Watch personal care	NO	NO	17213	Watch personal care
17214	Watch education	NO	NO	17214	Watch education
17215	Watch organizational activities	NO	NO	17215	Watch organizational activities
17216	Watch recreation	NO	NO	17216	Watch recreation
17220	Listen to radio / listen to recorded music / watch T.V.	NO	NO	17220	Listen to radio / listen to recorded music / watch T.V.
17221	Listen to radio	NO	NO	17221	Listen to radio
17222	Listen to recorded music	NO	NO	17222	Listen to recorded music
17223	Watch TV	NO	NO	17223	Watch TV
17230	Read, general	NO	NO	17230	Read, general
17231	Read books	NO	NO	17231	Read books

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17232	Read magazines / not ascertained	NO	NO	17232	Read magazines / not ascertained
17233	Read newspaper	NO	NO	17233	Read newspaper
17240	Converse / write	NO	NO	17240	Converse / write
17241	Converse	NO	NO	17241	Converse
17242	Write for leisure / pleasure / paperwork	NO	NO	17242	Write for leisure / pleasure / paperwork
17250	Think and relax	NO	NO	17250	Think and relax
17260	Other passive leisure	NO	NO	17260	Other passive leisure
17300	Other leisure	NO	NO	17300	Other leisure
17131	Walk, bike, or jog (not in transit)	YES	YES	17400	Walk, bike, or jog (not in transit), general
17131	Walk, bike, or jog (not in transit)	YES	YES	17410	Bike, general
17131	Walk, bike, or jog (not in transit)	YES	YES	17411	Bike
17131	Walk, bike, or jog (not in transit)	YES	YES	17412	Cycles, other
17131	Walk, bike, or jog (not in transit)	YES	YES	17413	Tricycle
17131	Walk, bike, or jog (not in transit)	YES	YES	17420	Run or jog, general
17131	Walk, bike, or jog (not in transit)	YES	YES	17421	Run around, casual
17131	Walk, bike, or jog (not in transit)	YES	YES	17422	Running, vigorous/sustained
17131	Walk, bike, or jog (not in transit)	YES	YES	17430	Walk, general
17131	Walk, bike, or jog (not in transit)	YES	YES	17431	Crawl
17131	Walk, bike, or jog (not in transit)	YES	YES	17432	Use of walker

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17131	Walk, bike, or jog (not in transit)	YES	YES	17433	Walk dog
17131	Walk, bike, or jog (not in transit)	YES	YES	17434	Walk for chores
17131	Walk, bike, or jog (not in transit)	YES	YES	17435	Walk inside
17110	Participate in sports	YES	YES	17500	Participate in sports, general
17110	Participate in sports	YES	YES	17501	Archery
17110	Participate in sports	YES	YES	17502	Equestrian sports
17110	Participate in sports	YES	YES	17503	Frisbee
17110	Participate in sports	YES	YES	17504	Gymnastics
17110	Participate in sports	YES	YES	17505	Skateboarding
17110	Participate in sports	YES	YES	17506	Skating
17110	Participate in sports	YES	YES	17507	Track
17110	Participate in sports	YES	YES	17510	Combat sports
17110	Participate in sports	YES	YES	17511	Boxing
17110	Participate in sports	YES	YES	17512	Fencing
17110	Participate in sports	YES	YES	17513	Martial arts
17110	Participate in sports	YES	YES	17514	Wrestling
17110	Participate in sports	YES	YES	17520	Racquet sports
17110	Participate in sports	YES	YES	17521	Badminton
17110	Participate in sports	YES	YES	17522	Racquetball
17110	Participate in sports	YES	YES	17523	Squash
17110	Participate in sports	YES	YES	17524	Tennis

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17110	Participate in sports	YES	YES	17530	Team sports
17110	Participate in sports	YES	YES	17531	Baseball
17110	Participate in sports	YES	YES	17532	Basketball
17110	Participate in sports	YES	YES	17533	Cheerleading
17110	Participate in sports	YES	YES	17534	Dodgeball
17110	Participate in sports	YES	YES	17535	Football
17110	Participate in sports	YES	YES	17536	Hockey
17110	Participate in sports	YES	YES	17537	Kickball
17110	Participate in sports	YES	YES	17538	Lacrosse
17110	Participate in sports	YES	YES	17539	Rugby
17110	Participate in sports	YES	YES	17541	Soccer
17110	Participate in sports	YES	YES	17542	Softball
17110	Participate in sports	YES	YES	17543	Volleyball
17110	Participate in sports	YES	YES	17550	Water sports
17110	Participate in sports	YES	YES	17551	Surfing
17110	Participate in sports	YES	YES	17552	Swimming
17110	Participate in sports	YES	YES	17560	Winter sports
17150	Play games	YES	YES	17600	Play games, general
17150	Play games	YES	YES	17610	Active games
17150	Play games	YES	YES	17611	Fighting
17150	Play games	YES	YES	17612	Running games

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17150	Play games	YES	YES	17613	Trampoline
17150	Play games	YES	YES	17620	Board games/card games
17150	Play games	YES	YES	17621	Board games
17150	Play games	YES	YES	17622	Bingo
17150	Play games	YES	YES	17623	Card games
17150	Play games	YES	YES	17630	Dress-up/make believe
17150	Play games	YES	YES	17640	Low energy games
17150	Play games	YES	YES	17641	Arts and crafts
17150	Play games	YES	YES	17642	Play with books
17150	Play games	YES	YES	17643	Writing/drawing
17150	Play games	YES	YES	17650	Outdoor play
17150	Play games	YES	YES	17651	Playground/swings
17150	Play games	YES	YES	17660	Play with animals
17150	Play games	YES	YES	17670	Puzzles
17150	Play games	YES	YES	17671	Jigsaw puzzle
17150	Play games	YES	YES	17672	Word puzzle
17150	Play games	YES	YES	17680	Toys
17150	Play games	YES	YES	17681	Toy balls
17150	Play games	YES	YES	17690	Video games
17150	Play games	YES	YES	17691	Active video games
17150	Play games	YES	YES	17692	Computer games

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17100	Participate in sports and active leisure	YES	YES	17700	Active leisure, general
17100	Participate in sports and active leisure	YES	YES	17701	Camping
17100	Participate in sports and active leisure	YES	YES	17702	Caving/rock climbing
17100	Participate in sports and active leisure	YES	YES	17703	Climb trees/structures
17100	Participate in sports and active leisure	YES	YES	17710	Dance
17100	Participate in sports and active leisure	YES	YES	17720	Hiking
17100	Participate in sports and active leisure	YES	YES	17730	Horseback riding
17100	Participate in sports and active leisure	YES	YES	17740	Water recreation
17100	Participate in sports and active leisure	YES	YES	17741	Boating
17100	Participate in sports and active leisure	YES	YES	17742	Recreational swim
17100	Participate in sports and active leisure	YES	YES	17743	Scuba diving
17130	Exercise	YES	YES	17800	Exercise, general
17130	Exercise	YES	YES	17810	Cardiovascular exercise

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
17130	Exercise	YES	YES	17811	Aerobics
17130	Exercise	YES	YES	17812	Bike for exercise
17130	Exercise	YES	YES	17813	Run or jog for exercise
17130	Exercise	YES	YES	17814	Swim for exercise
17130	Exercise	YES	YES	17815	Walk for exercise
17130	Exercise	YES	YES	17820	Strength/stretching
17130	Exercise	YES	YES	17821	Lift weights
17130	Exercise	YES	YES	17822	Physical therapy
17130	Exercise	YES	YES	17823	Stretching
18000	Travel, general	NO	YES	18000	Travel, general
18300	Travel for child care	YES	YES	18000	Travel, general
18400	Travel for goods and services	YES	YES	18000	Travel, general
18500	Travel for personal care	YES	YES	18000	Travel, general
18700	Travel for organizational activities	YES	YES	18000	Travel, general
18800	Travel for event/social activities	YES	YES	18000	Travel, general
18900	Travel for leisure	YES	YES	18000	Travel, general
18910	Travel for active leisure	YES	YES	18000	Travel, general
18920	Travel for passive leisure	YES	YES	18000	Travel, general
18000	Travel, general	NO	YES	18010	Travel by bus, general
18300	Travel for child care	YES	YES	18010	Travel by bus, general

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
18400	Travel for goods and services	YES	YES	18010	Travel by bus, general
18500	Travel for personal care	YES	YES	18010	Travel by bus, general
18700	Travel for organizational activities	YES	YES	18010	Travel by bus, general
18800	Travel for event/social activities	YES	YES	18010	Travel by bus, general
18900	Travel for leisure	YES	YES	18010	Travel by bus, general
18910	Travel for active leisure	YES	YES	18010	Travel by bus, general
18920	Travel for passive leisure	YES	YES	18010	Travel by bus, general
18000	Travel, general	NO	YES	18020	Travel by foot, general
18300	Travel for child care	YES	YES	18020	Travel by foot, general
18400	Travel for goods and services	YES	YES	18020	Travel by foot, general
18500	Travel for personal care	YES	YES	18020	Travel by foot, general
18700	Travel for organizational activities	YES	YES	18020	Travel by foot, general
18800	Travel for event/social activities	YES	YES	18020	Travel by foot, general
18900	Travel for leisure	YES	YES	18020	Travel by foot, general
18910	Travel for active leisure	YES	YES	18020	Travel by foot, general
18920	Travel for passive leisure	YES	YES	18020	Travel by foot, general
18000	Travel, general	NO	YES	18030	Travel by motor vehicle, general
18300	Travel for child care	YES	YES	18030	Travel by motor vehicle, general
18400	Travel for goods and services	YES	YES	18030	Travel by motor vehicle, general
18500	Travel for personal care	YES	YES	18030	Travel by motor vehicle, general

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
18700	Travel for organizational activities	YES	YES	18030	Travel by motor vehicle, general
18800	Travel for event/social activities	YES	YES	18030	Travel by motor vehicle, general
18900	Travel for leisure	YES	YES	18030	Travel by motor vehicle, general
18910	Travel for active leisure	YES	YES	18030	Travel by motor vehicle, general
18920	Travel for passive leisure	YES	YES	18030	Travel by motor vehicle, general
18000	Travel, general	NO	YES	18031	Drive a motor vehicle, general
18300	Travel for child care	YES	YES	18031	Drive a motor vehicle, general
18400	Travel for goods and services	YES	YES	18031	Drive a motor vehicle, general
18500	Travel for personal care	YES	YES	18031	Drive a motor vehicle, general
18700	Travel for organizational activities	YES	YES	18031	Drive a motor vehicle, general
18800	Travel for event/social activities	YES	YES	18031	Drive a motor vehicle, general
18900	Travel for leisure	YES	YES	18031	Drive a motor vehicle, general
18910	Travel for active leisure	YES	YES	18031	Drive a motor vehicle, general
18920	Travel for passive leisure	YES	YES	18031	Drive a motor vehicle, general
18000	Travel, general	NO	YES	18032	Ride in a motor vehicle, general
18300	Travel for child care	YES	YES	18032	Ride in a motor vehicle, general
18400	Travel for goods and services	YES	YES	18032	Ride in a motor vehicle, general
18500	Travel for personal care	YES	YES	18032	Ride in a motor vehicle, general
18700	Travel for organizational activities	YES	YES	18032	Ride in a motor vehicle, general

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
18800	Travel for event/social activities	YES	YES	18032	Ride in a motor vehicle, general
18900	Travel for leisure	YES	YES	18032	Ride in a motor vehicle, general
18910	Travel for active leisure	YES	YES	18032	Ride in a motor vehicle, general
18920	Travel for passive leisure	YES	YES	18032	Ride in a motor vehicle, general
18000	Travel, general	NO	YES	18040	Wait, general
18300	Travel for child care	YES	YES	18040	Wait, general
18400	Travel for goods and services	YES	YES	18040	Wait, general
18500	Travel for personal care	YES	YES	18040	Wait, general
18700	Travel for organizational activities	YES	YES	18040	Wait, general
18800	Travel for event/social activities	YES	YES	18040	Wait, general
18900	Travel for leisure	YES	YES	18040	Wait, general
18910	Travel for active leisure	YES	YES	18040	Wait, general
18920	Travel for passive leisure	YES	YES	18040	Wait, general
18100	Travel during work	NO	YES	18100	Travel during work, general
18100	Travel during work	NO	YES	18110	Travel during work by bus
18100	Travel during work	NO	YES	18120	Travel during work by foot
18100	Travel during work	NO	YES	18130	Travel during work by motor vehicle
18100	Travel during work	NO	YES	18131	Travel during work, drive a motor vehicle

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
18100	Travel during work	NO	YES	18132	Travel during work, ride in a motor vehicle
18100	Travel during work	NO	YES	18140	Travel during work, wait
18200	Travel to/from work	NO	YES	18200	Travel to/from work, general
18200	Travel to/from work	NO	YES	18210	Travel to/from work by bus
18200	Travel to/from work	NO	YES	18220	Travel to/from work by foot
18200	Travel to/from work	NO	YES	18230	Travel to/from work by motor vehicle
18200	Travel to/from work	NO	YES	18231	Travel to/from work, drive a motor vehicle
18200	Travel to/from work	NO	YES	18232	Travel to/from work, ride in a motor vehicle
18200	Travel to/from work	NO	YES	18240	Travel to/from work, wait
18600	Travel for education	YES	YES	18300	Travel for education, general
18600	Travel for education	YES	YES	18310	Travel for education by bus
18600	Travel for education	YES	YES	18320	Travel for education by foot
18600	Travel for education	YES	YES	18330	Travel for education by motor vehicle
18600	Travel for education	YES	YES	18331	Travel for education, drive a motor vehicle
18600	Travel for education	YES	YES	18332	Travel for education, ride in a motor vehicle
18600	Travel for education	YES	YES	18340	Travel for education, wait

Table B-1. Crosswalk between Previous and Current (November 2015 and later) CHAD Activity Codes

CHAD (August 15, 2014)		Change to Original CHAD Code Number in November 2015 Revision?	Activity Assessed for Potential Revision in November 2015?	Current CHAD (November 2015 and later)	
Activity Code	Activity Description			Activity Code	Activity Description
U	Uncertain	NO	NO	U	Uncertain
X	Missing	NO	NO	X	Missing

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