The Consolidated Human Activity Database – Master Version (CHAD-Master) Technical Memorandum

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Updated 09/15/2014

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A. Introduction

The Consolidated Human Activity Database is a repository of harmonized human activity data maintained by the Environmental Protection Agency's National Exposure Research Laboratory. CHAD provides direct critical input to a variety of EPA exposure models, including the Office of Air Quality Planning and Standards' Air Pollutants Exposure Model (APEX) and ORD's Stochastic Human Exposure and Dose Simulations (SHEDS) models for multimedia, multipathway chemicals (SHEDS-Multimedia), particulate matter (SHEDS-PM), and air toxics (SHEDS-AirToxics).

The original development of CHAD contained data from 10 studies, and was described in McCurdy et al. (2000). The original Microsoft Access version of the database is documented in Stallings et al. (2000); it is now referred to as CHAD-2000. Since 2000, however, additional studies have been added to CHAD, and this version of the database (called CHAD-Master) is provided in SAS dataset and text (comma separated values) formats. CHAD-Master is designed to have a straightforward data format to allow EPA to update it with newly available data in a timely manner. However, since additional variables and data from the original 10 CHAD studies (beyond what is contained in CHAD-Master) are included in the Access version of CHAD-2000, this database is still available for download on the CHAD website.

This short technical memo describes the contents of the CHAD-Master database. The database consists of two files, a **Questionnaire** file that contains demographic and daily variables for each diary-day in CHAD. The corresponding **Events** file contains the minute-by-minute human activity record (activities and locations) for each diary day. The two files are both indexed by a unique **CHADID** for each diary-day.

This memo includes a number of tables describing: the studies currently included in CHAD-Master, descriptions of all available CHAD-Master variables, an inventory of questionnaire and events variables by study, and definitions for all codes associated with these variables.

B. CHAD Contents

Table 1. Human Activity Studies in the CHAD Database

Study Name (CHAD Abbreviation)	Geographic Coverage	Study Dates	Study Subject Ages	Number of Diary Days	Study Reference
Baltimore Retirement Home Study (BAL)	One building in Baltimore, MD	1/1997 to 2/1997; 7/1998 to 8/1998	72 - 93	391	Williams et al. (2000)
California Adults Activity Patterns Study (CAA)	California	10/1987 to 9/1988	18 - 94	1579	Wiley et al. (1991a)
California Children Activity Patterns Study (CAC)	California	4/1989 to 2/1990	<1 - 11	1200	Wiley et al. (1991b)
California Youth Activity Patterns Study (CAY)	California	10/1987 to 9/1988	12 - 17	183	Wiley et al. (1991a)
Cincinnati Activity Patterns Study (CIN)	Cincinnati, OH metro. area	3/1985 to 4/1985; 8/1985	<1 - 86	2614	Johnson (1989)
Detroit Exposure and Aerosol Research Study (DEA)	Detroit, MI metro. area	7/2005 to 8/2005; 7/2006 to 8/2006	18 - 74	340	Williams et al. (2009)
Denver CO Personal Exposure Study (DEN)	Denver, CO metro. area	11/1982 to 2/1983	18 - 70	805	Johnson (1984), Johnson et al. (1986), Ackland et al. (1985)
EPA Longitudinal Studies (EPA)	RTP, NC	2/1999 to 2/2000; 2/2002 to 8/2002; 7/2006 to 6/2008	<1 - 60	1426	Isaacs et al. (2012)
Population Study of Income Dynamics PSID I (ISR)	National	2/1997 to 12/1997	<1 - 13	5616	University of Michigan (2012)
Population Study of Income Dynamics PSID II (ISR)	National	1/2002 to 12/2003	5 - 19	4997	University of Michigan (2012)
Population Study of Income Dynamics PSID III (ISR)	National	10/2007 to 4/2008	10 - 19	2741	University of Michigan (2012)
Los Angeles Ozone Exposure Study: Elementary School (LAE)	Los Angeles, CA	10/1989	10 - 12	51	Spier et al. (1992)
Los Angeles Ozone Exposure Study: High School (LAH)	Los Angeles, CA	9/1990 to 10/1990	13 - 17	43	Spier et al. (1992)

Study Name (CHAD Abbreviation)	Geographic Coverage	Study Dates	Study Subject Ages	Number of Diary Days	Study Reference
National Human Activity Pattern Study: Air (NHA)	National	9/1992 to 10/1994	<1 - 93	4723	Klepeis et al. (1996), Tsang and Klepeis (1996)
National Human Activity Pattern Study: Water (NHW)	National	9/1992 to 10/1994	<1 - 93	4663	Klepeis et al. (1996), Tsang and Klepeis (1996)
National-Scale Activity Survey (NSA)	7 US metro. areas	6/2009 to 9/2009	35 - 92	6862	Knowledge Networks (2009)
RTI Ozone Averting Behavior (OAB)	35 US metro. areas	7/2002 to 8/2003	2 - 12	2907	Mansfield et al. (2006)
RTP Particulate Matter Panel Study (RTP)	RTP, NC	6/2000 to 5/2001	55 - 85	998	Williams et al. (2003a,b)
Seattle (SEA)	Seattle, WA	10/1999 to 3/2002	6 - 91	1692	Liu et al. (2003)
Study of Use of Products and Exposure Related Behavior (SUP)	Broader Sacramento & San Francisco, CA Counties	7/2006 to 3/2010	1 - 88	9446	Hertz-Picciotto et al. (2010), Wu et al. (2001)
Valdez Air Health Study (VAL)	Valdez-Cordova County, AK	4/1990 to 3/1991	11-71	397	Goldstein et al., (1992)
Washington, D.C. (WAS)	Wash. DC metro. area	11/1982 to 2/1983	18 - 71	699	Hartwell et al. (1984), Akland et al. (1985)
Totals		**1982 - 2010**	**<1 - 94**	**54,373**	

Table 2. Description of Current CHAD Questionnaire Variables

CHAD Variable	Format	Description	Values*
DIARY VARIABLES			
CHADID	Character	EPA-assigned ID for this diary day	text ID
rawid	Character	Raw data id	text ID
daynum	Numeric	Index of current diary day for this subject	Integer, 1 though NDays
totaldays	Numeric	Number of diary days in CHAD for this subject	Integer
DATE VARIABLES			
month	Numeric	Month of diary day	number, 1 through 12

CHAD Variable	Format	Description	Values*
daymonth	Numeric	Day of the month of diary day	1 though 31
year	Numeric	Year of diary day	eg. 1999
dayofweek	Character	Day of the week - abbreviation	SUN MON TUE WED THU FRI SAT
wdwe	Character	Daytype 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 on day of study	Degrees F
maxtemp	Numeric	Maximum temperature	Degrees F
inchrain	Numeric	Hours of rainfall on day of study	Hours
hourrain	Numeric	Inches of rainfall on day of study	Inches
PERSONAL VARIABLES			
age	Numeric	Age of subject	Age in years (may be age 0)
gender	Character	Gender of participant	Male/Female (M/F)
weight	Numeric	Weight of subject	Kg
education	Character	Level of education for subject	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

CHAD Variable	Format	Description	Values*
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	Ethnic group	W White B Black A Asian H Hispanic O Other
income	Numeric	Household income before taxes	Income in thousands of dollars
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

CHAD Variable	Format	Description	Values*
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 seven days	Number of hours: 0 0_9 10_19 20_29 30_39 40_49 50_79 80_
PERSONAL FLAGS			
aircond	Character	Flag for air conditioning	YES/NO (Y/N)
asthma	Character	Flag for having Asthma	YES/NO (Y/N)
employed	Character	Flag for employed outside home	Yes/No (Y/N)
fulltime	Character	Flag for working full-time	YES/NO (Y/N)
garage	Character	Flag for attached garage	YES/NO (Y/N)
gasstove	Character	Flag for gas stove used in house	Yes/No (Y/N)
heartlung	Character	Flag for having a heart or lung condition	YES/NO (Y/N)
pesticides	Character	Flag for pesticide exposure	YES/NO (Y/N)

CHAD Variable	Format	Description	Values*
student	Character	Flag for attending school	YES/NO (Y/N)
smoker	Character	Flag for being a smoker	YES/NO (Y/N)
nearsmoker	Character	Flag for having been around smoker	YES/NO (Y/N)
QUALITY VARIABLES			
qcactloc	Numeric	Total minutes where QFACTLOC=1 (indicating location/activity mismatch)	minutes
qceattime	Numeric	Total eating minutes on diary	minutes
QCheavy	Numeric	Total minutes in heavy breathing (as reported by survey respondent)	minutes
Qcinfer	Numeric	Total minutes that were inferred from previous location when act was missing	minutes
qclong	Numeric	Longest number of minutes in the same act/loc	minutes
qcmeals	Numeric	Number of meals (groups of eating events separated by non-eating events) on diary	# meals
qcmetab	Numeric	Total minutes in activities with mean METS>3	minutes
qcmiss	Numeric	Total missing minutes (either act or loc)	minutes
qcsleep	Numeric	Total sleep minutes on diary	minutes
QFtravel	Numeric	Flag indicating AM/PM travel time inconsistencies. Flag is ON if 1) Person is employed AND 2) diary is a weekday AND 3) AM (6-9) and PM (4-7) 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	4-digit 24-hour time
wdwe	Character	Daytype of diary day	WE Weekend WD Weekday
weekend	Numeric	Flag for weekend for current diary day	0 No 1 Yes

*Missing Numeric variables are given as -999; Missing Character variables are given as ‘X’

Table 3. Description of Current CHAD Events Variables

CHAD Variable	Format	Description	Values
CHADID	Character	CHAD ID for diary-day: comprising 3-letter study ID, a unique subject identifier, and a day identifier	text id
starttime	Character	Time of start of event	4-digit 24-hour time
duration	Numeric	Duration of Event	minutes
act	Character	CHAD activity code	6-digit code
loc	Character	CHAD location code	6-digit 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.	0 no 1 yes
Qfmetab	Numeric	Quality flag for an event with mean METS > 3	0 no 1 yes
gasstove	Character	gas stove use during event	YES/NO (Y/N), X missing
smoking	Character	smokers near	YES/NO (Y/N), X missing
heavybreathing	Character	heaving breathing reported	YES/NO (Y/N), X missing
cookingself	Character	cooking by self reported	YES/NO (Y/N), X missing
cookingother	Character	cooking by other reported	YES/NO (Y/N), X missing
smokingmon	Character	ETS indicated by personal monitoring	YES/NO (Y/N), X missing
vocs	Character	VOCs near	YES/NO (Y/N), X missing
windowsopen	Character	windows open (car or house)	YES/NO (Y/N), X missing
combustion	Character	combustion occurring (candle or cooking, etc.)	YES/NO (Y/N), X missing

C. Inventory of Variables: Questionnaire File

Notes:
a. See Table 2 for definition of the CHAD variables
b. The following variables were assumed to be present in all studies: Age, Gender, Date, DayofWeek, Day, Year, Month, WeekdayWeekend, Weekend
c. The following CHAD variables are lumped into the variable "Weather" for the purpose of the following table: AvgTemperature, MaxTemperature, RainfallInches, RainfallHours
d. Starred weather data: * Rainfall for Valdez is not available. * RainfallHours is missing for all EPA data.

Legend
P = variable present for all (or most) diary days in study
S = variable present for small number of diary days
x = variable missing for all diary days in study

Table 4. Inventory of Variables: Questionnaire File

	AC	Asthma	County	Education	Fulltime	Employment	Garage	Gas Stove	HeartLung	Fueltype	Heatingtype	HoursWorked	HousingType	Income	Occupation	Pesticides	Pregnant	Race	Student	Smoker	SmokersNear	State	Weight	Weather	ZipCode
Baltimore Retirement Home Study (BAL)	P	x	P	x	P	P	P	P	x	P	P	P	P	x	x	x	x	P	P	P	x	P	x	P	P
California Adults Activity Patterns Study (CAA)	P	x	P	P	P	P	P	P	x	P	P	P	P	P	P	P	x	x	P	P	P	P	x	P	P
California Children Activity Patterns Study (CAC)	P	x	P	P	x	x	P	P	x	P	P	x	P	P	x	P	x	x	P	P	P	P	x	P	P
California Youth Activity Patterns Study (CAY)	P	x	P	P	P	P	P	P	x	P	P	P	P	P	P	P	x	x	P	P	P	P	x	P	P

	AC	Asthma	County	Education	Fulltime	Employment	Garage	Gas Stove	HeartLung	Fueltype	Heatingtype	HoursWorked	HousingType	Income	Occupation	Pesticides	Pregnant	Race	Student	Smoker	SmokersNear	State	Weight	Weather	ZipCode
Cincinnati Activity Patterns Study (CIN)	P	P	x	P	P	P	P	P	P	P	P	P	P	P	x	x	x	P	P	P	x	x	x	P	x
Detroit Exposure and Aerosol Research Study (DEA)	P	x	x	x	x	P	P	P	x	P	P	x	P	x	x	x	x	P	P	P	P	P	P	P	x
Denver CO Personal Exposure Study (DEN)	P	x	x	x	S	S	P	P	x	x	P	x	P	x	P	x	x	x	x	P	x	P	X	P	x
EPA Longitudinal Studies (EPA)	P	P	P	P	P	P	P	P	P	P	P	P	P	x	P	x	P	P	P	P	P	P	P	P*	P
Population Study of Income Dynamics PSID I (ISR)	x	P	x	P	P	P	x	x	P	x	x	P	x	P	x	x	x	P	P	P	x	x	P	P	x
Population Study of Income Dynamics PSID II (ISR)	x	x	x	x	x	P	x	x	x	x	x	x	x	x	x	x	x	P	x	x	x	P	P	P	x
Population Study of Income Dynamics PSID III (ISR)	P	P	x	P	x	P	x	x	P	P	x	x	x	x	x	x	x	P	P	x	x	P	P	P	x
Los Angeles Ozone Exposure Study: Elementary School	x	x	P	P	P	P	x	x	P	x	x	P	x	x	x	x	x	P	P	x	P	P	P	P	x

	AC	Asthma	County	Education	Fulltime	Employment	Garage	Gas Stove	HeartLung	Fueltype	Heatingtype	HoursWorked	HousingType	Income	Occupation	Pesticides	Pregnant	Race	Student	Smoker	SmokersNear	State	Weight	Weather	ZipCode
(LAE)																									
Los Angeles Ozone Exposure Study: High School (LAH)	x	x	P	P	P	P	x	x	P	x	x	P	x	x	x	x	x	P	P	x	P	P	P	P	x
National Human Activity Pattern Study: Air (NHA)	x	P	x	P	P	P	P	P	P	S	S	P	P	x	x	P	S	P	P	P	S	P	x	P	P
National Human Activity Pattern Study: Water (NHW)	x	P	x	P	P	P	P	P	P	P	P	P	P	x	x	P	S	P	P	P	P	P	x	P	P
National-Scale Activity Survey (NSA)	x	P	P	P	P	P	x	x	P	x	x	P	P	P	x	x	x	P	x	x	x	P	x	P	x
RTI Ozone Averting Behavior (OAB)	x	P	x	x	x	P	x	x	P	x	x	x	x	x	x	x	x	P	x	P	P	P	x	P	P
RTP Particulate Matter Panel Study (RTP)	x	x	P	x	x	x	P	P	P	x	x	x	P	x	x	x	x	P	x	x	x	P	x	P	x
Seattle (SEA)	P	x	x	x	x	x	P	x	P	x	P	x	P	x	x	x	x	x	x	x	x	P	x	P	x
Study of Use of Products and Exposure Related Behavior (SUP)	x	x	P	P	x	P	x	x	x	x	x	x	x	x	x	x	P	P	x	P	x	P	x	P	x
Valdez Air Health	P	x	P	x	x	P	P	x	P	P	P	x	x	x	P	x	x	x	x	x	x	P	P	P*	x

	AC	Asthma	County	Education	Fulltime	Employment	Garage	Gas Stove	HeartLung	Fueltype	Heatingtype	HoursWorked	HousingType	Income	Occupation	Pesticides	Pregnant	Race	Student	Smoker	SmokersNear	State	Weight	Weather	ZipCode
Study (VAL)																									
Washington, D.C. (WAS)	x	x	x	x	S	P	P	P	P	x	x	x	x	x	P	x	x	x	x	P	P	x	x	P	x

D. Inventory of Variables: Events File

See Table 3 for definition of the CHAD variables. The variables CHADID, act, loc, starttime, and duration are present in all studies.

Legend
P = variable present for all (or most) diary days in study
x = variable missing for all diary days in study

Table 5. Event Variables in the Different CHAD Studies

	Actdesc	Gasstove	Smoking	Heavybreathing	Cookingself	Cookingother	ETSMon	vocs	Windowsopen	Combustion
Baltimore Retirement Home Study (BAL)	x	P	P	x	x	x	x	x	x	x
California Adults Activity Patterns Study (CAA)	P	x	P	x	x	x	x	x	x	x
California Children Activity Patterns Study (CAC)	P	x	P	x	x	x	x	x	x	x
California Youth Activity Patterns Study (CAY)	P	x	P	x	x	x	x	x	x	x
Cincinnati Activity Patterns Study (CIN)			P	P	x	x	x	x	x	x
Detroit Exposure and Aerosol Research Study (DEA)	P	x	x	x	x	x	x	x	x	x
Denver CO Personal Exposure Study (DEN)	x	P	P	x	x	x	x	x	x	x
EPA Longitudinal Studies (EPA)	P	x	P	P	x	x	x	P	P	P
Population Study of Income Dynamics PSID I (ISR)	x	x	x	x	x	x	x	x	x	x

	Actdesc	Gasstove	Smoking	Heavybreathing	Cookingself	Cookingother	ETSMon	vocs	Windowsopen	Combustion
Population Study of Income Dynamics PSID II (ISR)	x	x	x	x	x	x	x	x	x	x
Population Study of Income Dynamics PSID III (ISR)	x	x	x	x	x	x	x	x	x	x
Los Angeles Ozone Exposure Study: Elementary School (LAE)	x	x	P	P	x	x	x	x	x	x
Los Angeles Ozone Exposure Study: High School (LAH)		x	P	P	x	x	x	x	x	x
National Human Activity Pattern Study: Air (NHA)	P	x	P	P	x	x	x	x	x	x
National Human Activity Pattern Study: Water (NHW)	P	x	P	P	x	x	x	x	x	x
National-Scale Activity Survey (NSA)	P	x	x	P	x	x	x	x	x	x
RTI Ozone Averting Behavior (OAB)	x	x	x	x	x	x	x	x	x	x
RTP Particulate Matter Panel Study (RTP)	P	x	P	x	P	P	P	P	x	x
Seattle (SEA)	P	x	P	x	P	P	x	x	x	x
Study of Use of Products and Exposure Related Behavior (SUP)	P	x	x	x	x	x	x	x	x	x
Valdez Air Health Study (VAL)	x	x	x	x	x	x	x	x	x	x
Washington, D.C. (WAS)	x	P	P	x	x	x	x	x	x	x

E. CHAD Codes

Tables 6 and 7 contain the activity (act) and location (loc) 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; the specificity of the codes used for each study depends on the level of detail collected in the original study protocol.

Table 6. 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

Location Code	Location
30341	Other's indoor garage
30342	Other's outdoor garage
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
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

Location Code	Location
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

Table 7. 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

Activity Code	Activity
10130	Work, secondary (income-related)
10200	Unemployment
10300	Breaks
11000	**General household activities**
11100	Prepare food
11110	Prepare and clean-up food
11200	Indoor chores
11210	Clean-up food
11220	Clean house
11300	Outdoor chores
11310	Clean outdoors
11400	Care of clothes
11410	Wash clothes
11500	Build a fire
11600	Repair, general
11610	Repair of boat
11620	Paint home / room
11630	Repair / maintain car
11640	Home repairs
11650	Other repairs
11700	Care of plants
11800	Care for pets/animals
11900	Other household
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
13210	Shop for food
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**
14100	Shower, bathe, personal hygiene
14110	Shower, bathe

Activity Code	Activity
14120	Personal hygiene
14200	Medical care
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	**General entertainment / social activities**
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
16800	Go to bar / lounge
16900	Other entertainment / social events
17000	**Leisure, general**
17100	Participate in sports and active leisure
17110	Participate in sports
17111	Hunting, fishing, hiking
17112	Golf
17113	Bowling / pool / ping pong / pinball
17114	Yoga
17120	Participate in outdoor leisure
17121	Play, unspecified
17122	Passive, sitting
17130	Exercise
17131	Walk, bike, or jog (not in transit)
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 games
17160	Use of computers

Activity Code	Activity
17170	Participate in recess and physical education
17180	Other sports and active leisure
17200	Participate in 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
18000	**Travel, general**
18100	Travel during work
18200	Travel to/from work
18300	Travel for child care
18400	Travel for goods and services
18500	Travel for personal care
18600	Travel for education
18700	Travel for organizational activity
18800	Travel for event / social activity
18900	Travel for leisure
18910	Travel for active leisure
18920	Travel for passive leisure
U	Uncertain
X	Missing

F. References

Ackland G., Harwell T., Johnson T, and Whitemore R. 1985. Measuring human exposure to carbon monoxide in Washington, D.C. and Denver, Colorado, during the winter 1982-1983 *Environmental Science and Technology*, 19:911-918.

Goldstein, B., R. Tardiff, G. Hoffnagle, and R. Kester. 1992. *Valdez Air Health Study: Summary Report*. Prepared for Alyeska Pipeline Service Company, Anchorage, AK.

Hartwell T. Clayton C, Michie R, Whitmore W, Zelon H, Jones S, and Whitehurst D. 1984. *A Study of Carbon Monoxide Exposure of Residents of Washington, B.C. and Denver,* Colorado, U.S. EPA Report EPA-600/S4-84-031.

Hertz-Picciotto I, Cassady D, Lee K, Bennett DH, Ritz B, Vogt R. 2010. Study of Use of Products and Exposure-Related Behaviors (SUPERB): study design, methods, and demographic characteristics of cohorts. *Environmental Health,* 29:9:54.

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.

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., J. Capel, and L. Wijnberg. 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.

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

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.

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

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.

Mansfield C, Johnson F, and Van Houtven G. 2006. The missing piece: Valuing averting behavior for children's ozone exposures. *Resource and Energy Economics*, 28 (3):215-228

McCurdy T, Glen G, Smith L, and Lakkadi Y. 2000. The National Exposure Research Laboratory's Consolidated Human Activity Database. *Journal of Exposure Analysis and Environmental Epidemiology*, 10(6):566-578.

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

Stallings C, Tippett J, Glen G, and Smith L. *CHAD User's Guide*. ManTech Environmental Technology, 2000.

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.

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.

University of Michigan. The Panel Study of Income Dynamics. http://psidonline.isr.umich.edu/Studies.aspx. Accessed July 14, 2014.

Williams R, Creason J, Zweidinger R, Watts R, Sheldon L, and Shy C. 2000. Indoor, outdoor, and personal exposure monitoring of particulate air pollution: The Baltimore elderly epidemiology-exposure pilot study. *Atmospheric Env*, 34: 4193-4204.

Williams R, Suggs J, Rea A, Leovic K, Vette A, Croghan C, Sheldon L, Rodes C, Thornburg J, Ejire A, Herbst M, 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.

Williams R, Rea A, Vette A, Croghan C, Whitaker D, Stevens C, McDow A, 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.

Wu X, Bennett DH, Lee K, Cassady DL, Ritz B, Hertz-Picciotto I. 2011. Feasibility of using web surveys to collect time-activity data. *Journal of Exposure Science and Environmental Epidemiology*, 22: 116-125.