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INDOOR AIR POLLUTION EXPOSURES OF LOW-INCOME INNER-CITY RESIDENTS

I. F. Goldstein, D. Hartel, L. R. Andrews, and A. L. Weinstein
Division of Epidemiology, School of Public Health, Columbia University, New York, New York, 10032, USA

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This report is based on a pilot project for a large epidemiologic study of inner-city asthma, in which exposures to air pollutants will be related to both incidence and prevalance of asthma. Nitrogen dioxide concentrations were measured in three rooms as well as outdoors in 44 inner-city apartments with gas cooking stoves. Fifty-two separate month-long series of 48-h time-integrated NO_2 samples (Palmes tubes) were gathered from fall 1982 to spring 1984. The 48-h average NO_2 concentrations taken within homes frequently exceeded the U.S. EPA outdoor annual mean NO_2 standard of 100 $\mu g/m^3$, and were observed to reach levels as high as 300 $\mu g/m^3$ in some homes. Short-term peaks of NO_2 were as high as 2000 $\mu g/m^3$ at 2.3 m from the floor and 1700 $\mu g/m^3$ at 1.7 m from the floor in kitchens. Activity records filled out by study subjects indicated an unusually large percentage of time spent indoors at home by inner-city residents, many of whom were asthma patients. On the basis of these activity patterns and the regular occurrence of high NO_2 levels in inner-city apartments, individuals in this population are likely to have elevated personal exposure to this combustion by-product.

Introduction

Air pollution has been a public health concern in the United States since the pollution episode in Donora, PA, in 1948 (Shrenk *et al.*, 1949). Since then, a variety of approaches have been employed to evaluate air pollution hazards and establish air quality standards, including a range of ecological-level studies of acute and chronic effects of air pollution on morbidity and mortality (Goldstein and Dulberg, 1981; Ribon and Glasser, 1972). Among the acute effects studied has been the asthmatic response, which is known to be influenced by a wide variety of environmental factors, including aeroallergens, temperature, humidity, and infectious agents, as well as air pollution. Although these factors have been associated with asthma under laboratory and clinical conditions, and assuredly play some part in inducing asthma symptoms under natural conditions, the contributions of the various implicated environmental factors to asthma exacerbations in different populations has not been sufficiently explored. This paper reports some of the results of NO_2 monitoring in a program of environmental monitoring carried out to assess conditions of exposure to selected airborne agents in the homes of Black and Hispanic inner-city residents in New York City, among whom the prevalence of asthma has been reported to be approximately four times the national average (Brunswick, 1980; Ng and Gergen, 1984; Task Force on Asthma, 1979).

Our interest in indoor pollutants derives from previous studies that pointed to the influence of environmental factors on asthma, yet failed to show an effect of outdoor agents in accounting for patterns of medical care for asthma in New York City (Greenberg *et al.*, 1966; Greenberg, 1966, 1978). Our own studies demonstrated the presence of time-space clusters of visits to inner-city hospital emergency rooms for asthma, but did not show this clustering (as expressed by the presence of "epidemic" days when emergency room visits for asthma were significantly greater than would be expected by chance) to be related to daily average outdoor levels of sulfur dioxide or particulates (Goldstein and Dulberg, 1981; Goldstein and Weinstein, 1984). Comparisons of emergency room data from inner-city hospitals in New York City with that from Charity Hospital in New Orleans showed that in New York, but not in New Orleans (1) asthma "epidemic" days were concentrated in the autumn, especially during the first one or two cold spells, when windows are shut and heat is first turned on; (2) independent of ''epidemic'' days, baseline numbers of visits for asthma rose in the late autumn, when people begin to spend more time indoors; and (3) numbers of asthma attacks were significantly greater on Sundays and the Thanksgiving holiday, when people tend to spend more time in their homes (Goldstein and Currie, 1981; Goldstein and Cuzick, 1983; Goldstein and Salvaggio, 1984).

A variety of agents exist in the indoor environment which may serve to account for these findings. Among those that are known to have measurable health effects and are found indoors in appreciable quantities, nitrogen dioxide seems especially relevant to the problem of respiratory disease and asthma in an inner-city population. Clinical and laboratory studies (Orehek *et al.*, 1976; Kerr *et al.*, 1979; Linn *et al.*, 1980) have shown elevated levels of NO_2 to elicit respiratory responses such as bronchoconstriction and have shown asthmatics to be particularly sensitive.

Methods

Study Population

Environmental monitoring was carried out within the homes of 44 low-income Black and Hispanic families in the Harlem and Washington Heights areas of Manhattan. Of these 44 homes, 32 contained at least one family member with asthma, and another two contained at least one family member who was allergic but not asthmatic. Asthmatic and allergic index subjects were recruited from three sources: the Asthma Self-Management Program at Babies Hospital of the Columbia-Presbyterian Medical Center, which is an educational program for child asthmatics and their families; and the pediatric allergy clinics at Presbyterian Hospital and at Harlem Hospital. The families without any asthmatic family members were recruited from the friends, relatives, and neighbors of the low-income clinic groups.

In addition to requirements that study families reside in Harlem or Washington Heights, criteria for selection included willingness to cooperate, and residence in a neighborhood safe enough that study personnel could make repeated trips to the homes. Prior to formal recruitment into the study, each family encountered in the clinic setting which showed a willingness to be interviewed was visited at home by the project director. Approximately 90 interviews were conducted over the course of 18 months to enroll 44 families from the community.

Apartment buildings included in this study are typical of those found in low-income areas in New York City. Most study apartments were in pre-war, six-story brick or stone tenements; approximately one-half of these buildings had elevators. Other low-income apartments were in government-subsidized ''projects'' built in the 1960s and 1970s which are 30-story brick buildings with surrounding lawns and playgrounds. Most apartments were small; average area was 80 m^2 and average volume was 230 m^3 with little cross-ventilation. Many apartments had new window frames installed by landlords as a heating fuel conservation measure. Air exchange rates that were determined in eight of our study apartments by the method of Drivas *et al.* (1972) averaged 0.85 air changes per hour (ach) and ranged from 0.26 to 2.05 ach. Similar housing conditions were observed in an earlier pilot project carried out in the South Bronx (Sterling and Kobayashi, 1981) in which it was also found that individuals sometimes used their gas stoves for supplementary heat; however, fewer persons reported such a practice in our current study.

Exposure Monitoring

Our program of environmental monitoring involved the collection of air samples representing 48-h time-integrated levels of nitrogen dioxide, an air pollutant which is created whenever high-temperature combustion occurs, such as during operation of a gas stove, or an internal combustion engine.

NO_2 was sampled and analyzed according to the method of Palmes *et al.* (1976). Briefly, this method is based on the use of the Palmes passive diffusion sampler consisting of a small acrylic tube less than 7.5 cm long. The tube, which is open at one end, contains a reagent (triethanolamine TEA) at the closed end which absorbs NO_2 which diffuses upwards through the tube. Quantitative analysis of the samples collected in the field is performed by a modification of the method of Saltzman (1954) in which a reagent composed of sulfanilimide and phosphoric acid is combined with an aqueous solution of *N*-1-napthylethylene-diamine dihydrochloride, and the "combined" reagent is added directly to each sampler. The color resulting from the consequent diazotization reaction is read spectrophotometrically at 540 nm and referenced to standards prepared from sodium nitrite.

In the present study, which was carried out throughout the four seasons of the period October 1982 through June 1984, side-by-side duplicate (quadruplicate in winter of 1982) samplers were mounted at adult breathing level (approximately 1.7 m from floor) to a door frame, shelf, or other surface protruding from the wall. Sets of samplers were placed in the kitchen (at least 60 cm from the stove), living room, and one or two bedrooms of each apartment, and also attached to an outside wall of the building directly outside the apartment, but not directly downwind from the kitchen window. Unexposed control samplers were also kept in the laboratory in order to account for background NO_2 absorbed in the reagent during sampler assembly. Duplicate sampling served to increase the accuracy of the measurements. The median difference in replicate pairs of Palmes tubes was 4.35 mg/m³, and 95% of all pairs differed by less than 30 $\mu g/m^3$.

Exposed air samplers were collected and replaced every 48 h during home visits by study personnel over a period of approximately 30 days. In this manner, time series consisting of approximately 15 consecutive 48-h average NO_2 levels were obtained at each location in each apartment.

The second component of exposure monitoring was related to the ascertainment of sites of exposure of both adult and child members of our study families. This was accomplished by the completion of daily activity questionnaires (Appendix) in which subjects were asked to report the approximate times spent at home and at various activities outdoors and indoors other than at home, such as shopping, travelling, attending school, or visiting friends. The responses can then be used to assess the proportion of time subjects actually were exposed to the NO_2 levels measured in their homes and outdoors.

In addition to the time-integrated average NO_2 levels measured by the Palmes tubes, a continuous NO_2 analyzer was used in selected apartments to assess peak NO_2 levels arising during the preparation of a meal on the gas stove. An Ecolyzer Model 2302 NO_2 Analyzer with strip chart recorder was used to measure NO_2 levels at various heights above the floor in the kitchen and an adjoining room (usually the living room) for 1h before turning on the stove, during the operation of the stove for 1 h, and for 1 h after shutting off the stove. In this manner, a truer assessment of levels of NO_2 to which individuals are exposed during the course of a day was obtained than by the Palmes tube method, which is only capable of providing 48-h averages at the levels of NO_2 expected in homes.

Results

Families were selected for home monitoring on the basis of their ability to fill out daily questionnaires, their willingness to be at home to let our interviewers collect the 48-h consecutive samplers for a period of 1 month, and their general ability to cooperate in carrying out study protocol.

Mean NO_2

Table 1 summarized the mean levels of NO_2 over all 48-h sampling periods for all families studied in a given season by site of the sample, and the proportions of 48-h average levels at each site that are above the U.S. Environmental Protection Agency (U.S. EPA) ambient air standard of 100 $\mu g/m^3$ (U.S. EPA, 1976). Seasons are not necessarily comparable one with another due to possible differences between the study groups in each season. In all seasons except autumn 1982, which, it may be noted, was unusually mild, the mean of the 48-h average NO_2 levels over all homes and sampling periods in kitchens exceeded the outdoor standard and at least one-half of the individual 48-h levels also exceeded the standard. Mean NO_2 levels and proportions of those levels above the 100 $\mu g/m^3$ standard decrease as one goes from the kitchen,

Table 1. Frequency, percent distribution* and means of average NO_2 levels** by site and season in inner-city residences***.

Location	FALL 82 15 homes	WINTER 83 8 homes	SUMMER 83 9 homes	FALL 83 7 homes	WINTER 84 8 homes	SPRING 84 5 homes	ALL SEASONS 52 homes
Kitchen Samples	n = 334	n = 97	n = 111	n = 96	n = 108	n = 53	n = 799
$\bar{X}$ $\mu g/m^3$ ± SD	96 ± 38	121 ± 41	117 ± 30	107 ± 37	140 ± 50	116 ± 50	111 ± 40
≥100 $\mu g/m^3$: n	n = 120	n = 61	n = 80	n = 48	n = 80	n = 27	n = 416
%	36%	63%	72%	50%	74%	51%	52%
Living Room Samples	n = 339	n = 99	n = 101	n = 93	n = 105	n = 52	n = 797
$\bar{X}$ $\mu g/m^3$ ± SD	71 ± 27	94 ± 35	103 ± 27	77 ± 28	96 ± 35	90 ± 43	84 ± 30
≥100 $\mu g/m^3$: n	n = 51	n = 34	n = 66	n = 14	n = 44	n = 15	n = 224
%	15%	35%	59%	15%	42%	29%	28%
Bedroom Samples	n = 398	n = 96	n = 139	n = 111	n = 103	n = 54	n = 901
$\bar{X}$ $\mu g/m^3$ ± SD	65 ± 24	76 ± 23	99 ± 30	66 ± 22	76 ± 29	72 ± 32	73 ± 26
≥100 $\mu g/m^3$: n	n = 33	n = 13	n = 63	n = 7	n = 18	n = 8	n = 142
%	8%	14%	45%	6%	17%	15%	16%
Outdoor Samples	n = 353	n = 75	n = 107	n = 95	n = 104	n = 50	n = 784
$\bar{X}$ $\mu g/m^3$ ± SD	61 ± 22	100 ± 28	109 ± 33	72 ± 25	72 ± 22	92 ± 25	77 ± 25
≥100 $\mu g/m^3$: n	n = 18	n = 31	n = 63	n = 17	n = 12	n = 17	n = 158
%	5%	41%	59%	18%	12%	34%	20%

*Dichotomized on basis of United States Environmental Protection Agency standard (100 $\mu g/m^3$).
**48-h sampling periods for 30 consecutive days.
***52 separate series of samples were obtained in 43 apartments.

to the living room, to the bedroom(s), which in most homes studied corresponds to an increasing distance from the gas stove. Outdoor levels are generally on the order of those found in the bedroom(s) and living room, although somewhat higher in the summer season.

Individual Series

Figure 1 displays, on a sample-by-sample basis, the variation in levels of NO_2 recorded in a series of 15 48-h samples at each location in one of our study homes during the period 4 January to 3 February 1984. These time series show the reduction in NO_2 levels from kitchen to living room to bedroom and outside, and demonstrate the co-variation of NO_2 levels at different sites within and outside a home, i.e., the patterns of relative highs and lows are similar from one location to another. Also evident on the time series representations are a few instances where NO_2 levels in the kitchens, averaged over a 48-h time period, greatly exceed the U.S. EPA standard.

Peak NO_2

Continuous NO_2 monitoring was carried out in a selected fraction of our study homes. Preliminary results of continuous NO_2 monitoring during stove operation indicate peak levels ranging from 150 to over 1000 μg/m³ after 10 min of stove use (two top burners and oven) at adult breathing height (1.7 m). After 40 min of stove use, these breathing zone peaks ranged from 200 to over 1700 μg/m³ with an arithmetic mean of 600 μg/m³ for seven homes. At 2.3 m from the floor, NO_2 concentrations were as high as 2000 μg/m³ in two homes.

Daily Activities

According to the completed daily activity questionnaires (See Table 2) both the adults and children in our study spend the greatest part of their day indoors, with the largest proportion of that spent at home. Adults and children in the study participated in general for a period of 30 consecutive days. Thus our population does not consist of the same individuals in each season.

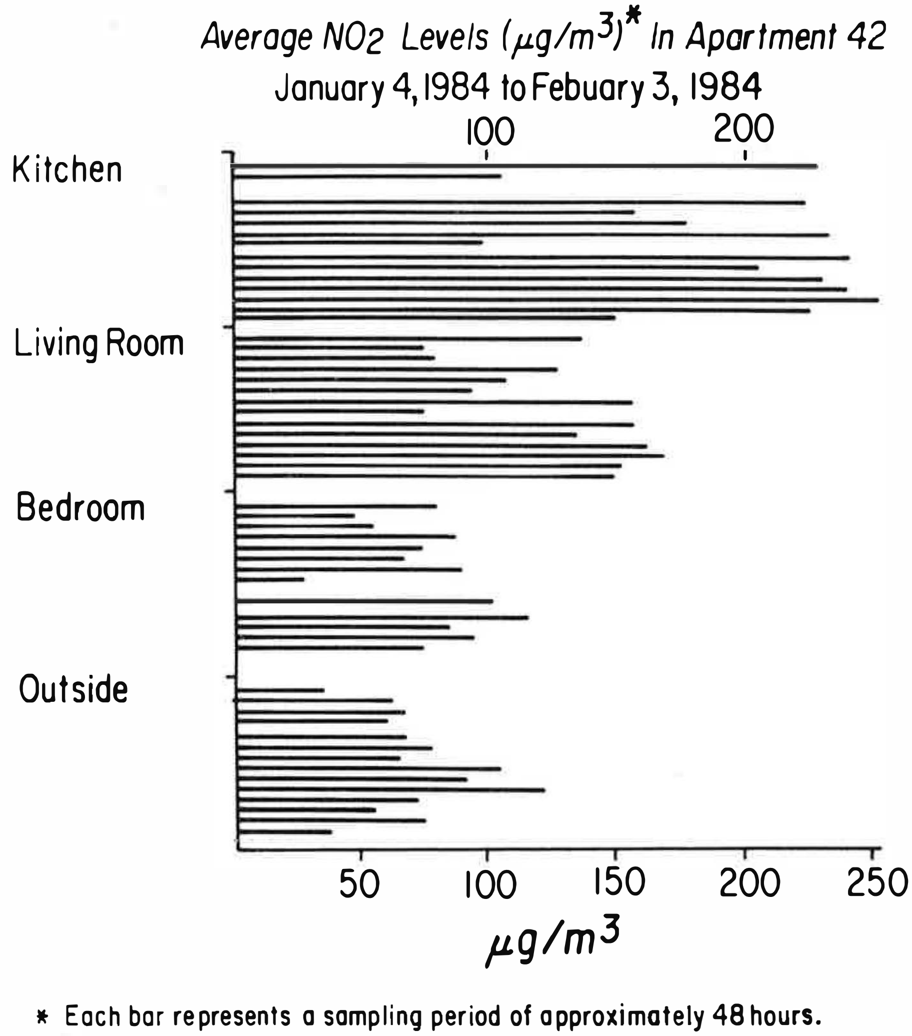

Fig. 1.

Table 2. Average number of hours* per day spent indoors and outdoors by 79 inner-city residents.

	WEEKDAYS			WEEKENDS and HOLIDAYS		
	Indoors at Home	Indoors Not Home	Outdoors	Indoors at Home	Indoors Not Home	Outdoors
FALL 1982						
child $n = 17$	17.3	4.9	1.8	20.1	1.8	2.1
adult $n = 13$	19.4	2.3	2.3	20.6	1.8	1.6
WINTER 1983						
child $n = 3$	19.0	3.6	1.4	21.9	0.7	1.4
adult $n = 9$	15.0	5.8	3.2	17.4	4.3	2.3
SUMMER 1983						
child $n = 9$	18.1	1.8	4.1	18.9	1.5	3.6
adult $n = 2$	21.1	0.7	2.2	20.7	0.7	2.6
FALL 1983						
child $n = 8$	16.3	5.8	1.8	18.8	3.4	1.8
adult $n = 1$	21.1	2.6	0.3	18.5	2.7	2.8
WINTER 1984						
child $n = 9$	16.5	5.9	1.6	19.6	3.2	1.2
adult $n = 2$	19.2	2.6	2.2	19.0	2.4	2.6
SPRING 1984						
child $n = 6$	14.4	8.0	1.6	15.3	6.7	2.0
adult $n = 0$	—	—	—	—	—	—

*Averages are based on approximately 30 consecutive daily activity records for each subject.

Preliminary Indoor Aeroallergen Studies

In addition to monitoring indoor (and outdoor) levels of NO_2 pollution in inner-city homes, preliminary work was carried out in eight homes to determine characteristic levels of various aeroallergens believed to be present within inner-city homes. Particulates were extracted daily from the air of the bedrooms and living rooms of four inner-city homes by a quiet, high-volume air sampling device, the Air Sentinel, developed by Reed and co-workers at the Mayo Clinic. Allergens collected on the filter sheets are assayed by a mini-RAST inhibition procedure (Agarwal *et al.*, 1981). The assays show high levels of certain allergens to be present in the study homes. In particular, levels of mouse urinary protein were on the order of those found in a small laboratory housing mice ranging from 400 to 600 pg/m^3 in some of the homes. House dust mite levels are about the same as those found in suburban homes; however cockroach antigen is exceptionally high (ranging from 2300 to 220,000 pg/m^3 in most homes), as would be expected in residences known to have large cockroach infestations. Preliminary findings and detailed description of the methodology of this phase of the study are reported in Swanson *et al.* (1984).

Discussion

Unlike certain other air pollutants known to be respiratory hazards, major sources of NO_2 exist indoors from gas or other organic fuel burning appliances. The gas cooking stove is particularly important in inner-city apartments, as it is usually the only major indoor NO_2 source (Sterling and Kobayashi, 1981). These dwellings, when compared to suburban detached housing, are often small and crowded, allowing the rapid build-up of any pollutants generated indoors. In addition, when the building's heating system is functioning but insufficient to provide the level of warmth the inhabitants were accustomed to in their native regions (such as the Southern United States, the Caribbean, and Latin America), inhabitants use their gas stoves as a source of supplemental heat. Due to a lack of resources and differing cultural practices, poor inner-city residents might be expected to eat out less frequently than other populations, and to use the stove more when preparing the meals they eat at home. These factors thus make it possible that NO_2 will be encountered in inner-city homes in concentrations high enough to be capable of eliciting significant respiratory effects.

The results of this study show high levels of NO_2 to be present in inner-city homes with gas stoves. In most cases, even the average NO_2 level in the kitchen, over all periods in all homes was above the U.S. EPA outdoor standard of 100 $\mu g/m^3$ (arithmetic annual mean). When the data are examined separately for each 48-h sampling period in each separate home, 48-h averages of up to 300 $\mu g/m^3$ are observed. Continuous monitoring, where instantaneous levels can be read, shows peak levels of NO_2 as high as 1700 $\mu g/m^3$ at breathing level.

NO_2 levels observed in our study population contrast sharply with those reported in other locations. In Portage, WI, indoor levels of NO_2 in kitchens with gas stoves averaged 67.37 $\mu g/m^3$ (range: 44.27 to 141.60 $\mu g/m^3$) and outdoor NO_2 averaged 5.18 $\mu g/m^3$ (Quackenboss *et al.*, 1982). Similar low concentrations were reported by the Harvard Six Cities Study group with gas appliance homes averaging between 14.7 to 54.3 $\mu g/m^3$ indoors (geometric means) (Speizer *et al.*, 1980). A maximum time-integrated NO_2 concentration of 146.4 $\mu g/m^3$ with an overall average for all samples in homes with gas stoves and no kerosene heaters of 44.7 $\mu g/m^3$ was reported in a suburban area of New Haven (Stolwijk *et al.*, 1983).

The generally higher averages found in our inner-city population are likely to be accompanied by short-term peaks that exceed average levels by one or more orders of magnitude. Peak concentrations of approximately 1100 $\mu g/m^3$ have been reported by the Harvard Six cities study, and we have preliminary indication that similar and higher peaks occur in our population. Exposure to high short-term NO_2 concentrations may have more deleterious acute health effects than constant exposure to low levels of NO_2, and further study of the occurrence and extent of these peaks is necessary.

The high levels of NO_2 encountered in inner-city dwellings may be a result of a number of factors. Apartments tend to be small and often crowded, and are generally well sealed to prevent loss of heat in the winter. The most significant indoor source of NO_2 in these homes is undoubtedly the gas stove, and most of the families we studied did a considerable amount of cooking (average number of hours cooking per family was 1.4, with cooking for periods longer than 3 h occurring frequently). NO_2 levels were found to increase when the stove is turned on and to decrease with increasing distance from the kitchen, and to attain their highest 48-h averages on days when the stove was reported to be in use for long periods of time. As these homes generally do not employ indoor gas or kerosene heaters, the most likely additional source of significant amounts of NO_2 is the outdoor air. Especially during the summer, when windows are open and outdoor levels are highest, outdoor concentrations appear to provide a background level to which the gas stove might add substantial contributions.

Our results also show that our subjects, especially the children, spend an unusual amount of time indoors at home. Averages of time spent at home for all children in each season were from 18.8 to 20.6 h per day on holidays (19.7 h per day overall), and from 16.3 to 19.0 h per day on school days (17.2 h per day overall). Adults in the study, mostly non-working women, spent 19.04 h per day overall on holidays and 18.03 h per day on nonholidays indoors at home. Time-use studies of Americans from other populations (mainly middle-class) give 16.75 (Szalai, 1972) and 16.03 (Chapin, 1974) h per day spent indoors at home, approximately $1-3$ h per day less than overall averages in our study population.

The children in our study population are kept at home so much possibly as a direct or indirect consequence of their asthma. We speculate that additional factors such as fear of street crime, bad weather, and an inability to purchase outside entertainment must also contribute to the disparity in behavior compared to other populations. The result of this constellation of factors is that inner-city children, especially those with asthma, have high exposures to indoor air pollutants, including NO_2 and possibly certain aeroallergens.

Conclusion

The combination of high indoor levels of the respiratory irritant NO_2 and various aeroallergens in the homes of inner-city residents and the fact that they spend a large proportion of their time in their homes indicates that we are dealing with a population with high pollutant exposures. This inner-city population is thus at high risk for showing any health effects these pollutants may induce, which might include the various stages of asthma or other respiratory illnesses prevalent in this community.

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APPENDIX: Sample Questionnaire on Daily Activity

DAILY ACTIVITY SUMMARY

Month/ Day / Year
Activities occurred on ____/____/____
Day of week (circle day activities occured on):

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7

Family ID ____________
Name ID ____________

At Home (Column 1)

___101. Cooked a meal
___102. Housework
___103. Sleeping
___104. Other ______

****

Outdoors (Column 2)

___201. In transit (in a vehicle)
___202. Walking
___203. Work outdoors
___204. Shopping & errands (mostly outdoors)
___205. Visiting or meeting friends outside
___206. Exercising (running, outdoor sports)
___207. Playing outside
___208. Went to park
___209. Eating outdoors
___210. Other ____________

****

Indoors Not At Home (Column 3)

___301. Visit doctor's office, clinic, or hospital
___302. At work
___303. At school
___304. Shopping (mostly indoors)
___305. Visiting with friends, neighbors, or relatives
___306. Entertainment (movies, music, dancing, etc.)
___307. Church activities (services, socials, etc.)
___308. Indoor exercise (home, school, gymnasium, exercise class, etc.)
___309. Ate meal or snack in restaurant or other indoor location
___310. Other ____________

****

INSTRUCTIONS: Please check all activities that apply to you for the day circled at top of page. Then, to show whether the activity occurred at home, outdoors, or indoors at locations other than the home, draw a line in the appropriate column to show when the activity started and ended. Indicate activity times to the nearest half hour. If you are doing more than one activity during any half hour period, fill in only the activity that took the longest time. For outdoor activities that occurred in less than 15 minutes, place a checkmark in the outdoor column and write in the time.

	HOME	OUT-DOORS	IN-DOORS	
AM 5:00				5:00 AM
6:00				6:00
7:00				7:00
8:00				8:00
9:00				9:00
10:00				10:00
11:00				11:00
NOON 12:00				12:00
PM 1:00				1:00 PM
2:00				2:00
3:00				3:00
4:00				4:00
5:00				5:00
6:00				6:00
7:00				7:00
8:00				8:00
9:00				9:00
10:00				10:00
11:00				11:00
12:00				12:00
AM 1:00				1:00 AM
2:00				2:00
3:00				3:00
4:00				4:00

Family Name ____________
ID ____________
Date ____________
Day of week ____________

DAILY HOUSEHOLD CONDITIONS

1. GAS STOVE USE

	Time On		Time Off			Number of Burners Used Or Oven/Broiler Temperature
Top burners for cooking	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
Oven for cooking	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
Broiler for cooking	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
Top burners for heat	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
Oven for heat	____	____	____	____	AM/PM	____
	____	____	____	____	AM/PM	____
Boiled water	____	____	____	____	AM/PM	____
for steam or heat	____	____	____	____	AM/PM	____

2. VENTILATION

Did you use:

N/A
(Circle if
not applicable)

[ ] Winter	[ ] Summer
[ ] Insulating materials	[ ] Air conditioner
[ ] Covering on windows	[ ] Door (front or back) open
[ ] Fan	[ ] Fan
[ ] Windows open by day	[ ] Windows open by day
[ ] Windows open at night	[ ] Windows open at night

3. OTHER CONDITIONS

Other Appliances Used:

[ ] None used
[ ] Space heater
[ ] Humidifier
[ ] Vaporizer

Yes	No	
[ ]	[ ]	Did you notice an increase in cockroaches?
[ ]	[ ]	Did you use any cockroach or insect spray?
[ ]	[ ]	Were there any new pet or pets belonging to someone else in your house today? (If yes, please list type of animal(s) ____________)
[ ]	[ ]	Did you see any rodents (rats or mice) today?

4. SMOKING

Number of guests in your home during the day or night ____

If anyone smoked in your home during the past 24 hours, please indicate the total number of cigarettes or other products smoked

N/A (Circle if not applicable)		Kitchen	Living Room	Other Rooms
	Cigarettes	____	____	____
	Other	____	____	____

5. HOUSEWORK (approximate time (in minutes) spent in each room)

N/A (Circle if not applicable)		Kitchen	Living Room	Other Rooms
	Vacuuming	____	____	____
	Dusting	____	____	____
	Sweeping	____	____	____

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