FIGURES

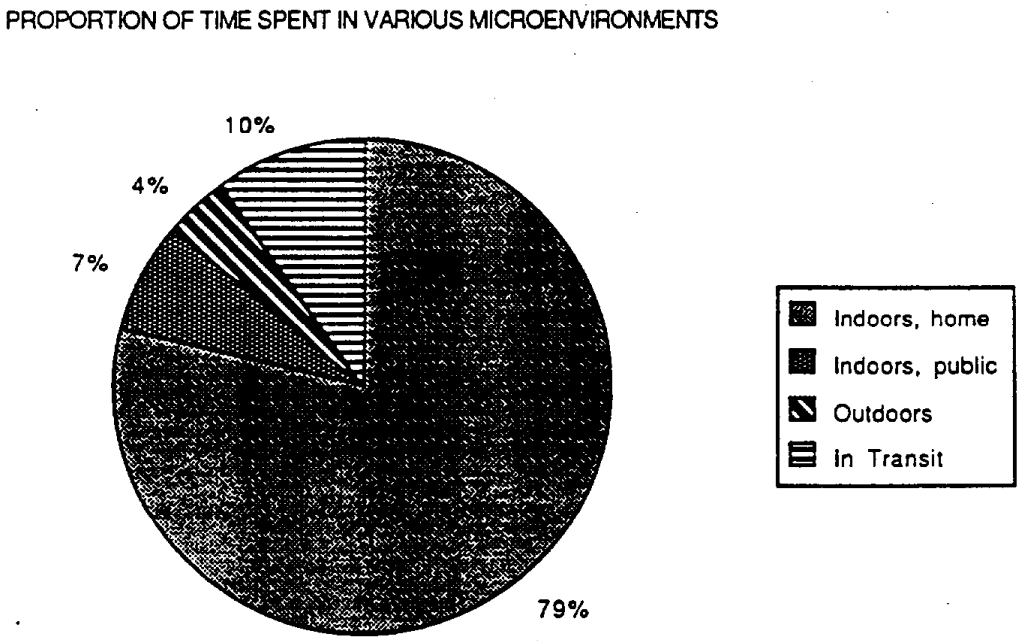


Figure 3.1 Proportion of time spent in major microenvironment classes for nonsmoking IHD subjects wearing the CO personal exposure monitors.

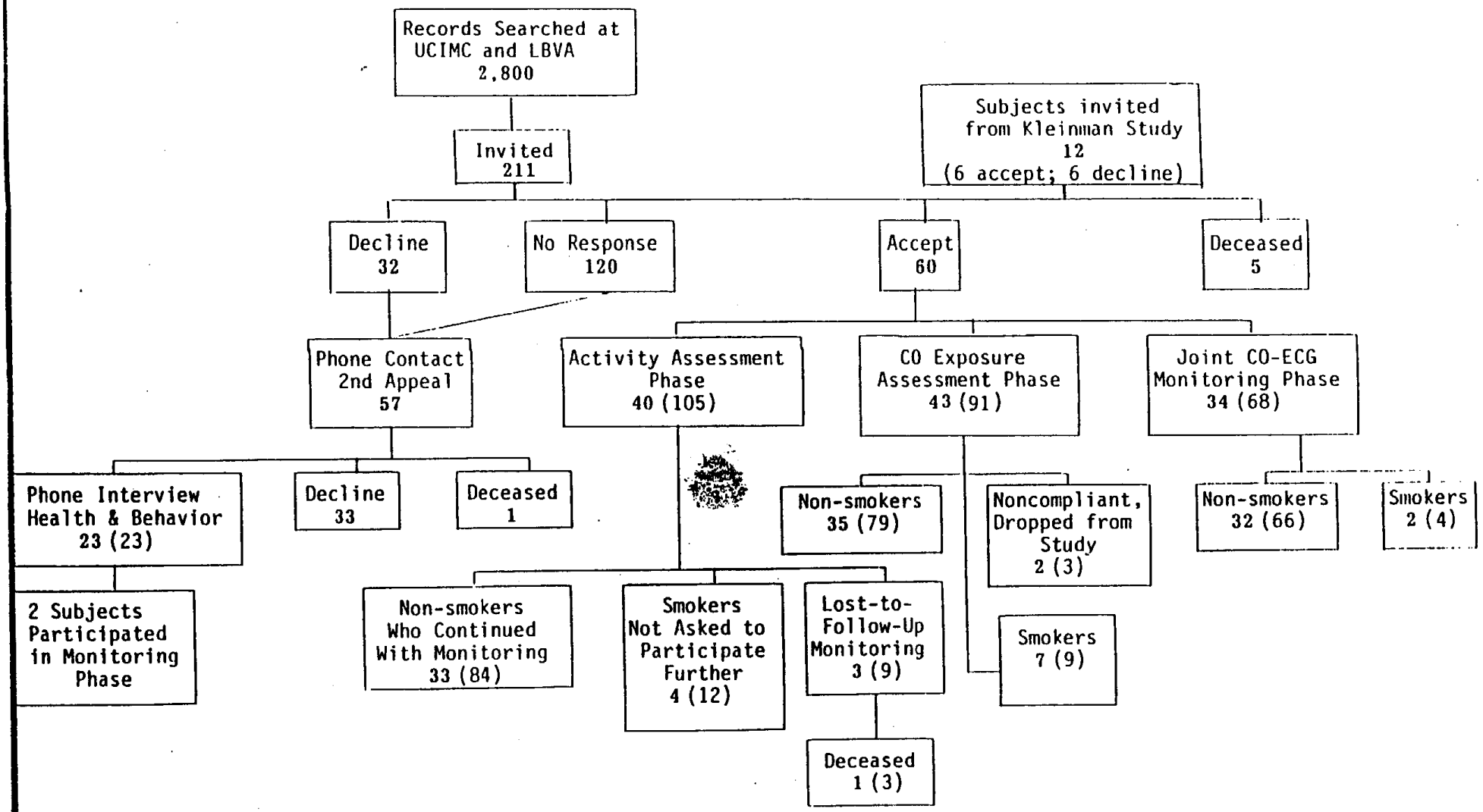
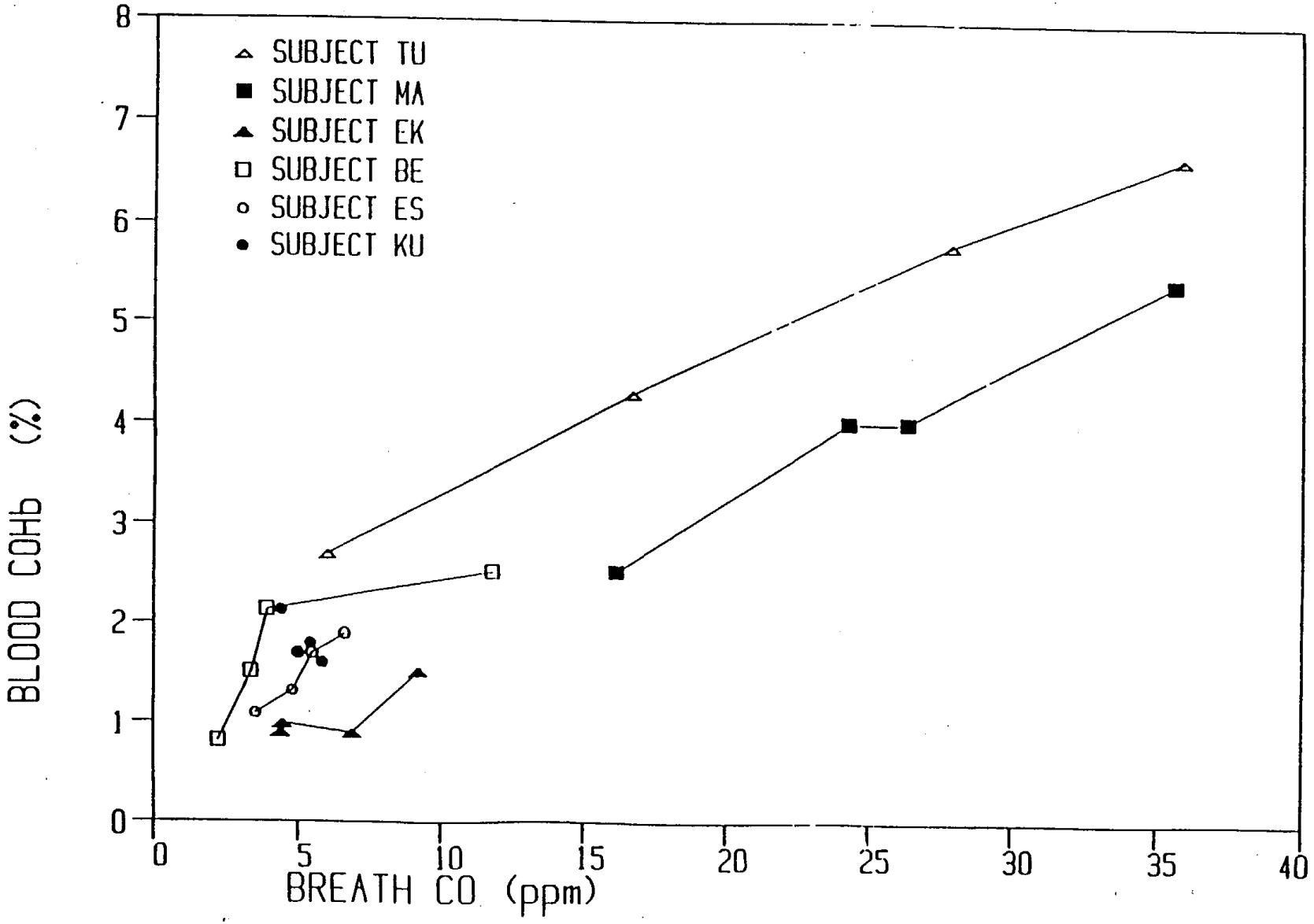


Figure 2.2 **Flowchart of subject screening, recruitment and experimental activities.**


SUBJECT TU
SUBJECT MA
SUBJECT EK
SUBJECT BE
SUBJECT ES
SUBJECT KU
BLOOD COHb (%)
BREATH CO (ppm)
0
1
2
3
4
5
6
7
8
0
5
10
15
20
25
30
35
40

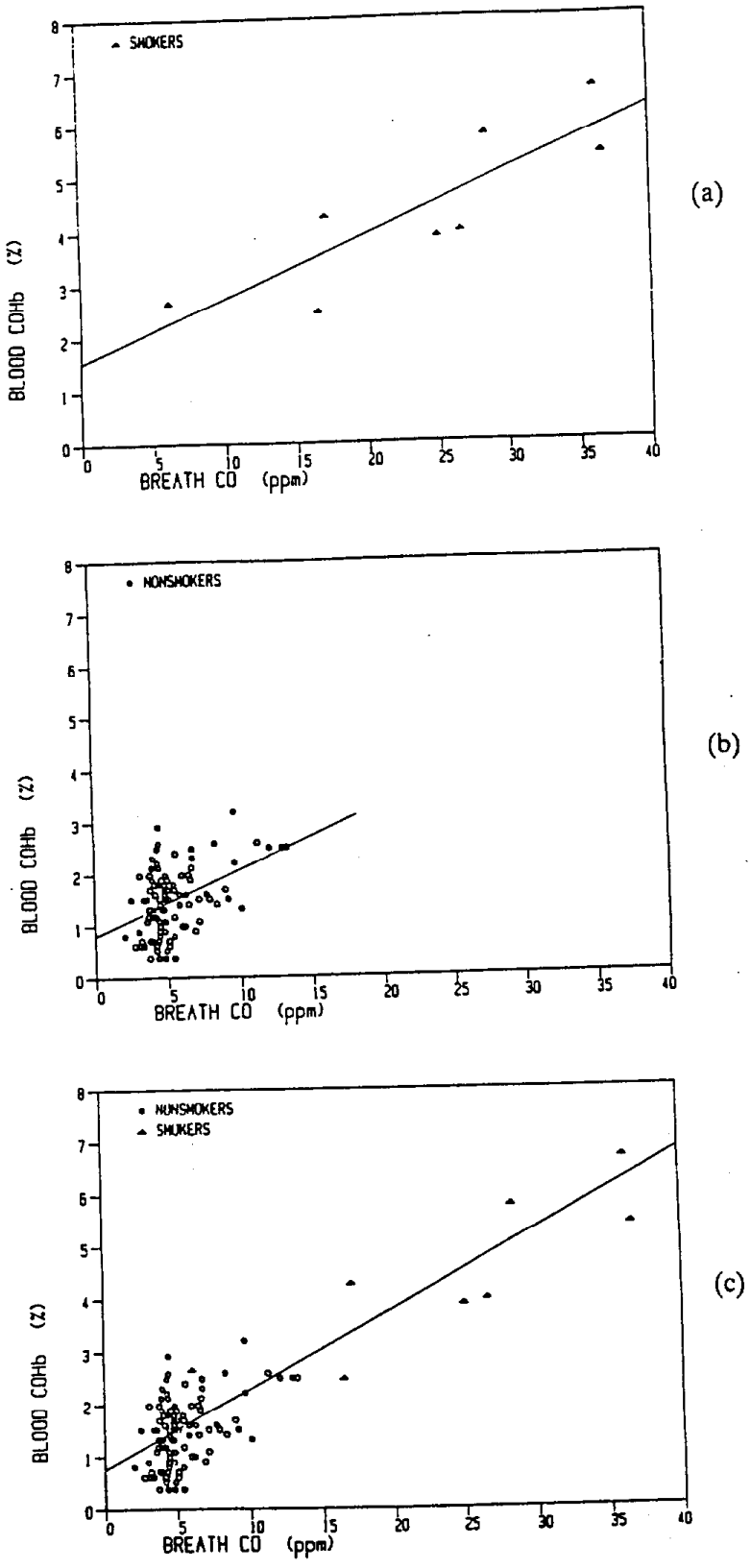


Figure 3.2 Relationship of carboxyhemoglobin levels as directly measured in blood samples to CO concentration in end-expired breath after 20-second breathhold. For (a) Smokers; (b) Nonsmokers; and (c) Smokers and nonsmokers combined.

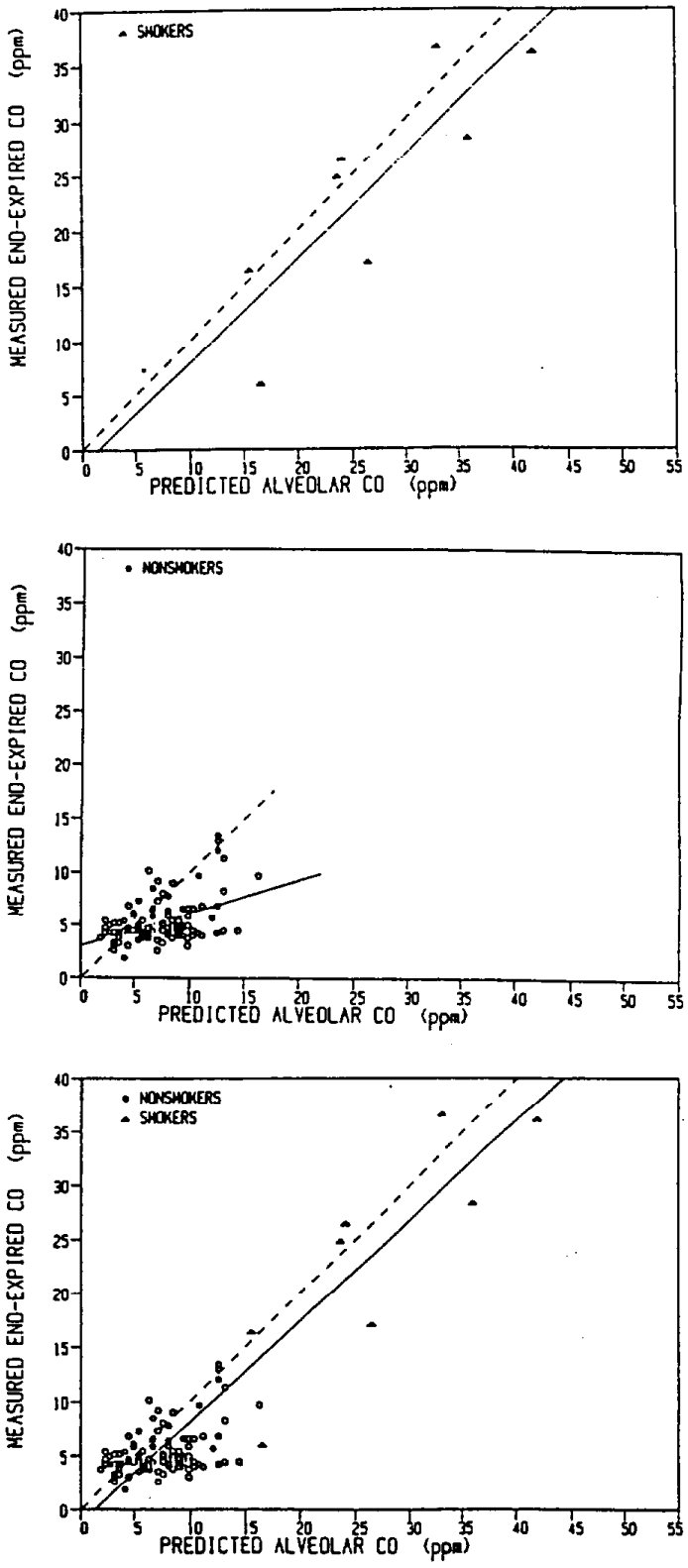


Figure 3.5 Relationship of end-expired breath [CO] to alveolar air [CO] as predicted by Haldane's first equation and blood analysis. Data is presented for all IHD subjects. Dotted line represents line of 1:1 correspondence. For (a) Smokers; (b) Nonsmokers; and (c) Smokers and nonsmokers combined.

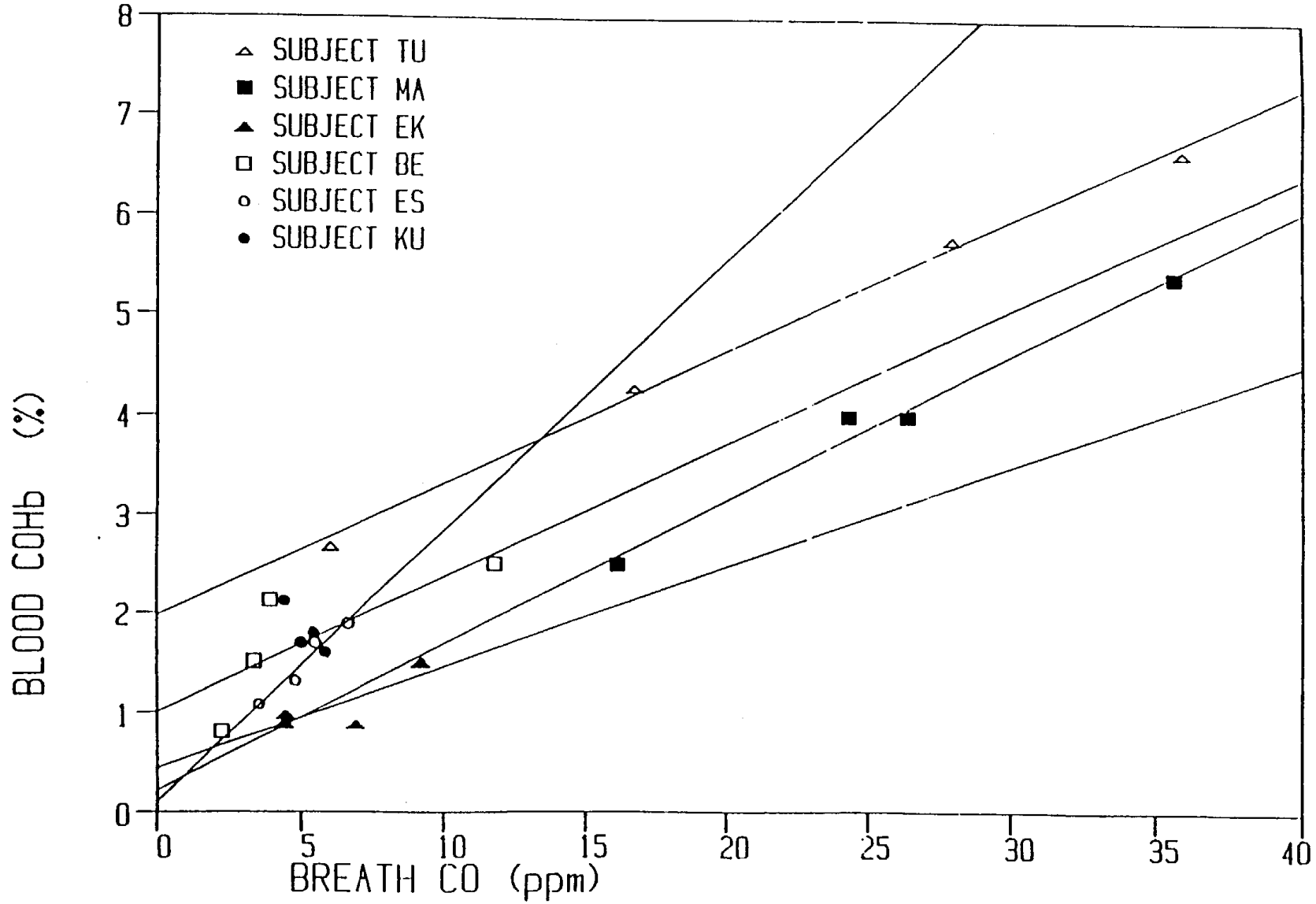


Figure 3.4 Regression of blood %COHb on end-expired breath [CO] for selected subjects with IHD.

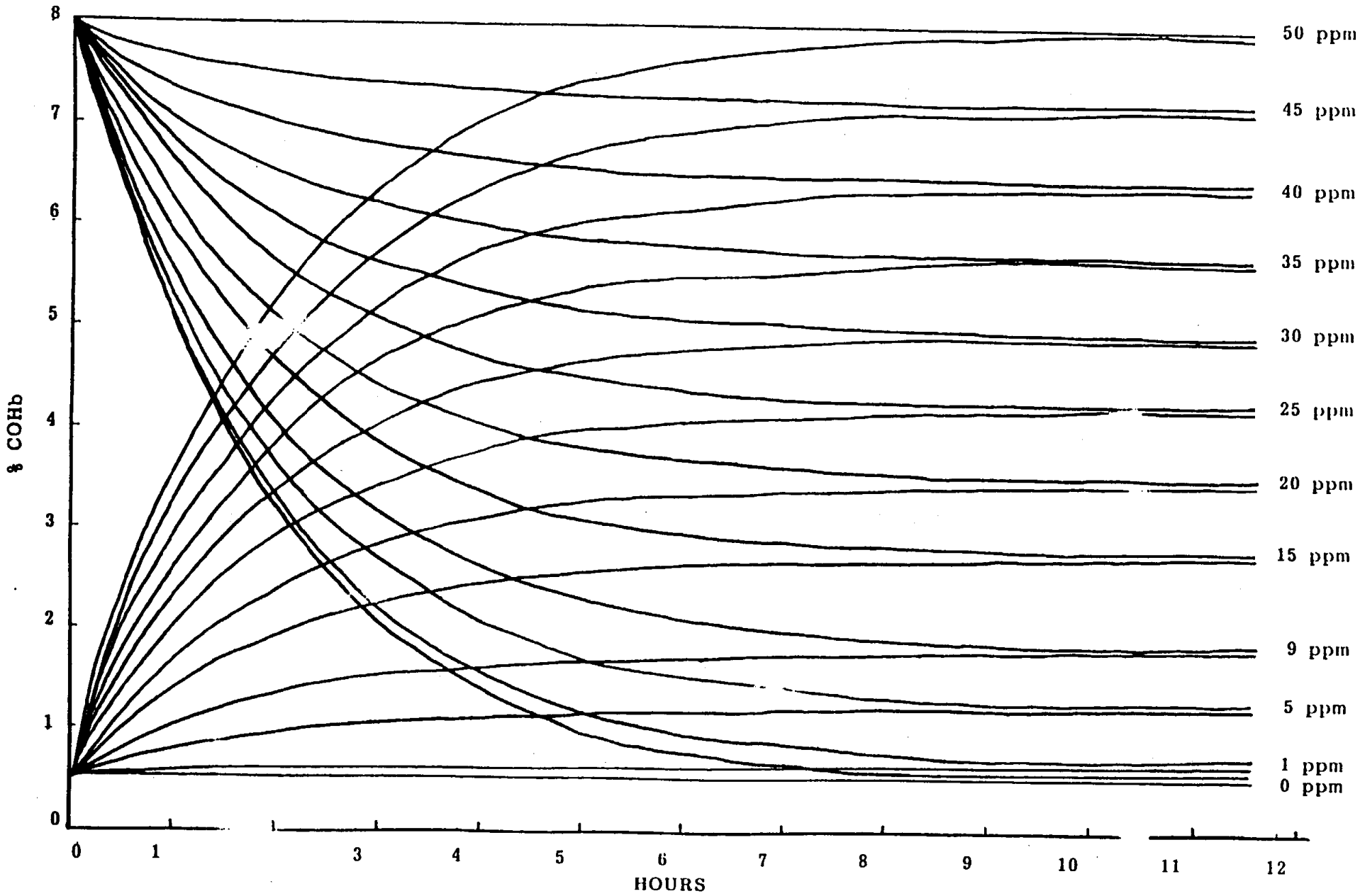


Figure 3.7 CO uptake and elimination curves as predicted by Ott and Mage (1978)

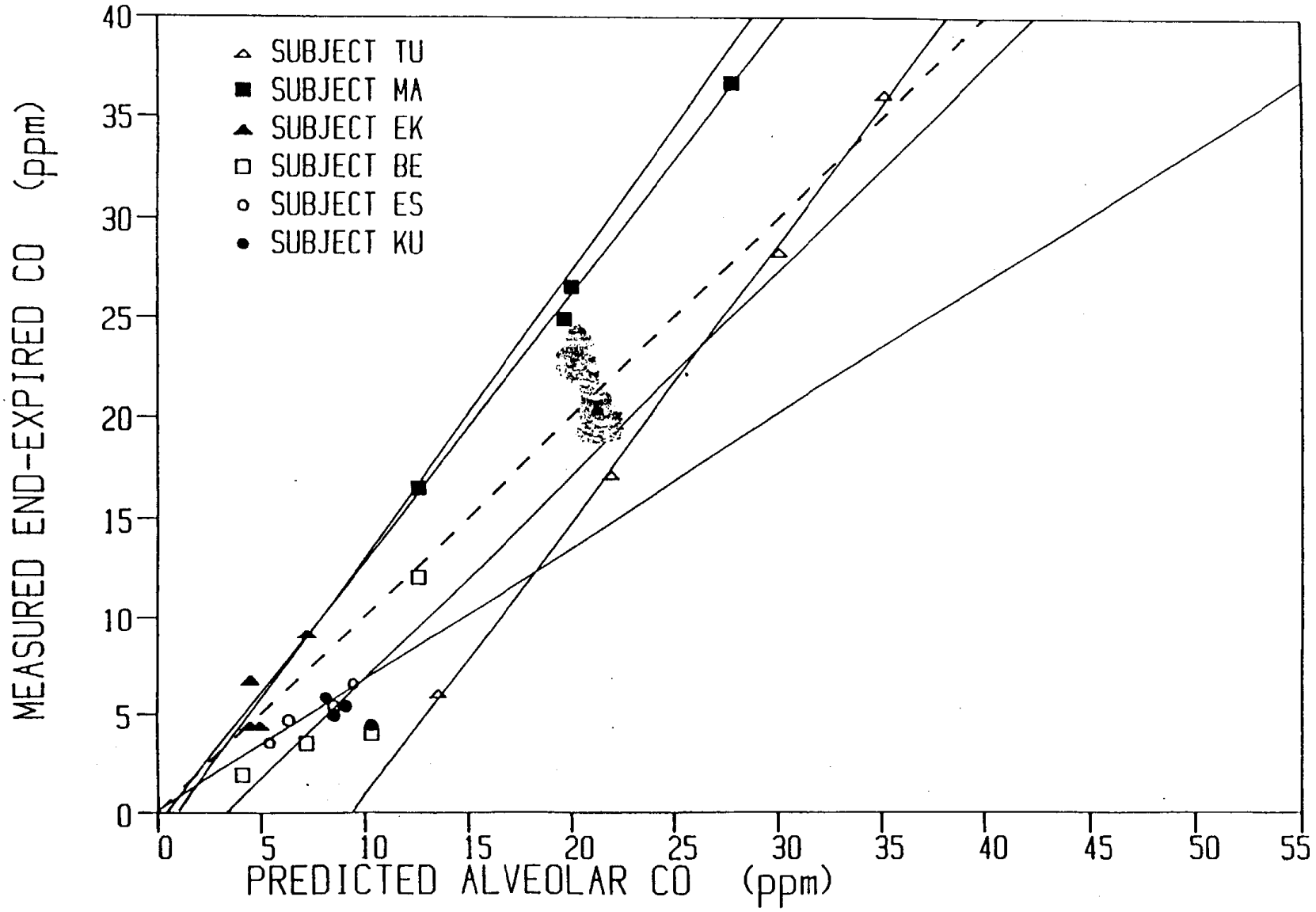


Figure 3.6 Relationship of end-expired air [CO] to alveolar air [CO] as predicted by Haldane's first equation and blood analysis. Data is presented for selected IHD subjects. Dotted line

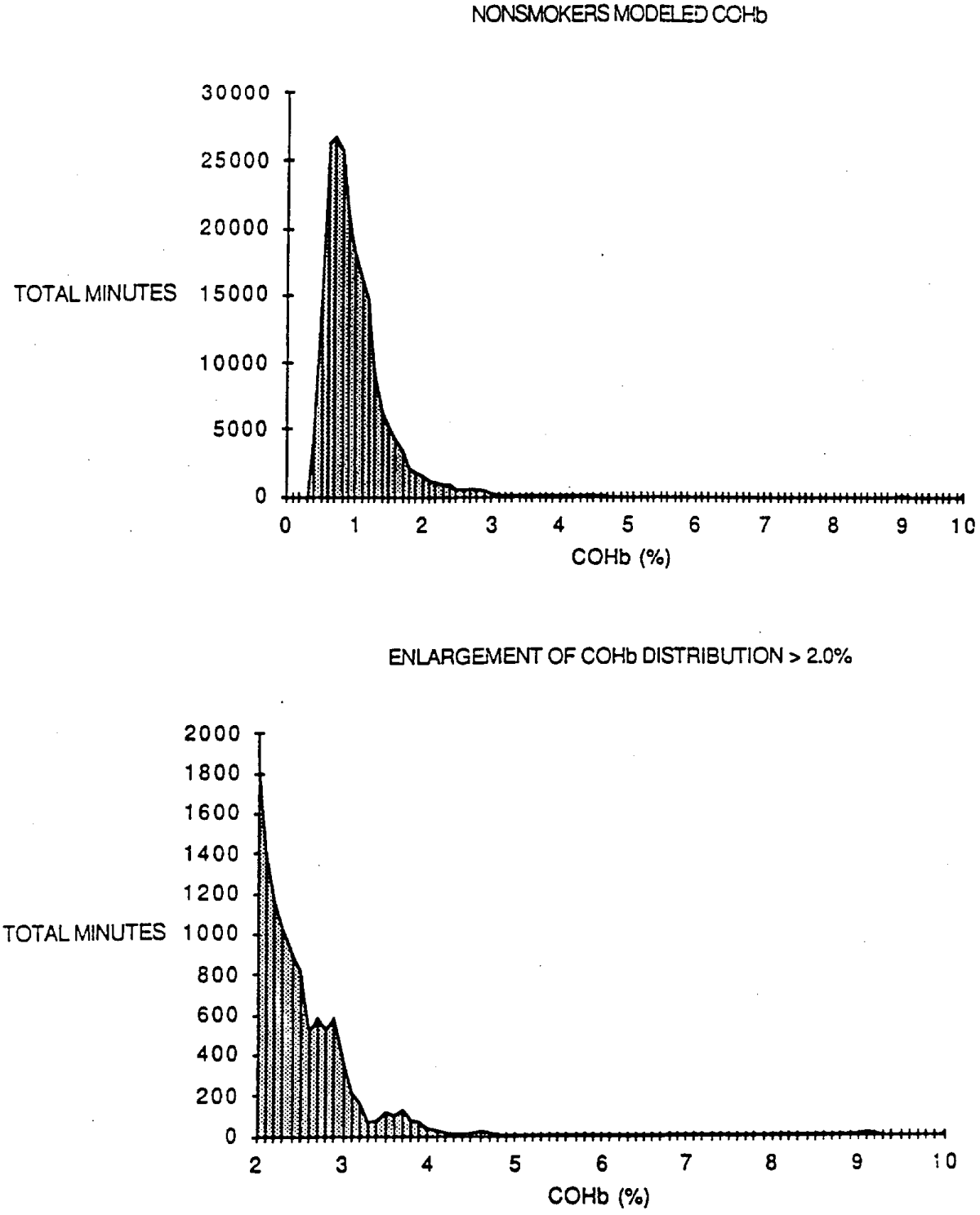
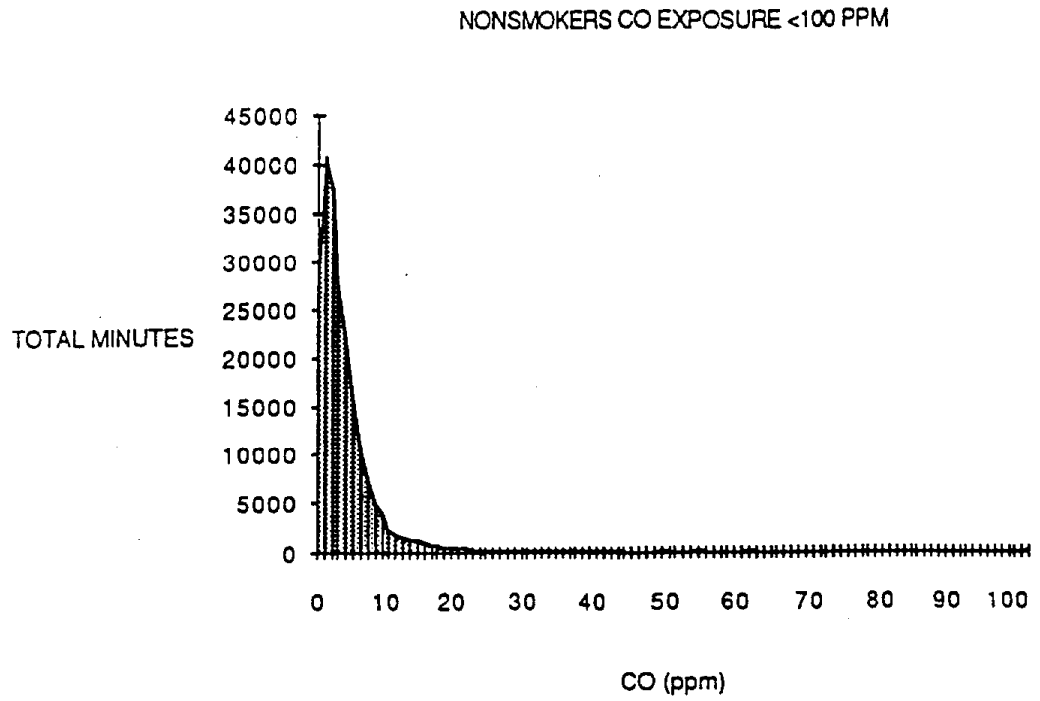


Figure 3.9 Distribution of "estimated" minute-by-minute COHb estimates as predicted for nonsmoking IHD subjects by PEM measurements using the Ott and Mage (197 algorithm (N = 36; 142 person-days).



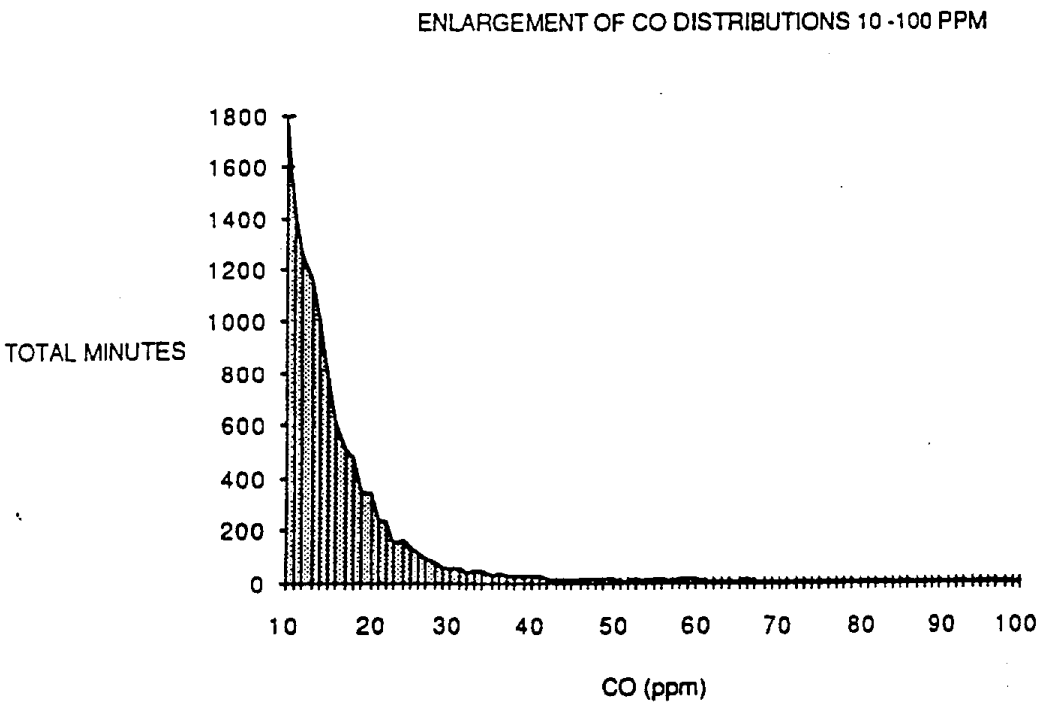


Figure 3.8 Distribution of minute-by-minute ambient CO measurements for nonsmoking subjects recorded by PEM (N=36; 142 person-days).

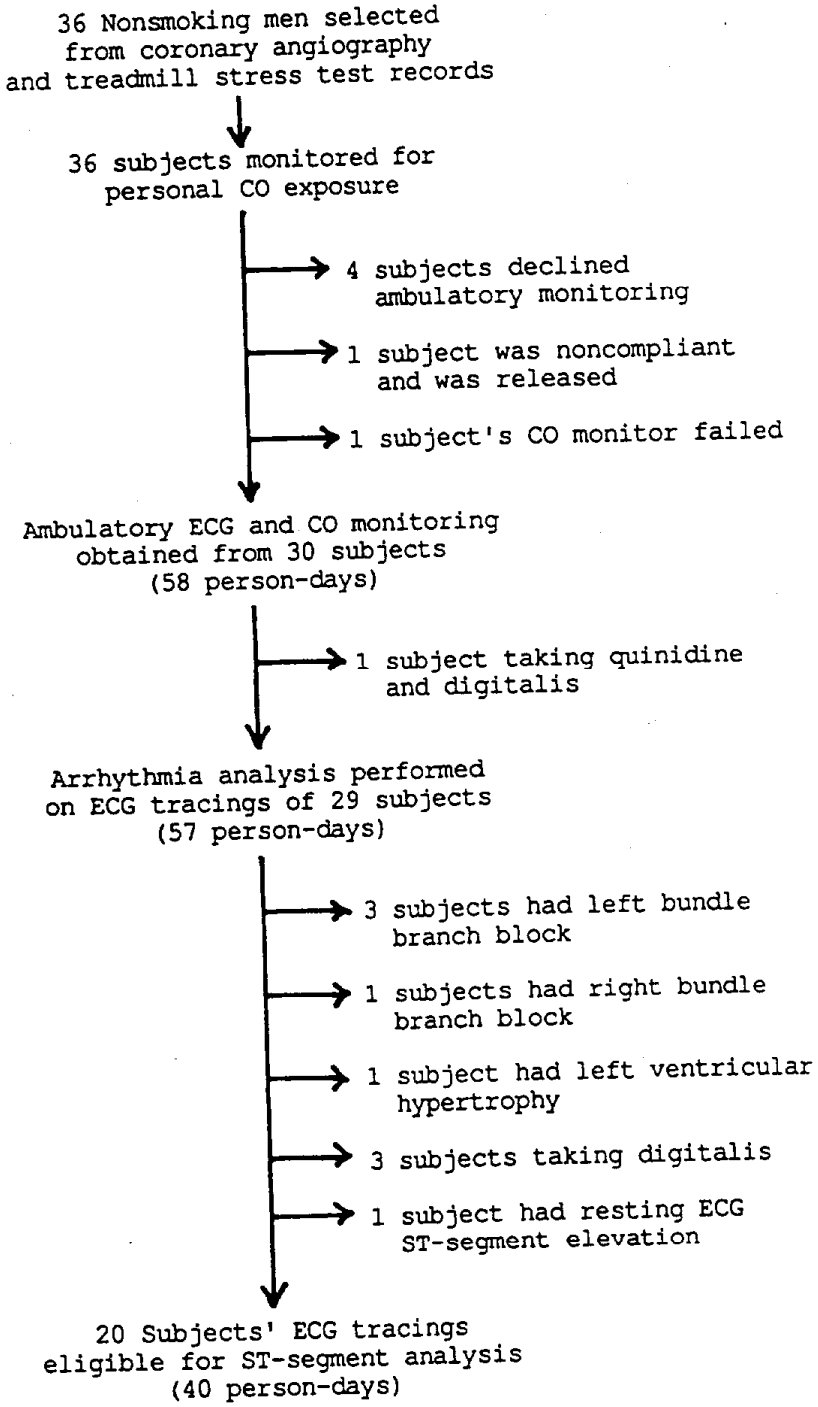


Figure 3-11. Ambulatory ECG and CO exposure data available for cardiac health effects analysis

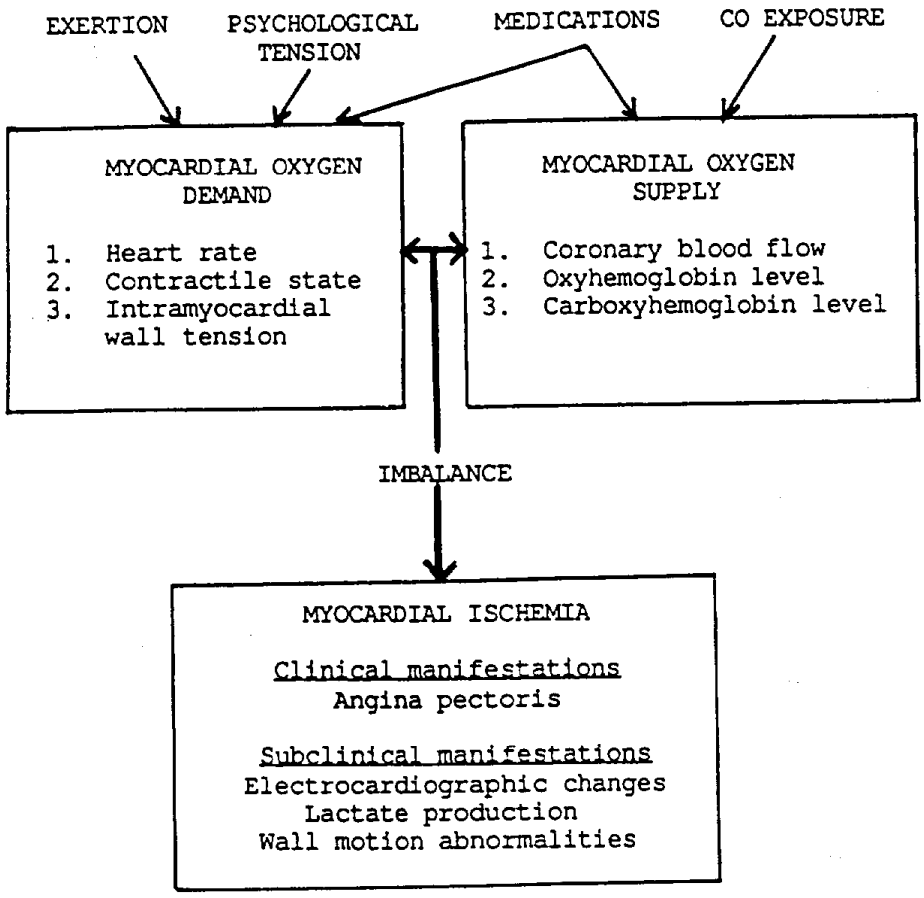


Figure 3-10 Balance of myocardial oxygen supply and demand (adapted from Miller 1985)

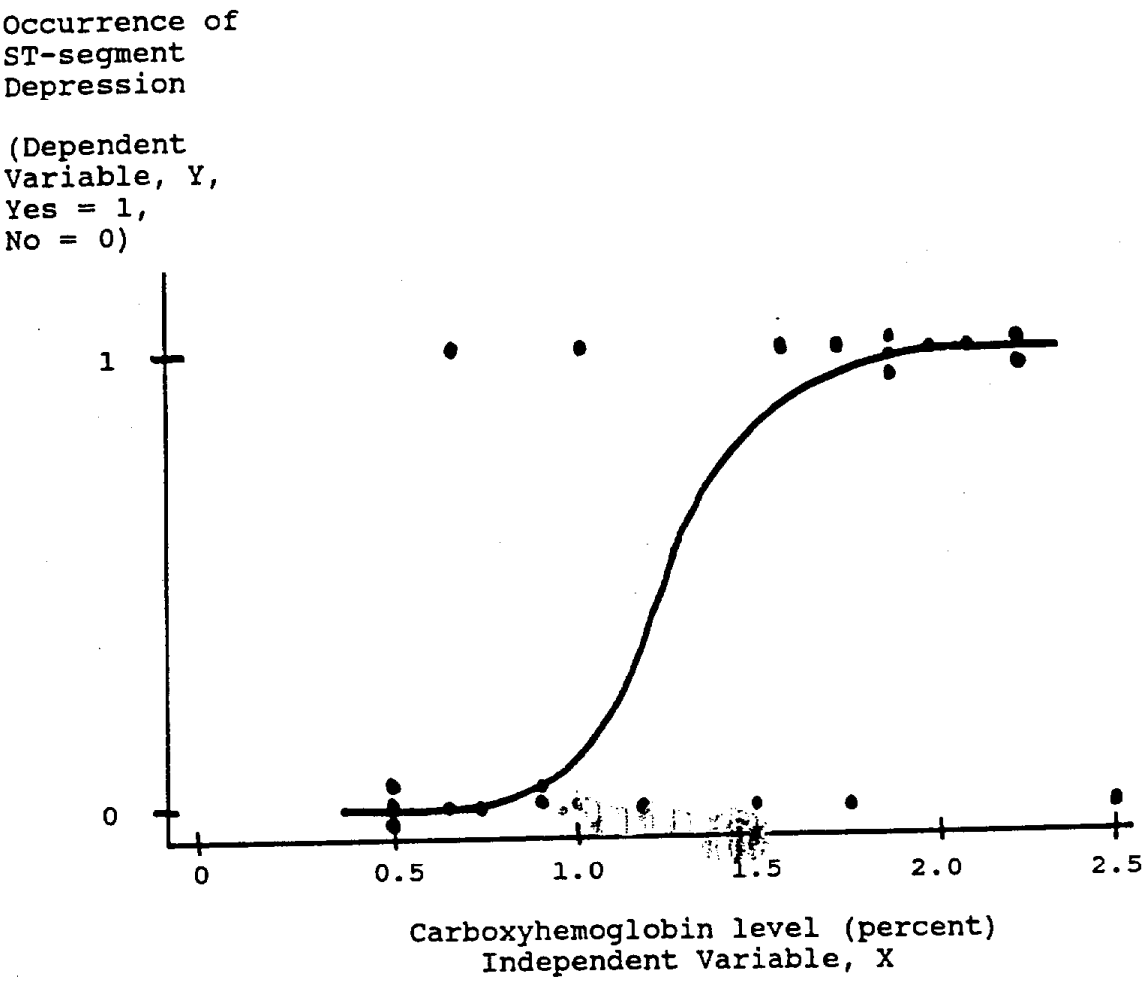


Figure 3-13. Example of scatterplot of data when the dependent variable is binary and a logistic response function has been fit to the data

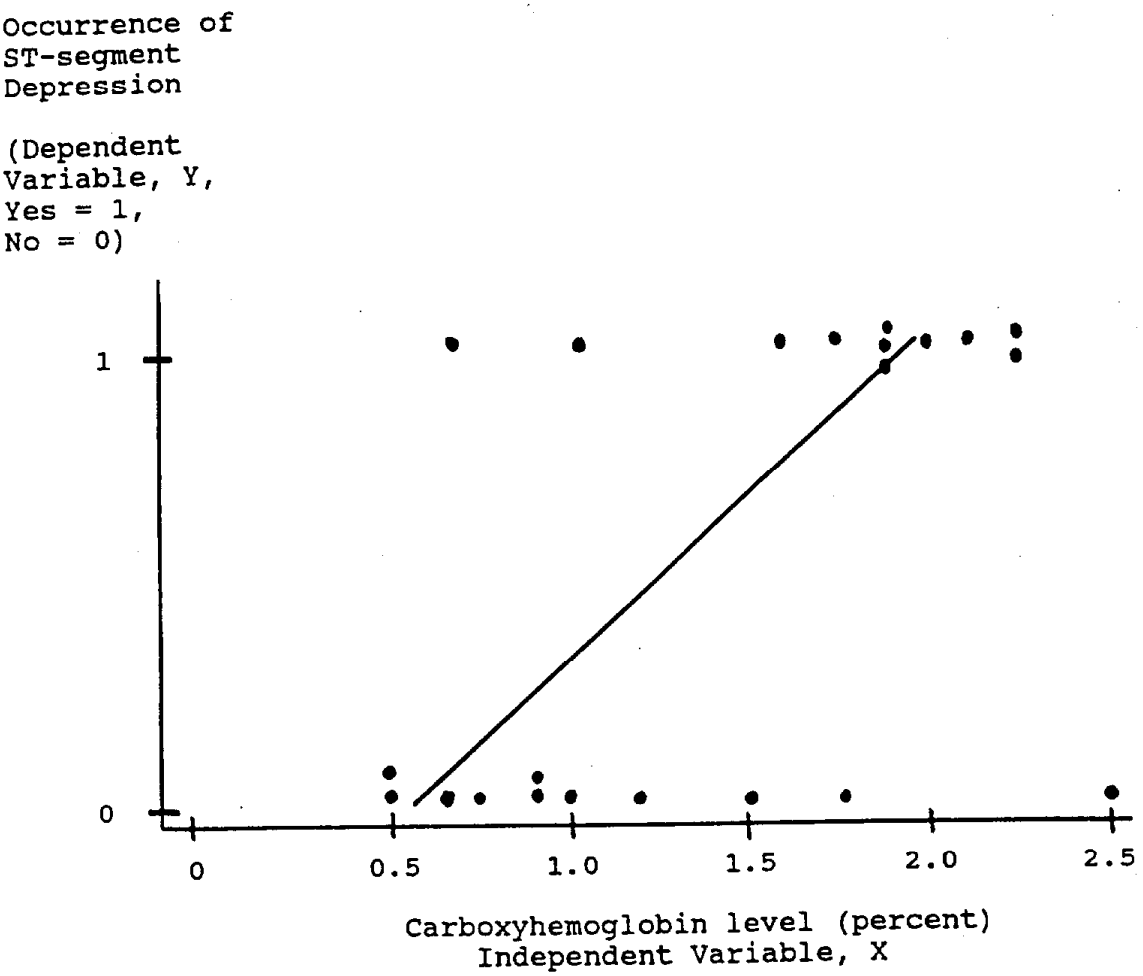


Figure 3-12. Example of scatterplot of data when the dependent variable is binary and a linear regression model has been fit to the data

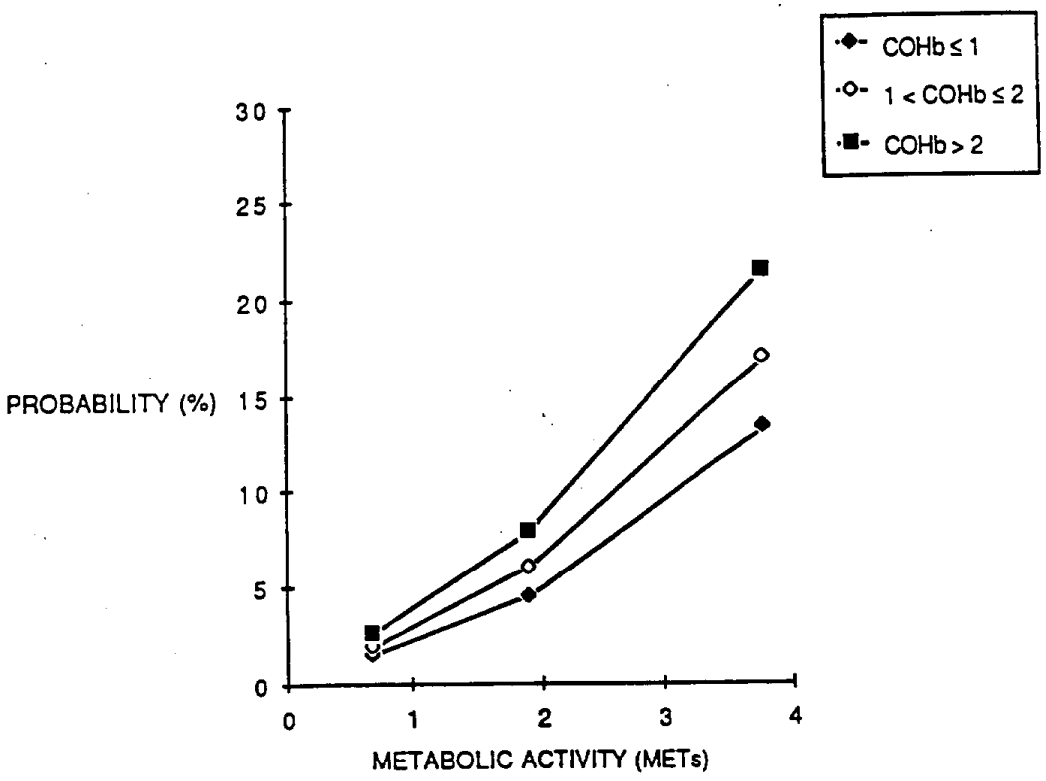


Figure 3-15. Point estimates of the probability of occurrence of ST-segment depression in any 15-minute follow-up interval estimated as a function of carboxyhemoglobin level (≤ 1, 1 to 2, and > 2%) and metabolic activity (≤ 1, 1 to 2.5, > 2.5 METs). Estimates were derived from multiple logistic regression model presented in Table 3-22.

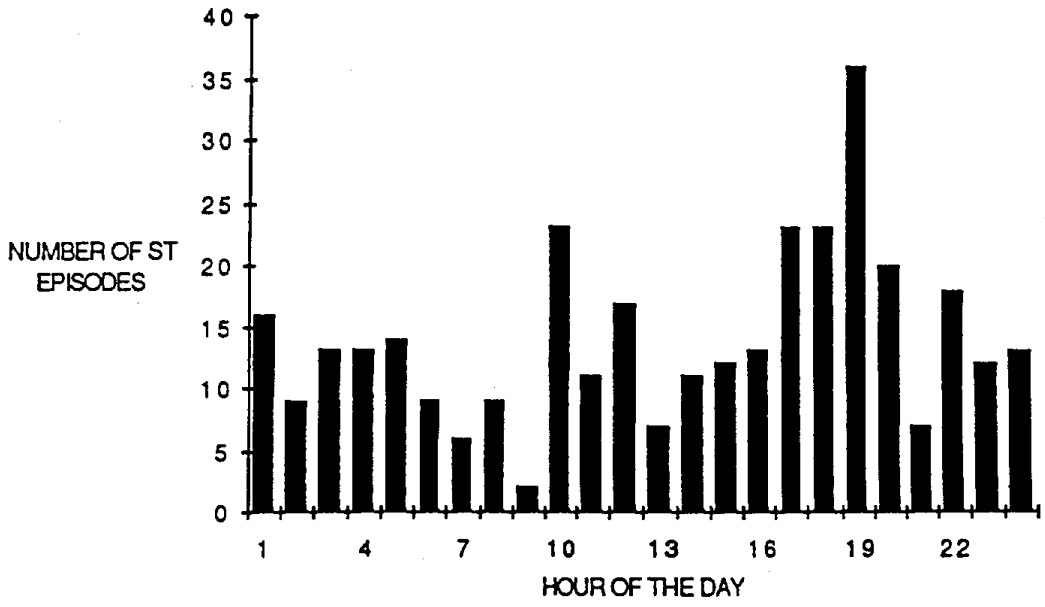


Figure 3.14 . Distribution of episodes of ST-segment depression by hour of the day

Table 1.1 Summary of previous research on the effects of CO exposure on exercise capacity.

STUDY	SUBJECTS	CO EXPOSURE PROTOCOL	Mean COHb (%)	EXERCISE PROTOCOL	RESULTS
Aronow and Isabell (1973)	10 men; CAD: age 40-55; non-smokers.	50 ppm for 2 hours. Compressed air control	2.7	Bicycle ergometer. Progressive 20 W increase in workload every 3 minutes.	16% decrease in mean time. Although not statistically significant, ST-segment depression occurred earlier and after less work.
Anderson, et al. (1973)	10 men; CAD; 5 smokers; stable angina pectoris	50 ppm for 4 hours.	2.9	Treadmill. Progressive increase in work-load. Stage B 2mph 5% grade " I 3 " 10% " " II 3 " 12% " " III 3 " 16% " 3 minutes per stage	16% decrease in mean exercise time. ST-segment depression occurred earlier and lasted longer.
		100 ppm for 4 hours.	4.5		15% decrease in mean exercise time. Duration of pain significantly pro longed. ST-segment depression occurred earlier and lasted longer
		Compressed air control.			
Aronow (1981)	14 men and 1 woman; CAD; mean age 50; non-smokers; stable angina	50 ppm for 1 hour Compressed air control	2.0	Bicycle ergometer. 50W starting workload, progressive 25 W increase in workload every 3 minutes.	10% decrease in mean exercise time. ST-segm depression occurred earlier at lower workloa

TABLES

Table 2.1 Number of subjects participating in various project phases.

	January	February	March	April	May	June
Activity Diaries	104	10	0	2	0	0
Telephone Interviews	0	0	0	11	3	6
CO-ECG Monitoring	2	15	16	17	17	1
CO Monitoring	3	29	17	14	17	10

Table 1.1 (cont.)

STUDY	SUBJECTS	CO EXPOSURE PROTOCOL	Mean COHb (%)	EXERCISE PROTOCOL	RESULTS
Whittenberger, Kleinman, and Davidson (1986)	26 men; CAD: nonsmokers; stable angina pectoris.	100 ppm for 1 hour. Room air control.	2.9	Bicycle ergometer. 50W starting workload; progressive 25W increase in workload every 3 minutes.	10% decrease in mean exercise time to angina. Increased duration of angina.

Table 3.1 (con't.)

Gas/fumes at work (%)	None	.85	(36/42)
	Mild	.10	(4/42)
	Moderate	.02	(1/42)
	Severe	.02	(1/42)
Around others who smoke (%)	Rarely	.60	(25/42)
	Job	.07	(3/42)
	Home	.28	(12/42)
	Other	.05	(2/42)
Usual Mode of Travel (%)	Personal Auto	.95	(40/42)
	Bus	.02	(1/42)
	Bicycle	.02	(1/42)
Commute 3 x per week, 1 way Travel Time	None	.40	(17/42)
	<15 min.	.05	(2/42)
	15 min.- ½ hr.	.14	(6/42)
	½ hr.- 1 hr.	.26	(11/42)
	1 hr.- 1½ hr.	.12	(5/42)
	>1½ hr.	.02	(1/42)
Smoking Behavior (%)	Never	.40	(17/42)
	Former	.45	(19/42)
	Current	.12	(5/42)
	Pipe or cigar	.02	(1/42)
Employment (%)	Part time	.14	(6/42)
	Full time (>30 hrs. per week)	.21	(9/42)
	Unemployed	.28	(12/42)
	Retired or on disability	.35	(15/42)
Marital Status (%)	Married	.78	(33/42)
	Never married	.14	(6/42)
	Divorced	.07	(3/42)
	Widowed	.00	(0/42)

Table 3.1 Characteristics of research subjects who wore CO personal exposure monitors and electrocardiograph monitors.

Age (yrs.)	Average	39-74	Mean 60.3	s.d. 8.0
Height (cm)		160-188	174.4	7.4
Weight (kg)		60-120	84.6	14.9
Angina Present (%)			.71	(30/42)
Angina Frequency (%)		Never	.28	(12/42)
		<1/month	.07	(3/42)
		1/month	.00	(0/42)
		1/week	.00	(0/42)
		2-3/week	.28	(12/42)
		every day	.35	(15/42)
Self-Assessed Heart Health (%)		Good	.26	(11/42)
		Average	.52	(22/42)
		Poor	.21	(9/42)
Self-Assessed General Health (%)		Good	.17	(7/42)
		Average	.62	(26/42)
		Poor	.21	(9/42)
Coronary Artery Bypass Graft Surgery (%)			.43	(18/42)
Angioplasty (%)			.12	(5/42)
Medications				
Nitrates (%)			0.54	(23/42)
B-blocker (%)			0.35	(15/42)
Slow Inward Calcium Channel Blockers (%)			0.21	(9/42)
Digitalis (%)			0.07	(3/42)
Quinidine/Pronestyl (%)			0.05	(2/42)
Anti-hypertensives (%)			0.48	(20/42)
Diuretics (%)			0.42	(18/42)
Potassium (%)			0.14	(6/42)
Proximity to CO Sources				
Fireplace, used (%)			.28	(12/42)
Wood stove (%)			.02	(1/42)
Gas stove (%)			.74	(31/42)
Gas furnace (%)			.95	(40/42)
Gas water heater (%)			.81	(34/42)
Gas clothes dryer (%)			.33	(14/42)
Kerosene or Gas space heater (%)			.05	(2/42)
Attached garage (%)			.40	(17/42)

Table 3.2 (cont.)

ACTIVITIES PURSUED		Occurrences		Occupancy Time (min.)			
		Docrs	Max (min.)	Arithmetic		Geometric	
Code	Activity			$\bar{X}$	SD	$\bar{Y}$	SD
17	Gardening, animal care	14	34	152	15	39	4	5
18	Heat, water	2	7	111	3	18	1	2
19	Other duties	16	46	152	28	49	4	7
20	Baby care	0	0	0	0	0	0	0
21	Child care	2	3	16	1	3	1	2
22	Help on homework	0	0	0	0	0	0	0
23	Talk to children	0	0	0	0	0	0	0
24	Indoor playing	0	0	0	0	0	0	0
25	Outdoor playing	1	1	25	1	4	1	2
26	Child health	0	0	0	0	0	0	0
27	Other, baby-sit	0	0	0	0	0	0	0
28	Blank	0	0	0	0	0	0	0
29	Travel w/child	2	7	30	2	7	1	2
30	Marketing	20	43	34	8	11	3	4
31	Shopping	13	22	90	8	17	3	4
32	Personal care	2	2	20	1	3	1	2
33	Medical care	11	16	86	8	17	2	4
34	Administrative	8	12	68	6	16	2	4
35	Repair service	4	6	29	1	5	1	2

Table 3.2 Frequency of time spent (minutes per day) in activities for nonsmoking IHD subjects on days when wearing CO personal exposure monitor (N = 36; 142 person-days).

ACTIVITIES PURSUED		Doers	Occurrences	Max (min.)	Occupancy Time (min.)			
					Arithmetic		Geometric	
Code	Activity				$\bar{X}$	SD	$\bar{X}$	SD
00	Regular work	10	81	522	94	179	4	12
01	Work at home	5	13	181	13	38	2	4
02	Overtime	0	0	0	0	0	0	0
03	Travel for job	3	9	48	2	8	1	2
04	Waiting, delays	1	1	6	1	1	1	1
05	Second job	0	0	0	0	0	0	0
06	Meals at work	3	8	40	2	8	1	2
07	At work, other	0	0	0	0	0	0	0
08	Work breaks	3	13	36	2	7	1	2
09	Travel to job	10	78	240	19	46	3	6
10	Prepare food	21	71	135	26	36	7	6
11	Meal cleanup	3	7	34	2	7	1	2
12	Clean house	10	16	75	7	17	2	4
13	Outdoor chores	12	26	120	12	25	3	5
14	Laundry, ironing	2	3	30	1	5	1	2
15	Clothes upkeep	2	2	12	1	2	1	2
16	Other upkeep	13	21	68	6	14	2	4

Table 3.2 (cont.)

ACTIVITIES PURSUED		Doers	Occurrences	Max (min.)	Occupancy Time (mir			
					Arithmetic		Geometri	
Code	Activity				$\bar{X}$	SD	$\bar{X}$	SD
55	Read to learn	0	0	0	0	0	0	0
56	Other stud"	0	0	0	0	0	0	0
57	Monitor st	0	0	0	0	0	0	0
58	Blank	0	0	0	0	0	0	0
59	Travel, study	2	3	5	1	1	1	1
60	Union, politics	0	0	0	0	0	0	0
61	Work as officer	0	0	0	0	0	0	0
62	Other participation	2	2	21	1	4	1	2
63	Civic activities	4	15	144	10	[illegible]	2	4
64	Religious organizations	2	4	62	3	12	1	2
65	Religious practice	2	5	110	4	18	1	2
66	Factory council	0	0	0	0	0	0	0
67	Misc. organizations	0	0	0	0	0	0	0
68	Other organization	0	0	0	0	0	0	0
69	Travel, organization	8	34	38	4	8	2	3
70	Sports events	1	4	50	1	8	[illegible]	2
71	Mass culture	1	1	30	1	5	1	2
72	Movies	0	0	0	0	0	0	0
73	Theatre	0	0	0	0	0	0	0

Table 3.2 (cont.)

ACTIVITIES PURSUED		Doers	Occurrences	Max (min.)	Occupancy Time (min.)			
					Arithmetic		Geometric	
Code	Activity				$\bar{X}$	SD	$\bar{X}$	SD
36	Waiting in line	13	20	45	4	10	2	3
37	Other service	1	3	20	1	3	1	2
38	Monitor attach.	36	229	116	34	21	28	2
39	Travel service	32	269	190	64	42	40	4
40	Personal hygiene	35	238	100	46	22	38	2
41	Personal medical	4	5	12	1	2	1	2
42	Care to adults	0	0	0	0	0	0	0
43	Meals, snacks	33	241	178	70	41	47	4
44	Restaurant meals	14	50	98	16	25	4	6
45	Night sleep	36	146	590	476	66	471	1
46	Daytime sleep	2	2	84	3	14	1	2
47	Resting	21	53	153	33	41	9	7
48	Private, other	3	4	24	1	5	1	2
49	Travel, personal	12	58	42	6	11	2	4
50	Attend school	0	0	0	0	0	0	0
51	Other classes	2	2	45	2	8	1	2
52	Special lecture	0	0	0	0	0	0	0
53	Political courses	0	0	0	0	0	0	0
54	Homework	0	0	0	0	0	0	0

Table 3.2 (cont.)

ACTIVITIES PURSUED		Doers	Occurrences	Max (min.)	Occupancy Time (Min			
					Arithmetic		Geometri	
Code	Activitv				$\bar{X}$	SD	$\bar{X}$	SD
93	Read book	19	64	234	40	61	7	8
94	Read magazine	3	3	33	2	6	1	2
95	Read paper	16	33	115	18	28	5	6
96	Conversation	10	27	73	9	20	2	4
97	Letters, private	3	3	44	2	8	1	2
98	Relax, think	28	202	337	90	88	29	8
99	Travel, leisure	2	3	100	3	16	1	2

Table 3.2. (cont.)

ACTIVITIES PURSUED		Doers	Occurrences	Max (min.)	Occupancy Time (Min.)			
					Arithmetic		Geometric	
Code	Activity				$\bar{X}$	SD	$\bar{X}$	SD
74	Museums	0	0	0	0	0	0	0
75	Visiting w/friends	14	30	120	21	34	4	7
76	Party, meals	4	5	80	5	18	1	3
77	Cafe, pubs	1	1	7	1	1	1	1
78	Other social	0	0	0	0	0	0	0
79	Travel, social	14	45	100	12	22	3	5
80	Active sports	12	51	181	22	45	4	7
81	Fishing, hiking	1	2	26	1	4	1	2
82	Taking a walk	25	96	114	28	31	10	5
83	Hobbies	2	2	22	1	2	1	4
84	Ladies hobbies	0	0	0	0	0	0	0
85	Art work	0	0	0	0	0	0	0
86	Making music	2	4	33	1	6	1	2
87	Parlor games	6	9	51	4	10	2	3
88	Other pastime	1	1	12	1	2	1	2
89	Travel, pastime	7	24	48	4	11	2	3
90	Radio	4	6	35	2	6	1	2
91	TV	34	181	604	167	143	91	4
92	Play records	1	5	50	1	8	1	2

Table 3.3 (con't.)

MICROENVIRONMENT OCCUPIED		Doers	Occurrences	Max (min.)	Occupancy Time (min.)			
					Arithmetic		Geometric	
Code	Microenvironment				$\bar{X}$	SD	$\bar{X}$	SD
131	Restaurant	5	48	98	16	25	4	5
132	Store, Post office, Barber shop	24	64	93	14	18	6	4
133	Shopping mall	9	12	90	6	16	2	3
134	Office	7	11	105	7	21	2	4
135	Church	4	8	116	7	24	2	4
136	School	3	3	45	2	8	1	2
137	Bar or Night club	0	0	0	0	0	0	0
138	Health care facility (i.e., hospital, clinic, physician's office)	32	124	95	31	26	18	4
139	Auditorium or sports arena	0	0	0	0	0	0	0
140	Dance hall	1	1	30	1	5	1	2
141	Bowling alley	1	1	77	2	12	1	2
142	Indoor gymnasium or swimming facility	2	4	80	3	13	1	2
143	Public garage (underground parking garage)	0	0	0	0	0	0	0
144	Service station or other motor vehicle repair facility	1	2	29	1	5	1	2
145	Other repair shop	0	0	0	0	0	0	0
146	Home of friend	9	17	138	13	31	2	5
147	Meeting hall or lodge, clubhouse	11	26	144	16	31	3	5

Table 3.3 Frequency of time spent (minutes per day) in microenvironments for nonsmoking IHD subjects on days when wearing CO personal exposure monitor (N = 36; 142 person-days).

MICROENVIRONMENT OCCUPIED		Doers	Occurrences	Max (min.)	Occupancy Time (min.) Arithmetic $\bar{X}$	Arithmetic SD	Geometric $\bar{X}$	Geometric SD
Code	Microenvironment							
100	Indoors, unspecified	2	4	18	1	3	1	2
110	Indoors, home, unspecified	29	128	654	80	132	20	7
111	Family room, den	12	95	444	76	131	5	12
112	Kitchen	27	186	225	58	60	21	7
113	Dining room or area	21	114	214	35	52	9	7
114	Living room	30	340	926	234	206	88	8
115	Bedroom	35	213	849	515	134	437	3
116	Bathroom	34	165	191	37	33	26	3
117	Laundry room, workshop, utility room	4	21	208	7	34	1	3
118	Garage, enclosed carport	11	19	51	7	14	2	4
119	Home, other room	1	1	5	1	1	1	1
120	Indoors, work, unspecified	1	1	50	1	8	1	2
121	Office (clerical or admin.)	3	28	311	21	71	2	4
122	Work area (assemblyline, shop warehouse, garage)	7	43	505	49	124	3	8
123	Lunch room, break area	2	14	51	1	8	1	2
124	Rest room, locker room	0	0	0	0	0	0	0
130	Indoors, public place, unspecified	1	1	20	1	3	1	2

Table 3.3 (con't.)

MICROENVIRONMENT OCCUPIED		Doers	Occurrences	Max (min)	Occupancy Time (min			
					Arithmetic		Geometric	
					$\bar{X}$	SD	$\bar{X}$	SD
Code	Microenvironment							
310	Personal auto	34	440	272	97	64	64	4
311	Truck	5	47	135	10	32	2	4
312	Bus	1	7	71	2	12	1	2
313	Motorcycle	1	2	29	1	5	1	2
314	Walking	2	8	28	1	5	1	2
315	Bicycle	3	13	27	2	5	1	2
316	Jogging or brisk walk for exercise	1	4	39		6	1	2
317	SOHC van	4	5	38	2	7	1	2
318	Motor home	2	8	34	1	6	1	2
319	Diesel truck	1	8	364	10	60	1	3

Table 3.3 (con't.)

MICROENVIRONMENT OCCUPIED		Docrs	Occurrences	Max (min.)	Occupancy Time (min.)			
					Arithmetic		Geometric	
Code	Microenvironment				$\bar{X}$	SD	$\bar{X}$	SD
148	Hotel/motel room	2	7	250	12	49	1	3
149	Library	1	1	4	1	1	1	1
200	Outdoors, unspecified	1	1	4	1	1	1	1
210	Around the house*	26	123	173	46	51	15	7
211	Neighborhood residential streets	16	46	73	10	17	4	5
212	Within 10 yards of active roadway	13	51	114	14	28	3	5
213	Parking lot or carport (open car building)	8	31	60	3	10	2	3
214	Service station or motor vehicle repair service	8	10	11	1	2	1	2
215	Park, golf course, outdoor recreation area, beach	5	14	181	8	31	2	4
216	Restaurant patio	0	0	0	0	0	0	0
217	Restaurant drive-in	0	0	0	0	0	0	0
218	Sports arena, stadium, amphitheatre	0	0	0	0	0	0	0
219	Bike path	2	5	100	4	17	1	3
220	Outdoor store (lumber yard)	1	1	6	1	1	1	1
230	Outdoors, working	2	7	245	12	50	1	3
231	Truck yard	2	10	44	1	8	1	2
300	In transit, unspecified	0	0	0	0	0	0	0

*Yard, patio, outside house, within building areas but not in own unit

Table 3.5 Approximate metabolic cost of activities according to activity pattern classification of IHD subjects.

Code	Activity	Mets
Working Time and Time Connected to It		
00	Regular work	1.5 to 9.5
01	Work at home	1.5 to 9.5
02	Overtime	1.5 to 9.5
03	Travel for job	1.5 to 3.5
04	Waiting, delays	1.5
05	Second job	1.5 to 9.5
06	Meals at work	1.5
07	At work, other	1.5 to 9.5
08	Work breaks	1.5
09	Travel to job	1.5 to 3.5
	(Because primary activities were not coded by specific activities suitable for assignment of metabolic equivalents, diaries must by reviewed to assign by the following code scheme.)	
	Desk work, auto driving, typing, computer terminal work	1.5
	Auto repair, electronics, janitorial work, light housecleaning	2.5
	Brick laying, plastering, trailer-truck driving in heavy traffic, heavy housework	3.5
	Painting, masonry, light carpentry	4.5
	Shoveling light earth, digging in garden	5.5
	Lifting, carrying 40 lbs.	6.5
	Digging ditches, carrying 80 lbs., sawing hardwood	7.5

Table 3.4 Approximate metabolic cost of activities expressed in terms of oxygen and energy consumption.

Metabolic Equivalent	Oxygen Consumption	Energy Consumption	Typical Activity
1	3.5 ml O_2/min/kg	1.5 kcal/min	Rest, sleep, no visible activity
1.5-2	4-7	2-2.5	Standing, tablework
2-3	7-11	2.5-4	Level walking, slow bicycle, light house work
3-4	11-14	4-5	Walking (3 mph) Cycling (6 mph) Housework
4-5	14-18	5-6	Many calisthenics, yardwork
5-6	18-21	6-7	Walking (4 mph) Cycling (10 mph)
6-7	21-25	7-8	Very brisk walk, many recreational sports
7-8	25-28	8-10	True jog, aerobic dance
8-9	28-32	10-11	Running, fast cycling
10+	32+	11+	Competitive sports activities

Table 3.5 (con't.)

Code	Activity	Mets
28	Blank	---
29	Travel w/child	1.5 to 3.5
Purchasing of goods and services		
30	Marketing	2.5
31	Shopping	2.5
32	Personal care	1.5
33	Medical care	1.5
34	Administrative	1.5
35	Repair service	1.5
36	Waiting in line	1.5
37	Other service	---
38	Monitor attachment	1.5
39	Travel service	1.5 to 3.5
Private needs: meals and sleep, etc.		
40	Personal hygiene	1.5
41	Personal medical	1.5
42	Care to adults	2.5
43	Meals, snacks	1.5
44	Restaurant meals	1.5
45	Night sleep	1.0
46	Daytime sleep	1.0
47	Resting	1.0
48	Private, other	4.5
49	Travel, personal	1.5 to 3.5
Adult education and professional training		
50	Attend school	1.5

Table 3.5 (con't.)

Code	Activity	Mets
	Heavy shoveling	8.5
	Very rigorous activity, lifting on stairs	9.5+
Domestic Work		
10	Prepare food	2.5
11	Meal cleanup	2.5
12	Clean house	2.5
13	Outdoor chores	1.5 to 6.5
14	Laundry, ironing	2.5
15	Clothes upkeep	1.5
16	Other upkeep (Home/car upkeep)	2.5 to 3.5
17	Gardening, animal care	2.5
18	Heat, water	2.5 to 4.5
19	Other duties	---
Care to Children		
20	Baby care	2.5
21	Child care	2.5
22	Help on homework	1.5
23	Talk to children	1.5
24	Indoor playing	1.5 to 2.5
25	Outdoor games	1.5 to 4.5
	Shuffleboard, bowling, level walking (2 mph), billiards	2.5
	Many calisthenics	4.5
	Level bicycling (5 mph)	3.5
26	Child health	2.5
27	Other, baby-sit	1.5

Table 3.5 (con't.)

Code	Activity	Mets
76	Party, meals	2.5
77	Cafe, pubs	2.5
78	Other social	2.5
79	Travel, social	1.5 to 3.5
Sports and Active Leisure		
80	Active sports	1.5 to 9.5
81	Fishing, hiking	2.5 to 9.5
82	Taking a walk	1.5 to 6.5
83	Hobbies	1.5
84	Ladies hobbies	1.5
85	Art work	1.5
86	Making music	2.5 to 3.5
87	Parlor games	1.5
88	Other pastime	1.5 to 9.5
89	Travel, pastime	1.5 to 3.5
Passive Leisure		
90	Radio	1.5
91	TV	1.5
92	Play records	1.5
93	Read book	1.5
94	Read magazine	1.5
95	Read paper	1.5
96	Conversation	2.5
97	Letters, private	1.5
98	Relax, think	1.5
99	Travel, leisure	1.5 to 3.5

Table 3.5 (con't.)

Code	Activity	Mets
51	Other classes	1.5
52	Special lecture	1.5
53	Political courses	1.5
54	Homework	1.5
55	Read to learn	1.5
56	Other study	1.5
57	Monitor Start	1.5
58	Blank	1.5 to 3.5
59	Travel, study	1.5 to 3.5
Civic and Collective Participation Activities		
60	Union, politics	dependent on task
61	Work as officer	"
62	Other participation	"
63	Civic activities	"
64	Religious organizations	"
65	Religious practice	1.5 to 2.5
66	Factory council	dependent on task
67	Misc. organizations	"
68	Other organization	"
69	Travel, organization	1.5 to 3.5
Spectacles, Entertainment, Social Life		
70	Sports events	2.5 to 4.5
71	Mass culture	2.5
72	Movies	1.5 to 3.5
73	Theatre	1.5 to 3.5
74	Museums	2.5
75	Visiting w/friends	2.5

Table 3.6 (con't.)

	Activity Pursued	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentrations (ppm) Min.	CO Concentrations (ppm) Max.	CO Concentrations (ppm) Arithmetic Mean	CO Concentrations (ppm) Arithmetic SD	CO Concentrations (ppm) Geometric Mean	CO Concentrations (ppm) Geometric SD
18	Heat, water	2	7	1	2	0.0	9.0	3.3	2.6	2.5	2.2
19	Other duties	16	46	4	7	0.0	245.0	4.8	8.5	3.2	2.4
20	Baby care	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
21	Child care	2	3	1	2	2.0	14.0	4.9	2.7	4.3	1.6
22	Help on homework	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
23	Talk to children	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
24	Indoor playing	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
25	Outdoor playing	1	1	1	2	0.0	3.0	1.4	0.6	1.4	1.4
26	Child health	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
27	Other, baby sit	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
28	Blank	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
29	Travel w/child	2	7	1	2	0.0	37.0	8.9	7.8	5.7	2.8
30	Marketing	20	43	3	4	0.0	144.0	7.6	11.3	4.7	2.6
31	Shopping	13	22	3	4	0.0	27.0	4.8	4.2	3.6	2.1
32	Personal care	2	2	1	2	6.0	17.0	7.8	2.5	7.5	1.3
33	Medical care	11	16	2	4	0.0	28.0	4.2	3.2	3.3	2.0
34	Administrative	8	12	2	4	0.0	23.0	3.0	2.8	2.2	2.2

Table 3.6 Mean minutely CO exposure by activity classification for nonsmoking IHD subjects (N = 36; 142 person-days).

	Activity Pursued	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min.	Max.	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
00	Regular work	10	81	4	12	0.0	190.0	4.8	10.6	2.9	2.4
01	Work at home	5	13	2	4	0.0	166.0	5.8	7.2	4.4	2.2
02	Overtime	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
03	Travel for job	3	9	1	2	0.0	37.0	5.4	7.6	3.2	2.5
04	Waiting, delays	1	1	1	1	4.0	5.0	4.4	0.5	4.3	1.1
05	Second job	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
06	Meals at work	3	8	1	2	1.0	28.0	3.3	2.2	2.9	1.7
07	At work, other	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
08	Work breaks	3	13	1	2	1.0	14.0	4.4	2.1	4.0	1.6
09	Travel to job	10	78	3	6	0.0	96.0	8.9	8.7	6.0	2.5
10	Prepare food	21	71	7	6	0.0	58.0	3.7	4.0	2.8	2.2
11	Meal cleanup	3	7	1	2	2.0	115.0	6.1	7.3	4.9	1.8
12	Clean house	10	16	2	4	0.0	48.0	3.5	3.7	2.5	2.2
13	Outdoor chores	12	26	3	5	0.0	226.0	4.4	14.9	2.3	2.4
14	Laundry, ironing	2	3	1	2	0.0	3.0	0.6	1.0	1.2	1.4
15	Clothes upkeep	2	2	1	2	3.0	33.0	10.2	10.2	6.5	2.5
16	Other upkeep	13	21	2	4	0.0	29.0	4.6	3.8	3.3	2.4
17	Gardening, animal care	14	34	4	5	0.0	134.0	6.2	9.8	3.7	2.7

Table 3.6 (con't.)

	Activity Pursued	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentrations (ppm) Min.	Max.	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
53	Political ... rses	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
54	Homework	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
55	Read to learn	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
56	Other study	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
57	Monitor start	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
58	Blank	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
59	Travel, study	2	3	1	1	[illegible]	18.0	9.4	5.1	7.4	2.3
60	Union, politics	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
61	Work as officer	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
62	Other participation	2	2	1	2	8.0	16.0	12.2	1.6	12.2	1.1
63	Civic activities	4	15	2	4	0.0	41.0	3.6	3.5	2.7	2.2
64	Religious organizations	2	4	1	2	0.0	20.0	6.2	4.8	4.8	2.2
65	Religious practice	2	5	1	2	1.0	5.0	2.6	1.0	2.3	1.6
66	Factory council	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
67	Misc. organizations	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
68	Other organization	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
69	Travel, organization	8	34	2	3	0.0	41.0	7.7	5.5	5.8	2.3

Table 3.6 (con't.)

	Activity Pursued	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentrations (ppm) Min.	Max.	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
35	Repair service	4	6	1	2	1.0	29.0	7.4	4.8	6.2	1.9
36	Waiting in line	13	20	2	3	0.0	66.0	9.6	8.5	6.4	2.6
37	Other service	1	3	1	2	1.0	14.0	6.7	2.8	5.8	1.9
38	Monitor attach.	36	229	28	2	0.0	50.0	4.0	4.0	2.9	2.2
39	Travel service	32	269	40	4	0.0	239.0	9.1	10.2	6.1	2.4
40	Personal hygiene	35	238	38	2	0.0	47.0	3.1	2.9	2.4	2.1
41	Personal medical	4	5	1	2	0.0	5.0	2.2	1.7	2.0	1.9
42	Care to adults	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
43	Meals, snacks	33	241	47	4	0.0	79.0	3.7	3.6	2.7	2.2
44	Restaurant meals	14	50	4	6	0.0	35.0	5.7	5.2	4.1	2.3
45	Night sleep	36	146	471	1	0.0	89.0	2.0	2.3	1.8	2.0
46	Daytime sleep	2	2	1	2	3.0	10.0	4.9	1.0	4.8	1.2
47	Resting	21	53	9	7	0.0	31.0	4.1	3.6	3.1	2.2
48	Private, other	3	4	1	2	0.0	3.0	1.4	1.0	1.3	1.6
49	Travel, personal	12	58	3	4	0.0	46.0	6.7	6.5	4.4	2.7
50	Attend school	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
51	Other classes	2	2	1	2	0.0	19.0	7.6	7.4	4.0	3.4
52	Special lecture	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3.6 (con't.)

	Activity Pursued	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentrations (ppm) Min.	CO Concentrations (ppm) Max.	CO Concentrations (ppm) Arithmetic Mean	CO Concentrations (ppm) Arithmetic SD	CO Concentrations (ppm) Geometric Mean	CO Concentrations (ppm) Geometric SD
87	Parlor games	6	9	2	3	0.0	38.0	3.8	4.9	2.4	2.7
88	Other pastime	1	1	1	2	0.0	4.0	0.9	1.3	1.3	1.6
89	Travel, pastime	7	24	2	3	0.0	113.0	7.9	10.1	4.4	3.0
90	Radio	4	6	1	2	0.0	8.0	2.9	2.2	2.3	2.0
91	TV	34	181	91	4	0.0	76.0	3.5	3.3	2.7	2.1
92	Play records	2	5	1	2	0.0	20.0	4.5	3.3	3.7	1.9
93	Read book	19	64	7	8	0.0	63.0	3.6	2.6	3.0	1.9
94	Read magazine	3	3	1	2	0.0	6.0	1.4	1.3	1.4	1.7
95	Read paper	16	33	5	6	0.0	21.0	4.1	3.2	3.0	2.2
96	Conversation	10	27	2	4	0.0	28.0	3.5	2.5	3.0	1.8
97	Letters, private	3	3	1	2	1.0	9.0	3.6	1.8	3.2	1.6
98	Relax, think	28	202		8	0.0	208.0	3.7	5.1	2.7	2.2
99	Travel, leisure	2	3	1	2	0.0	11.0	5.5	2.2	5.0	1.6

Table 3.6 (con't.)

	Activity Pursued	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentrations (ppm) Min.	Max.	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
70	Sports events	1	4	1	2	0.0	2.0	0.3	0.5	1.0	1.1
71	Mass culture	1	1	1	2	0.0	5.0	0.6	1.3	1.2	1.5
72	Movies	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
73	Theatre	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
74	Museums	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
75	Visiting w/friends	14	30	4	7	0.0	30.0	4.2	4.2	3.1	2.2
76	Party, meals	4	5	1	3	1.0	22.0	8.3	5.2	6.8	1.9
77	Cafe, pubs	1	1	1	1	6.0	12.0	8.9	1.4	8.8	1.2
78	Other social	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
79	Travel, social	14	45	3	5	0.0	45.0	9.2	7.5	6.2	2.7
80	Active sports	12	51	4	7	0.0	30.0	4.8	5.2	3.1	2.6
81	Fishing, hiking	1	2	1	2	0.0	14.0	0.6	2.1	1.2	1.7
82	Taking a walk	25	96	10	5	0.0	64.0	3.8	4.2	2.8	2.2
83	Hobbies	2	2	1	4	3.0	5.0	3.9	0.8	3.8	1.2
84	Ladies hobbies	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
85	Art work	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
86	Making music	2	4	1	2	0.0	54.0	2.6	5.5	1.8	2.0

Table 3.7 (con't.)

Code	Microenvironment	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min	Max	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
121	Office (clerical or admin)	3	28	2	4	0.0	50.0	3.4	3.1	2.6	2.0
122	Work area (assemblyline, shop, warehouse, garage)	7	43	3	8	0.0	190.0	6.0	13.7	3.3	2.6
123	Lunch room, break room	2	14	1	2	0.0	17.0	5.2	3.0	4.3	1.9
124	Rest room, locker room	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
130	Indoors, public place, unspecified	1	1	1	2	3.0	4.0	3.4	0.5	3.4	1.2
131	Restaurant	15	48	4	5	0.0	35.0	6.0	5.5	4.3	2.3
132	Store, post office, barber shop	24	64	6	4	0.0	144.0	6.9	9.6	4.4	2.5
133	Shopping mall	9	12	2	3	0.0	41.0	5.8	4.7	4.4	2.0
134	Office	7	11	2	4	0.0	25.0	3.5	3.0	2.6	2.3
135	Church	4	8	2	4	0.0	21.0	4.6	3.9	3.5	2.1
136	School	3	3	1	2	0.0	19.0	7.5	7.3	4.1	3.3

Table 3.7 Mean minutely CO exposure by microenvironment classification for nonsmoking IIID subjects (N = 36; 142 person-days).

CO Monitoring Days		Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min	Max	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
Code	Microenvironment										
100	Indoors, Unspecified	2	4	1	2	1.0	30.0	9.1	7.3	6.2	2.7
110	Indoors, home, unspecified	29	128	20	7	0.0	245.0	4.1	6.1	3.0	2.2
111	Family room, Den	12	95	5	12	0.0	134.0	4.0	4.1	2.9	2.2
112	Kitchen	27	186	21	7	0.0	115.0	3.9	4.0	2.9	2.2
113	Dining room or area	21	114	9	7	0.0	27.0	3.8	3.4	2.9	2.1
114	Living room	30	340	88	8	0.0	76.0	3.5	3.2	2.8	2.1
115	Bedroom	35	213	437	3	0.0	89.0	2.1	2.4	1.8	2.0
116	Bathroom	34	165	26	3	0.0	47.0	2.8	3.0	2.2	2.2
117	Laundry room, workshop, utility room	4	21	1	3	0.0	188.0	3.0	7.4	2.3	1.9
118	Garage, enclosed carport	11	19	2	4	0.0	166.0	3.9	7.8	2.8	2.2
119	Home, other room	1	1	1	1	2.0	17.0	7.0	4.2	5.7	1.9
120	Indoors, work, unspecified	1	1	1	2	0.0	10.0	0.3	1.2	1.1	1.4

Table 3.7 (con't.)

Code	Microenvironment	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min	CO Concentration (ppm) Max	CO Concentration (ppm) Arithmetic Mean	CO Concentration (ppm) Arithmetic SD	CO Concentration (ppm) Geometric Mean	CO Concentration (ppm) Geometric SD
147	Meeting hall or lodge, clubhouse	11	26	3	5	0.0	41.0	5.1	4.3	3.7	2.4
148	Hotel/motel room	2	7	1	3	0.0	8.0	2.4	1.9	2.0	1.9
149	Library	1	1	1	1	0.0	2.0	0.3	0.6	1.0	1.2
200	Outdoors, unspecified	1	1	1	1	1.0	3.0	1.5	0.8	1.3	1.6
210	Around the house*	26	123	15	7	0.0	226.0	4.9	9.6	3.1	2.4
211	Neighborhood residential streets	16	46	4	5	0.0	30.0	3.1	3.4	2.3	2.2
212	Within 10 yards of active roadway	13	51	3	5	0.0	61.0	4.0	3.8	3.0	2.1
213	Parking lot or carport (open car building)	8	31	2	3	0.0	73.0	7.9	10.0	5.1	2.5
214	Service station or motor vehicle repair service	8	10	1	2	0.0	28.0	7.9	5.9	6.1	2.0

*yard, patio, outside house, within building areas but not in own unit)

Table 3.7 (con't.)

Code	Microenvironment	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min	Max	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
137	Bar or night club	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
138	Health care facility (i.e., hospital, clinic, physician's office)	32	124	18	4	0.0	66.0	4.5	5.1	3.1	2.3
139	Auditorium or sports arena	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
140	Dance Hall	1	1	1	2	0.0	5.0	0.6	1.3	1.2	1.5
141	Bowling Alley	1	1	1	2	2.0	10.0	4.2	1.4	4.1	1.3
142	Indoor gymnasium or swimming facility	2	4	1	2	1.0	23.0	12.1	7.5	8.3	2.9
143	Public garage (underground parking garage)	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
144	Service station or other motor vehicle repair facility	1	2	1	2	3.0	29.0	7.7	4.4	7.0	1.5
145	Other repair shop	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
146	Home of friend	9	17	2	5	0.0	28.0	4.4	4.3	3.2	2.3

Table 3.7 (con't.)

Code	Microenvironment	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min	CO Concentration (ppm) Max	CO Concentration (ppm) Arithmetic Mean	CO Concentration (ppm) Arithmetic SD	CO Concentration (ppm) Geometric Mean	CO Concentration (ppm) Geometric SD
314	Walking	2	8	1	2	0.0	8.0	4.1	1.8	3.7	1.7
315	Bicycle	3	13	1	2	0.0	12.0	2.8	2.7	2.2	2.1
316	Jogging or brisk walk for exercise	1	4	1	2	0.0	19.0	3.5	3.7	2.6	2.4
317	SOHC van	4	5	1	2	0.0	28.0	11.1	5.6	9.3	2.0
318	Motor home	2	8	1	2	1.0	96.0	9.1	10.9	5.2	3.0
319	Diesel truck	1	8	1	3	0.0	34.0	2.6	2.3	2.2	2.0

Table 3.7 (con't.)

Code	Microenvironment	Doers	Occur.	Occupancy Time (min) Geometric Mean	Occupancy Time (min) Geometric SD	CO Concentration (ppm) Min	Max	Arithmetic Mean	Arithmetic SD	Geometric Mean	Geometric SD
215	Park, golf course, outdoor recreation area, beach	5	14	2	4	0.0	64.0	5.4	6.5	3.5	3.0
216	Restaurant patio	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
217	Restaurant drive-in	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
218	Sports arena, stadium, amphitheatre	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
219	Bike path	2	5	1	3	0.0	9.0	1.5	1.5	1.5	1.7
220	Outdoor store (lumber yard)	1	1	1	1	4.0	5.0	4.0	0.2	4.0	1.0
230	Outdoors, working	2	7	1	3	0.0	150.0	3.8	7.1	2.6	2.3
231	Truck yard	2	10	1	2	0.0	51.0	3.2	4.8	2.3	2.4
230	In transit, unspecified	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
310	Personal auto	34	440	64	4	0.0	239.0	8.6	9.6	5.6	2.6
311	Truck	5	47	2	4	0.0	61.0	9.9	7.7	7.7	2.1
312	Bus	1	7	1	2	1.0	14.0	5.7	2.5	5.1	1.6
313	Motorcycle	1	2	1	2	0.0	47.0	8.7	8.8	4.9	3.2

Table 3.8 (con't.)

RANK	ACTIVITY	CODE	TIME-WEIGHTED CO EXPOSURE (ppm-min)	GEOMETRIC MEAN OCCUPANCY TIME (min)	GEOMETRIC MEAN CO CONCENTRATION (ppm)
36	Clothes care	15	7.3	1.1	6.5
37	Conversations	96	7.2	2.4	3.0
38	Travel with child	29	6.9	1.2	5.7
39	Outdoor chores	13	6.8	2.9	2.3
40	Meal cleanup, doing dishes	11	6.4	1.3	4.9
41	Obtaining other services	37	6.3	1.1	5.8
42	Religious activities	64	5.9	1.2	4.8
43	Travel related to passive leisure	99	5.8	1.2	5.0
44	Daytime sleep	46	5.8	1.2	4.8
45	House cleaning	12	5.4	2.1	2.5
46	Work breaks	08	5.1	1.3	4.0
47	Child care	21	4.9	1.1	4.3
48	Other classes or courses	51	4.9	1.2	4.0
49	Waiting, delays at work	04	4.6	1.1	4.3
50	Volunteer activities	63	4.3	1.6	2.7
51	Hobbies	83	4.4	1.2	3.8
52	Reading or writing letters	97	4.1	1.3	3.2
53	Playing records or tapes	92	4.1	1.1	3.7
54	Travel for job	03	4.0	1.3	3.2
55	Government or financial services	34	3.9	1.7	2.2
56	Parlor games	87	3.8	1.6	2.4
57	Meals at work	06	3.8	1.3	2.9
58	Household activities related to heat or water	18	3.0	1.2	2.5
59	Radio listening	90	2.9	1.3	2.3
60	Religious practice	65	2.9	1.2	2.3
61	Personal medical care	41	2.4	1.2	2.0
62	Making music	86	2.1	1.2	1.8
63	Reading magazines	94	1.8	1.3	1.4
64	Private activity	48	1.6	1.2	1.3
65	Outdoor playing with children	25	1.5	1.2	1.4
66	Other active leisure	88	1.4	1.1	1.3
67	Laundry, ironing of clothing	14	1.4	1.2	1.2
68	Fishing, hiking	81	1.3	1.1	1.2
69	Entertainment events	71	1.3	1.1	1.2

Table 3.8 Ranking of time-weighted exposures by activity class.

RANK	ACTIVITY	CODE	TIME-WEIGHTED CO EXPOSURE (ppm-min)	GEOMETRIC MEAN OCCUPANCY TIME (min)	GEOMETRIC MEAN CO CONCENTRATION (ppm)
1	Night sleep	45	825.6	471.0	1.8
2	Television viewing	91	245.4	91.5	2.7
3	Travel related to goods and services	39	244.1	39.7	6.1
4	Meals, snacks at home	43	130.4	47.5	2.7
5	Personal hygiene	40	91.7	38.4	2.4
6	Monitor attachment	38	81.5	27.8	2.9
7	Relaxing, thinking, doing nothing	98	80.7	29.5	2.7
8	Taking a walk	82	29.0	10.5	2.8
9	Resting	47	26.5	8.6	3.1
10	Reading books	93	21.7	7.3	3.0
11	Travel related to social activities	79	21.1	3.4	6.2
12	Preparing food	10	20.1	7.3	2.8
13	Travel to and from work	09	17.4	2.9	6.0
14	Meals at restaurant	44	16.0	3.9	4.1
15	Marketing	30	15.3	3.3	4.7
16	Reading newspapers	95	14.3	4.7	3.0
17	Other household duties	19	14.2	4.4	3.2
18	Civic participation	62	14.0	1.2	12.2
19	Visiting with friends	75	13.2	4.3	3.1
20	Regular work	00	13.1	4.5	2.9
21	Gardening, animal care	17	13.0	3.6	3.7
22	Waiting for goods or services	36	13.0	2.0	6.4
23	Travel related to personal care	49	11.2	2.6	4.4
24	Active sports	80	11.0	3.6	3.1
25	Travel related to organizational activity	69	10.8	1.8	5.8
26	Parties, receptions, picnics	76	10.2	1.5	6.8
27	Shopping for durable household goods	31	9.8	2.7	3.6
28	Social activity at cafe or bar	77	9.3	1.1	8.8
29	Personal care	32	8.5	1.1	7.5
30	Medical care	33	8.4	2.5	3.3
31	Other household upkeep and repairs	16	8.0	2.4	3.3
32	Travel related to study or school	59	7.9	1.1	7.4
33	Work (for pay) at home	01	7.8	1.8	4.4
34	Repair services	35	7.5	1.2	6.2
35	Travel related to active leisure	89	7.5	1.7	4.4

Table 3.9 (con't.)

RANK	MICROENVIRONMENT	CODE	TIME-WEIGHTED CO EXPOSURE (ppm-min)	GEOMETRIC MEAN OCCUPANCY TIME (min)	GEOMETRIC MEAN CO CONCENTRATION (ppm)
27	Indoors, home other room	119	6.0	1.0	5.7
28	Bus	312	5.8	1.1	5.1
29	Motorcycle	313	5.4	1.1	4.9
30	Church	135	5.4	1.6	3.5
31	Neighborhood residential streets	211	5.3	3.6	2.3
32	School	136	5.1	1.3	4.1
33	Park, golf course, outdoor recreation area, beach	215	5.0	1.6	3.2
34	Lunchroom, breakroom	123	5.0	1.2	4.3
35	Office, public place	134	4.6	1.8	2.6
36	Bowling alley	141	4.6	1.1	4.1
37	Outdoor store, lumber yard, nursery	220	4.2	1.1	4.0
38	Walking	314	4.2	1.1	3.7
39	Office, work area	121	4.2	1.6	2.6
40	Indoors, public place, unspecified	130	3.7	1.1	3.4
41	Outdoors, walking	230	3.4	1.3	2.6
42	Home laundry room, workshop, utility room	117	3.3	1.4	2.3
43	Jogging or brisk walk for exercise	316	2.9	1.1	2.6
44	Bicycle	315	2.9	1.3	2.2
45	Outdoors, truck yard	231	2.8	1.2	2.3
46	Hotel/motel room	148	2.7	1.3	2.0
47	Diesel truck	319	2.6	1.2	2.2
48	Bicycle path	219	1.9	1.2	1.5
49	Outdoors, unspecified	200	1.4	1.0	1.3
50	Dance hall	140	1.3	1.1	1.2
51	Indoors, work, unspecified	120	1.2	1.1	1.1
52	Library	149	1.1	1.0	1.0

Table 3.9 Ranking of time-weighted exposures by microenvironment class.

RANK	MICROENVIRONMENT	CODE	TIME-WEIGHTED CO EXPOSURE (ppm-min)	GEOMETRIC MEAN OCCUPANCY TIME (min)	GEOMETRIC MEAN CO CONCENTRATION (ppm)
1	Bedroom	115	786.8	436.8	1.8
2	Personal Auto	310	357.2	63.8	5.6
3	Living Room	114	242.0	87.6	2.8
4	Kitchen	112	59.7	20.6	2.9
5	Indoors, home, unspecified	110	60.9	20.1	3.0
6	Bathroom	116	56.7	26.1	2.2
7	Hospital (includes monitor attachment)	138	56.5	18.2	3.1
8	Outdoors, around the house[1]	210	45.7	14.9	3.1
9	Store, post office, barbershop	132	27.9	6.4	4.4
10	Dining room area	113	25.2	8.7	2.9
11	Restaurant	131	17.8	4.2	4.3
12	Family room, den	111	15.8	5.4	2.9
13	Truck	311	12.9	1.7	7.7
14	Occupational Health Center Van	317	12.8	1.4	9.3
15	Meeting hall, lodge, clubhouse	147	10.8	2.9	3.7
16	Indoor gymnasium or swimming facility	142	10.2	1.2	8.3
17	Within 10 yards of active roadway	212	9.7	3.2	3.0
18	Work area (assemblyline, shop, warehouse)	122	9.1	2.7	3.3
19	Shopping mall	133	8.9	2.0	4.4
20	Outdoors, service station or motor vehicle repair facility	214	8.0	1.3	6.1
21	Parking lot or carport (open car building)	213	7.7	1.5	5.1
22	Indoors, service station or other motor vehicle repair facility	144	7.6	1.1	7.0
23	Indoors at home of friend	146	7.6	2.4	3.2
24	Indoors, unspecified	100	7.2	1.2	6.2
25	Garage or enclosed carport	118	6.5	2.4	2.8
26	Motor home	318	6.1	1.2	5.2

[1]Yard, patio, outside house, within building areas but not in own unit.

Table 3.10 (con't.)

Reference	Thesis	Methods	Sample Population (N)	%COHb Range	Expired CO Range (ppm)	Blood-Breath Relationship
Rea et al., 1970	Epidemiologic research investigating tobacco smoking behavior and blood COHb levels.	20-sec breathhold; discard first 300 ml; save next 500 ml expired air. Breath: IR (CO_2 scrubbed by soda lime) Blood: Venous; spectrophotometric	59 (men and women, smokers and nonsmokers)	0.3 - 8.1	2 - 41	No regression equation reported; estimated regression from bivariate plot: %COHb = 0.21 [CO]
Stewart et al., 1976	Developed practical method to rapidly estimate COHb from breath samples in field firefighting situation.	20-sec breathhold; discard first portion; save remainder expired breath. Breath: Electrochemical (Ecolyzer 2100); GC Blood: not described	56 (male, firefighters)	0.8 - 33	1 - 239	Line of fit as predicted by Haldane equation (without correction for water vapor pressure): $\%COHb = \frac{0.197\ ([CO_{ppm}]}{[\ + 0.00197\ [CO_{ppm}]}$
Rawbone et al., 1976	End-expired air analysis may be used to distinguish between populations of smokers and non-smokers	Breath: IR (CO_2 scrubbed by soda lime) Blood: Venous; spectrophotometric (Tietz and Fiereck, 1973)	14 (assume men & women)	0.3 - 8.0	4 - 46	$\%COHb = 0.18\ [CO_{ppm}] - 0.26$ r^2 = .92; 95% confidence limits = ± 1 %COHb
Smith, 1977	Ambient CO levels during time of breathholding maneuver bias %COHb estimate.	20-sec breathhold; discard first portion; save end-expired. Breath: Electrochemical (Ecolyzer 2000) Blood: Venous; IL 192 (verified by unspecified spectrophotometric technique)	46 (assume men & women)	0.4 - 11.5	2 - 64	For constant, low ambient CO environment: $\%COHb = 0.18\ [CO_{ppm}]$ $r^2 = 0.94$ For fluctuating, high ambient CO environment: $\%COHb = 0.14\ [CO_{ppm}]$ $r^2 = 0.48$

Table 3.10 Summary of previous research on end-expired breath sampling technique to estimate COHb.

Reference	Thesis	Methods	Sample Population (N)	%COHb Range	Expired CO Range (ppm)	Blood-Breath Relationship
Sjöstrand, 1948	Developed rebreathing method to estimate COHb from alveolar air CO concentration	Rebreathing into Douglas bag.	23 (assume men and women)	5 - 35	----	$M \cdot \frac{P_{CO}}{P_{O_2}} = \frac{COHb}{O_2Hb}$
Jones et al., 1958	Using lungs as aerotonometers, sampling of alveolar air allows estimation of COHb.	20-sec breathhold; save end-expired sample. Breath: NDIR corrected for CO_2. Blood: Venous; NDIR	13 (men and women)	0.7 - 26.0	2 - 185	Line of fit as predicted by Haldane equation: $\%COHb = \frac{0.206\ [CO_{ppm}]}{1 + 0.00206\ [CO_{ppm}]}$
Ringold et al., 1962	Verify method of Jones et al. 1958. Apply to community exposure survey.	20-sec breathhold; first few hundred ml volume discarded; save end-expired sample. Breath: IR (CO_2 scrubbed by Ascarite) Blood: Venous; NDIR	4 (men, 2 smokers & 2 nonsmokers	1.2 - 20.0	3 - 100	$\%\ COHb = 0.2\ [CO_{ppm}] + 0.5$
Goldsmith, 1965	End-expired breath measurements can be used as an indicator of exposure to cigarette smoking and community air pollution.	Not described.	209 (men, longshoremen, smokers and nonsmokers)	0.2 - 19.0	0 - 82	For respondants (N = 130) with cardiorespiratory conditions: $\%COHb = 1.09 + 0.14\ [CO_{ppm}]$ $r^2 = .56$
Peterson, 1970	Experimental exposure study correlating alveolar breeath CO to venous blood COHb.	20-sec breathhold; discard first half expired; save end-expired. Breath: GC and Long path IR Blood: Venous; GC	14 (men, white, ages 24-42)	0 - 32	4 - 250	$\%COHb = \sqrt{109.08 + 7.60\ [CO_{ppm}]} - 11.89$ $S_x = 1.06\ \%COHb$

Table 3.10 (con't.)

Reference	Thesis	Methods	Sample Population (N)	%COHb Range	Expired CO Range (ppm)	Blood-Breath Relationship
Wald et al., 1981	End-expired breath analysis may be used to distinguish between smokers and non-smokers.	20-sec breathhold; expire to collection tube Breath: Electrochemical, Ecolyzer 2000 Blood: Venous; IL282	187 (men; 162 smokers, 25 nonsmokers)	0.4 - 13	3 - 65	$\%COHb = 0.18 [CO_{ppm}] - 0.14$
Wallace, 1983	To most accurately estimate %COHb, end-expired breath samples require a correcting for inspired ambient CO at time of sampling.	20-sec breathhold; discard first portion; save end-expired Breath: Electrochemical, COED-1 (GE) Blood: Not sampled.	1 (male, nonsmoker)	----	----	$[CO_{ppm}]_{measured} = 0.83 [CO_{ppm}]_{alv} + 0.17 [CO_{ppm}]_{inspired}$

Table 3.10 (con't.)

Reference	Thesis	Methods	Sample Population (N)	%COHb Range	Expired CO Range (ppm)	Blood-Breath Relationship
Rees et al., 1980	Mixed-expired air samples are equivalent to 30-second end-expired air sample collection method.	30-sec breathhold and rebreathing methods Breath: IR (CO_2 scrubbed by soda lime) Blood: Venous, IL 282; verified by spectrophotometric method of Tietz & Fiereck (1973)	29 (assume men & women; 4 nonsmokers, 25 smokers)	0.8 - 10.4	8 - 62	%COHb = $0.395\ [CO_{ppm}] - 0.0032\ ([CO_{ppm}])^2 - 2.4$
Jabara et al., 1980	End-expired breath analysis is useful for estimating %COHb in traffic control personnel.	Breath: Electrochemical, Ecolyzer 200 Blood: Venous; IL282	N = ?	1.1 - 12.5	5 - 60	Cites Stewart and Stewart, 1978: %COHb = $0.202\ [CO_{ppm}] + 0.0365$
Jarvis et al., 1980	In subjects with emphysema, increased end-expired [CO] is attributed to impaired diffusion.	20-sec breathhold; expire to bag. Breath: Electrochemical, Ecolyzer 2000 Blood: Venous; IL282	182 smokers (assume men & women) 35 emphysema patients	0.3 - 14.5	4 - 90	For normal smokers: %COHb = $-0.28 + 0.175\ [CO_{ppm}]$ $r^2 = .98$ For emphysema patients: %COHb = $-0.12 + 0.211\ [CO_{ppm}]$ $r^2 = .92$ Slopes of two regression lines were significantly different.

Table 3-12. Number of person-hours and proportion of total time spent at various COHb levels

COHb Level (Percent)	Person-Hours	Number of Subjects	Percent of Total Monitoring Time	Cumulative Percent Total Monitoring Time*	Mean hours per subject who attained COHB level	Percent time per subject who attained COHb level
0.5-0.9	1653.8	36	47.06	47.06	45.9	47.1
1.0-1.9	1675.9	32	47.69	94.75	52.4	53.6
2.0-2.9	155.4	23	4.42	99.17	6.8	6.9
3.0-3.9	22.9	9	0.65	99.82	2.5	2.6
4.0-4.9	3.2	3	0.09	99.91	1.1	1.1
5.0-5.9	0.6	1	0.02	99.93	0.6	0.6
6.0-6.9	0.6	1	0.02	99.95	0.6	0.6
7.0-7.9	0.6	1	0.02	99.97	0.6	0.6
8.0-8.9	0.5	1	0.02	99.99	0.5	0.5
9.0-9.2	0.4	1	0.01	100.0	0.4	0.4

* The cumulative frequency distribution of estimated minute-by-minute COHb levels is plotted in Figure 3.9

Table 3.11 Regression summaries for blood-breath data on IHD subjects.

Regression	N	Observations	Intercept	Slope	r^2	Standard Error of Estimate	Standard Error of Slope	p
%COHb on [CO]								
Nonsmokers	26	104	0.81	0.13	0.19	0.56	0.44	.0000
Smokers	2	8	1.54	0.12	0.71	0.85	0.84	.0083
All subjects	28	112	0.72	0.15	0.68	0.59	0.85	.0000
Subject TU	1	4	1.94	0.13	1.00	0.00	0.00	.0009
Subject MA	1	4	0.21	0.14	0.99	0.00	0.01	.0026
Subject EK	1	4	0.44	0.10	0.69	0.05	0.05	.1885
Subject BE	1	4	1.01	0.13	0.66	0.06	0.07	.1902
Subject ES	1	4	0.11	0.27	0.94	0.04	0.05	.0300
Subject KU	1	4	3.44	-0.32	0.77	0.13	0.12	.1215
Measured End-Expired on Predicted Alveolar [CO]								
Non-smokers	26	104	3.03	0.31	0.20	1.96	0.06	.0000
Smokers	2	8	-0.84	1.10	0.70	6.16	0.29	.0095
All subjects	28	112	-1.17	0.93	0.70	3.26	0.06	.0000
Subject TU	1	4	-12.95	1.38	1.00	0.50	0.31	.0005
Subject MA	1	4	-0.55	1.34	0.99	0.62	0.06	.0018
Subject EK	1	4	-1.34	1.44	0.67	1.60	0.71	.1815
Subject BE	1	4	-3.35	1.02	0.70	3.07	0.83	.1661
Subject ES	1	4	0.15	0.67	0.92	0.44	0.14	.0401
Subject KU	1	4	10.00	-0.54	0.75	0.36	0.22	.1339

Table 3-13. Continued

Reference	Population	Design	Exposure	Outcomes	Findings
Kurt et al. 1978	Colorado General Hospital, 8556 emergency room admissions, winter of 1975-1976	Ecological	Outdoor monitoring network data	Cardio-respiratory complaints including angina, at emergency room	Cardiorespiratory complaints increased to 7.9 from 6.4 percent on "high" CO days (mean = 9.3 ppm) relative to "low" CO days (mean = 5.9 ppm)
Kurt et al. 1979	Colorado General Hospital, 8556 emergency room admissions, winter of 1975-1976	Ecological	Outdoor monitoring network data	Cardio-respiratory complaints including angina, at emergency room	On days when the 24-hr mean level exceeded 5 ppm or the maximum one-hour mean exceeded 11 ppm cardio-respiratory admissions increased from 5 to 8 per day
Stern et al. 1988	5,529 bridge and tunnel workers, New York City, 1952-1981	Retrospective	Tunnel and bridge monitors and employment histories; tunnel workers defined as high exposure group	Cardiovascular mortality	Standardized mortality ratio of 1.35 was observed for tunnel versus bridge workers. Risk declined with cessation of exposure

Table 3-13. Epidemiologic investigations of the relationship between exposure to CO and cardiac health

Reference	Population	Design	Exposure	Outcomes	Findings
Cohen, Deane, and Goldsmith 1969	MI admissions at 35 Los Angeles hospitals during 1958	Ecological	Outdoor monitoring network data	Case fatality rate	Case fatality rate was 3.41 per 100 man-days inside the 8 ppm CO isopleth relative to 2.85 outside the 8 ppm isopleth
Hexter and Goldsmith 1971	Los Angeles County, 1962-1965	Ecological	Outdoor monitoring network data	Total deaths and deaths from athero-sclerotic disease	11 deaths of 160 were attributed to CO on the highest ambient mean CO day (20.2 ppm)
Kuller et al. 1972	Eight Baltimore hospitals, 1970-1972	Case-control	Postmortem COHb measure-ments and outdoor CO from 1 central site monitor	Suddden cardiac death and myocardial infarction (MI) admissions	No difference in COHb levels between sudden death patients and living controls; no association between daily outdoor CO levels and daily sudden cardiac deaths or MI admissions

Table 3-15. Medications used by subjects who underwent ambulatory ECG monitoring

ID	Long-acting nitrates	Dipyridimole	Beta-blocking agents	Calcium channel blockers	Anti-hypertensives	Digitalis	Quinidine
010							
012							
020	x				x	x	
033	x		x	x	x		
036							
038							
046	x				x		
065		x	x	x		x	
076						x	x
080							
082		x	x				
125		x	x	x			
151							
152	x		x				
154	x			x	x		
166							
189							
197		x					
201	x						
202	x						
203	x			x			
204	x			x			
205			x				
206	x			x	x		
207							
208							
209	x		x	x	x	x	
210	x		x	x	x		
211	x			x	x		
212	x		x				
Totals							
30	14	4	9	10	8	4	1

Table 3-14. Characteristics of subjects who underwent ambulatory monitoring

ID	Age (yrs)	Most recent infarction (years prior)	Number of stenotic vessels* (≥ 70%)	CABG (years prior)	Angio-plasty (years prior)	Reported frequency of angina (times·wk^{-1})
010	61	None	1	None	None	<1
012	57	3	3	None	None	<1
020	70	0.5	3	12	None	7
033	61	None	3	None	None	14
036	70	0.5	3	None	None	<1
038	55	None	2	None	None	7
046	71	None	3	None	1	2
065	58	None	3	1	None	0
076	71	1	2	None	None	1
080	52	None	3	None	None	2
082	57	None	3	1	None	0
125	57	2	3	2	2	2
151	55	None	3	2	None	0
152	50	None	1	None	None	14
154	67	5	3	None	None	2
166	65	1	3	1	None	<1
189	66	None	3	1	None	0
197	59	0.5	3	0.5	None	1
201	70	None	3	8	None	3
202	65	None	Unknown†	None	None	<1
203	62	0.5	3	15	None	14
204	64	None	3	None	None	<1
205	63	None	3	9	None	2
206	60	0.5	3	6	None	1
207	62	0.5	Unknown†	None	None	7
208	64	None	Unknown†	None	None	<1
209	53	2	3	3	None	7
210	52	0.5	3	4	None	14
211	54	None	Unknown†	None	None	<1
212	70	11	Unknown†	None	None	14

* Left main stenosis counted as 2-vessel disease.

† No angiography data was available on these subjects, however, a cardiologist diagnosed ischemic heart disease based on medical history and ST-segment depression during exercise stress testing.

3-17. Perceived symptoms during 58 person-days of ambulatory ECG ersonal CO exposure monitoring

ct	Day	Number of Episodes Angina	Dyspnea	Syncope	Other Symptoms
	1	1	0	0	0
	2	0	0	0	1 (chest discomfort)
	1	1	0	0	0
	2	0	0	0	0
	1	2	0	0	0
	2	5	0	0	0
	1	0	0	0	0
	2	0	0	0	0
	1	0	0	0	0
	2	0	0	0	0
	1	0	0	0	2 (leg pain)
	2	1	1	1	4 (leg pain) + 2 (chest discomfort)
	1	1	0	0	0
	2	0	0	0	0
	1	0	0	0	0
	2	0	0	0	0
	1	0	0	0	1 (fatigue)
	1	0	0	0	0
	2	0	0	0	0
	1	0	0	0	1 (headache)
	1	0	0	0	0
	2	0	0	0	0
	1	0	0	0	0
	2	0	0	0	0
	1	[illegible]	0	0	0
	2	[illegible]	0	0	0
	1	0	0	0	0
	2	0	0	0	0
	1	1	0	0	0
	2	0	0	0	0
	1	0	1	0	0
	2	0	0	0	0

Table 3-16. Sources and categories of independent variables used in the analysis of the incidence of ST-segment depression

Variable	Source	Categories
CO	Personal exposure monitors measured 1-minute average exposures to the nearest ppm	$CO \leq 9$ $9 < CO \leq 35$ $CO > 35$
COHb	Minute-by-minute carboxyhemoglobin concentrations were estimated from CO exposure profiles using a linear model	$COHb \leq 1$ $1 < COHb \leq 2$ $COHb > 2$
Metabolic Activity	Levels assigned from diary descriptions of activities using published reports of energy expediture	$MET \leq 1$ $1 < MET \leq 2.5$ $MET > 2.5$
Psychological Tension	Levels of tension from self report by subjects in dairies	$Tension < 3$ $3 \leq Tension \leq 5$ $Tension > 5$

Table 3-18. Frequency of occurrence of ST-segment depression, and personal and environmental variables among the 20 subjects eligible for ST-segment analysis.

ID	Day	Episodes	Duration			Peak ST Depression			Integrated ST Depression			Heart Rate			METs (1 MET = 3.5			Tension			COHb			CO		
		(number)	(minutes)			(mm)			(mm·min)			(beats·min^{-1})			ml O_2·kg^{-1}·min^{-1})			(1 to 7)			(percent)			(ppm)		
			min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean
010	1	0	-	-	-	-	-	-	-	-	-	65	120	80	0.7	4.0	1.6	4	7	5.5	0.7	1.6	1.2	0	14	4.3
010	2	0	-	-	-	-	-	-	-	-	-	65	130	85	0.7	4.0	1.6	5	7	5.9	0.5	3.0	1.3	0	115	6.2
033	1	44	1.5	66.2	8.6	1.0	2.2	1.3	1.5	80.5	8.0	53	125	96	0.7	2.5	1.6	4	5	4.0	0.6	1.5	0.9	0	17	2.5
033	2	22	1.5	18.0	4.5	1.0	3.5	1.4	1.4	19.9	4.6	46	92	68	0.7	2.5	1.6	4	5	4.7	0.5	1.5	1.0	0	12	3.4
036	1	0	-	-	-	-	-	-	-	-	-	52	120	71	0.7	4.0	1.8	5	7	5.6	0.5	1.7	0.8	0	25	1.3
036	2	0	-	-	-	-	-	-	-	-	-	52	112	74	0.7	4.0	1.6	5	6	6.0	0.8	9.2	2.5	0	190	12.9
080	1	1	2.0	2.0	2.0	1.2	1.2	1.2	2.4	2.4	2.4	39	105	58	0.7	4.0	1.7	5	6	5.8	0.6	1.5	1.1	0	40	4.0
080	2	1	5.0	5.0	5.0	1.4	1.4	1.4	7.0	7.0	7.0	41	125	67	0.7	4.0	1.8	6	7	6.0	0.5	1.2	0.8	0	40	1.8
125	1	46	1.5	27.5	6.6	1.1	1.9	1.3	1.5	34.0	7.5	41	112	60	0.7	4.0	1.5	5	6	5.6	0.5	1.7	1.0	0	65	3.0
125	2	41	1.5	43.5	6.7	1.0	2.9	1.3	1.5	66.2	7.7	41	112	59	0.7	4.0	1.5	5	7	6.3	0.5	2.2	1.0	0	53	3.5
151	1	0	-	-	-	-	-	-	-	-	-	48	96	58	0.7	4.0	1.7	4	6	5.3	0.5	1.2	0.8	0	25	1.8
151	2	0	-	-	-	-	-	-	-	-	-	53	97	60	0.7	4.0	1.6	3	6	4.3	0.7	1.1	0.8	0	34	2.3
152	1	0	-	-	-	-	-	-	-	-	-	43	81	55	0.7	2.5	1.5	4	5	5.0	0.9	2.3	1.4	0	79	6.4
152	2	0	-	-	-	-	-	-	-	-	-	37	83	48	0.7	2.5	1.4	2	6	5.1	1.1	1.9	1.4	0	39	5.4
154	1	39	1.5	27.5	4.7	1.1	2.8	1.6	1.4	19.6	7.5	44	120	71	0.7	4.0	2.1	3	7	5.4	0.6	1.6	1.0	0	33	2.9
154	2	41	1.5	62.7	7.4	1.0	4.5	1.8	1.5	115.5	10.8	50	139	72	0.7	4.0	1.8	3	6	5.3	0.6	1.4	0.8	0	13	1.3
166	1	5	1.7	4.0	2.5	1.1	1.4	1.2	1.7	4.0	2.6	58	109	77	0.7	4.0	1.8	4	6	5.6	0.7	1.1	0.9	0	10	2.3
166	2	19	1.5	37.0	5.0	1.0	1.6	1.2	1.5	44.9	5.6	48	108	78	0.7	2.5	1.6	5	6	5.6	0.7	1.6	1.2	0	48	4.9
189	1	0	-	-	-	-	-	-	-	-	-	54	156	80	0.7	4.0	1.6	2	7	5.1	0.8	2.3	1.2	0	82	4.5
189	2	0	-	-	-	-	-	-	-	-	-	55	166	81	0.7	4.0	1.8	3	7	5.1	0.8	2.8	1.8	0	134	9.3

Table 3-17. (Continued)

Subject	Day	Number of Episodes Angina	Dyspnea	Syncope	Other Symptoms
197	1	0	0	0	0
197	2	0	0	0	0
201	1	0	0	0	0
201	2	0	0	0	0
202	1	0	0	0	0
202	2	0	0	0	0
203	1	3	0	1	2 (chest discomfort)
203	2	4	0	0	0
204	1	4	0	0	0
204	2	0	0	0	0
205	1	0	0	0	0
205	2	0	0	0	0
206	1	1	0	0	0
206	2	1	0	0	0
207	1	5	0	0	0
207	2	3	0	0	0
208	1	1	0	0	1 (chest discomfort)
208	2	0	0	0	0
209	1	0	0	0	0
209	2	0	0	0	0
210	1	3	0	0	0
210	2	4	0	0	0
211	1	0	0	0	0
211	2	0	0	0	0
212	1	0	0	0	0
212	2	2	0	0	0
TOTAL	58	45	2	2	14

Table 3-19. Results of the Pearson chi-square test of the proportion of 15-minute follow-up intervals with ST-segment depression by level of CO, COHb, metabolic activity and psychological tension

ID	Number of follow-up intervals	Probability (P) From Chi-square Test of Significance			
		CO	COHb	MET*	Tension
033	127	NS	0.000	†	†
080	123	NS	0.131	NS	NS
125	128	0.014	0.006	0.001	0.044
154	128	NS	NS	NS	NS
166	128	0.006	NS	0.220	0.029
202	127	NS	NS	NS	NS
204	124	NS	0.009	0.000	†
206	127	0.169	0.007	0.220	0.115
ST subjects (n = 8)	1012	0.000	0.000	0.032	NS
All subjects (n = 20)	3310	0.194	0.000	0.000	0.001

*1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$
NS = Not significant; $P > 0.25$
† = Variable has insufficient range
"ST subjects" denotes the combined follow-up data for subjects that displayed at least 1 episode of ST-segment depression
"All subjects" denotes the combined follow-up data for all subjects eligible for ST-segment analysis

Table 3-18. Continued

ID	Day	Episodes	Duration			Peak ST Depression			Integrated ST Depression			Heart Rate			METs (1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$)			Tension (1 to 7)			COHb			CO		
		(number)	(minutes)			(mm)			(mm·min)			(bpm)									(percent)			(ppm)		
			min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean	min	max	mean
197	1	0	–	–	–	–	–	–	–	–	–	49	114	93	0.7	2.5	1.8	1	7	4.4	0.7	1.5	1.0	0	10	3.1
197	2	0	–	–	–	–	–	–	–	–	–	59	120	90	0.7	2.5	1.7	3	6	4.3	0.7	1.7	1.2	0	20	4.2
201	1	0	–	–	–	–	–	–	–	–	–	41	96	56	0.7	1.5	1.3	5	6	5.6	0.5	1.2	1.0	2	7	3.8
201	2	0	–	–	–	–	–	–	–	–	–	43	114	55	0.7	1.5	1.1	4	6	5.5	0.4	0.8	0.7	0	7	1.6
202	1	3	1.5	4.2	2.4	1.3	1.5	1.4	1.5	5.3	2.8	50	109	75	0.7	2.5	1.6	3	7	5.7	0.7	1.5	1.0	1	18	3.2
202	2	5	1.7	2.7	2.1	1.2	1.5	1.3	1.7	3.1	2.3	52	109	77	0.7	3.0	1.7	3	7	6.2	0.5	1.2	0.8	0	33	2.3
203	1	0	–	–	–	–	–	–	–	–	–	41	126	55	0.7	4.0	1.5	2	7	5.0	1.4	3.1	2.3	1	32	12.2
203	2	0	–	–	–	–	–	–	–	–	–	39	112	55	0.7	4.0	1.6	5	5	5.0	0.6	1.5	1.0	0	22	3.1
204	1	6	2.0	3.0	2.2	1.1	1.5	1.4	1.5	5.3	2.8	55	137	87	0.7	4.0	1.5	6	6	6.0	0.6	2.7	1.3	0	25	4.0
204	2	0	–	–	–	–	–	–	–	–	–	50	134	78	0.7	2.5	1.5	6	6	6.0	0.7	1.4	0.8	0	21	1.6
206	1	22	1.5	10.5	2.9	1.1	1.6	1.3	1.5	12.0	3.2	45	122	74	0.7	4.0	1.8	3	7	6.2	0.5	2.3	1.0	0	59	2.0
206	2	45	1.5	15.0	4.0	1.0	2.2	1.3	1.5	15.0	4.3	45	116	76	0.7	4.0	1.6	4	7	5.5	0.5	2.3	0.9	0	48	1.9
207	1	0	–	–	–	–	–	–	–	–	–	53	117	75	0.7	4.0	1.8	3	7	6.2	0.7	1.3	1.0	0	11	2.7
207	2	0	–	–	–	–	–	–	–	–	–	55	120	80	0.7	4.0	1.8	2	5	3.3	0.5	1.3	0.9	0	22	2.4
208	1	0	–	–	–	–	–	–	–	–	–	38	130	53	0.7	2.5	1.2	6	7	6.2	0.8	1.9	1.2	0	24	4.3
208	2	0	–	–	–	–	–	–	–	–	–	33	84	52	0.7	4.0	1.6	2	6	5.2	0.6	2.0	1.3	0	20	5.6
210	1	0	–	–	–	–	–	–	–	–	–	62	137	82	0.7	2.5	1.3	1	4	3.1	0.8	1.8	1.2	1	18	4.1
210	2	0	–	–	–	–	–	–	–	–	–	58	137	88	0.7	2.5	1.2	4	4	4.0	0.7	1.7	1.1	0	37	3.8
211	1	0	–	–	–	–	–	–	–	–	–	52	112	72	0.7	2.5	1.5	7	7	7.0	0.7	2.4	1.3	0	245	4.8
211	2	0	–	–	–	–	–	–	–	–	–	50	130	78	0.7	4.0	1.6	6	7	6.7	0.8	2.4	1.2	1	54	4.9

Table 3-21. Estimated coefficients and standard errors in the multivariate logistic regression models of the incidence of ST-segment depression in 15-minute follow-up intervals

ID	Model	Estimated Coefficients* (Standard Error) Constant	CO	COHB	MET
033	1	--	--	--	--
080	--	--	--	--	--
125	1	-1.557† (0.622)	1.237† (0.521)	--	--
125	2	-1.860* (0.680)	--	1.011* (0.379)	--
125	3	-5.771§ (3.230)	--	--	--
154	--	--	--	--	--
166	1	-4.678* (1.34)	2.686† (1.26)	--	--
166	2	0.855 (1.59)	--	-1.397§ (0.818)	--
202	--	--	--	--	--
204	1	-5.334* (1.34)	--	1.192† (0.581)	--
204	2	-12.71* (2.81)	--	--	4.372* (1.160)
206	1	-2.271* (0.51)	--	0.790* (0.290)	--
"ST"	1	-2.782* (0.325)	1.081* (0.285)	--	--
Subjects	2	-3.023* (0.256)	--	0.912* (0.147)	--
(n = 8)	3	-2.405* (0.458)	--	--	0.383§ (0.217)
All	1	-3.533* (0.225)	--	0.371* (0.124)	--
Subjects	2	-5.215* (0.343)	--	--	1.178* (0.161)
(n = 20)	3	-5.672* (0.406)	--	0.289† (0.126)	1.169* (0.165)

§ $p < 0.10$ † $p < 0.05$ * $p < 0.01$

Table 3-20. Cross-classification of data on ST-segment depression and level of metabolic activity, carboxyhemoglobin, and psychological tension for combined follow-up data of all subjects

ST Depression Incidence	Metabolic Activity: Low (MET ≤1)	Medium (1< MET ≤ 2.5)	High (MET > 2.5)	Total
No	835	2135	171	3142
Yes	2	149	17	168
Total	837	2285	188	3310
Odds Ratio	1.0	29.12	41.51	
95% C.I.		(7.2, 117.8)	(9.5, 181.3)	
ln Odds Ratio	0.0	3.37	3.72	

ST Depression Incidence	Carboxyhemoglobin: Low (COHb ≤1)	Medium (1< COHb ≤ 2.0)	High (COHb > 2.0)	Total
No	1587	1358	197	3142
Yes	60	98	10	168
Total	1647	1456	207	3310
Odds Ratio	1.0	1.91	1.34	
95% C.I.		(1.37, 2.65)	(0.68, 2.67)	
ln Odds Ratio	0.0	0.65	0.29	

ST Depression Incidence	Psychological Tension: Relaxed (TEN > 5)	Neutral (3< TEN ≤ 5)	Tense (TEN ≤ 3)	Total
No	1544	1184	414	3142
Yes	104	55	9	168
Total	1648	1239	423	3310
Odds Ratio	1.45	1.0	0.21	
95% C.I.	(1.04, 2.03)		(0.05, 0.87)	
ln Odds Ratio	0.37	0.0	-1.56	

COHb = carboxyhemoglobin level (percent)
1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$
TEN = psychological tension scale (1 = very tense to 7 = very relaxed)

Table 3-23. Observed and estimated numbers of 15-minute follow-up intervals with ST-segment depression by level of metabolic activity and carboxyhemoglobin

COHb Level (percent)	Number of Follow-up Intervals (N)	Observed (O)	Estimated* (E)	$\frac{O - E}{N}$
		Low Metabolic Level (MET† ≤ 1)		
COHb ≤ 1	559	2	8	-0.011
1 < COHb ≤ 2	252	0	5	-0.020
COHb > 2	26	0	1	-0.038
		Medium Metabolic Level (1 < MET ≤ 2.5)		
COHb ≤ 1	982	48	44	+0.004
1 < COHb ≤ 2	1137	92	68	+0.021
COHb > 2	166	9	13	-0.024
		High Metabolic Level (MET > 2.5)		
COHb ≤ 1	106	10	14	-0.038
1 < COHb ≤ 2	67	6	11	-0.075
COHb > 2	15	1	3	-0.133
Totals	3310	168	167	-0.314

* Probability of ST-segment depression estimated using the model describe in Table 3-22.

†1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$

Table 3-24. Estimated excess numbers of 15-minute follow-up intervals with ST-segment depression caused by elevated carboxyhemoglobin

COHb Level (percent)	Number of Follow-up Intervals (N)	Estimated* ST-Depression Incidence		
		Total	Attributed to Metabolic Level	Attributed to COHb Level
		Low Metabolic Level (MET† ≤ 1)		
COHb ≤ 1	559	8	8	0
1 < COHb ≤ 2	252	5	4	1
COHb > 2	26	1	0	1
		Medium Metabolic Level (1 < MET ≤ 2.5)		
COHb ≤ 1	982	44	44	0
1 < COHb ≤ 2	1137	68	52	16
COHb > 2	166	13	8	5
		High Metabolic Level (MET > 2.5)		
COHb ≤ 1	106	14	14	0
1 < COHb ≤ 2	67	11	9	2
COHb > 2	15	3	2	1
Totals	3310	167	141	26

COHb = carboxyhemoglobin level (percent)

†1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$

* Probability of ST-segment depression estimated using the model described in Table 3-22.

Table 3-25. Stratum specific incidence of ST-segment depression in 15-minute follow-up intervals by level of metabolic activity and COHb, and the Mantel-Haenszel test statistic of trend by COHb level

ST Depression Incidence	Low COHb (COHb ≤1%)	Medium COHb (1 < COHb ≤ 2%)	High COHb (COHb > 2)
	Low Metabolic Activity (MET† ≤ 1)		
No	557	252	26
Yes	2	0	0
Total	559	252	26
	Medium Metabolic Activity (1 < MET ≤ 2.5)		
No	934	1045	157
Yes	48	92	9
Total	982	1137	166
	High Metabolic Activity (MET > 2.5)		
No	96	61	14
Yes	10	6	1
Total	106	67	15
	MANTEL-HAENSZEL ODDS RATIO FOR COHb* = 1.97		

*Computed using the Mantel (1963) extension of the Mantel-Haenszel test statistic for 2 x 2 contingency tables

†1 MET = 3.5 ml $O_2 \cdot kg^{-1} \cdot min^{-1}$

Table 3-26. Results of nine subjects who participated in ambulatory monitoring and controlled clinical testing

	LABORATORY SETTING			AMBULATORY SETTING		
ID	Time to onset of angina after CO	Time to onset of ST depression after CO	Arrhythmia during exercise	ST-segment depression	Statistical Association With COHb	Frequent Arrhythmia
010	No change	No ST dep*	Yes	0	None	Yes
012	No change	Increased	No	Ineligible†	--	No
152	Decreased	No ST dep	No	0	None	No
202	Decreased	Decreased	No	8	NS	Yes
204	Decreased	Decreased	No	6	S	Yes
205	Decreased	No ST dep	No	Ineligible§	--	No
206	Decreased	No ST dep	Yes	67	S	Yes
208	Increased	No ST dep	No	0	None	No
211	Increased	No change	No	0	None	No

* No ST-segment depression observed during exercise test
† Ineligible for ST-segment analysis due to left bundle branch block condition
§ Ineligible for ST-segment analysis due to resting ST-segment elevation
S = significant association with COHb by logistic regression
NS = no statistically significant association with COHb by logistic regression

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Steven D. Colome, ScD, Dennis M. Davidson, M.D., William E. Lambert, Michael T. Kleinman, Ph.D. and Sandra Wojciechowski

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Irvine, CA 92717

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13. ABSTRACT *(Maximum 200 Words)*

Thirty-six men with ischemic heart disease (IHD) wore personal carbon monoxide monitor that recorded one-minute average exposure and portable heart monitors for 24 hour periods, and maintained a written diary of activities, locations, symptoms, and psychologic tension. Blood CO levels measured by end-expired breath samples were compared with levels predicted from CO exposure profiles. The daily activities of these IHD subjects experienced variable and sometimes elevated exposures to CO. Over half were estimated to spend 2% of their time in exposure conditions leading to blood CO levels shown in laboratory studies to aggravate myocardial ischemia. Exposures to CO in the urban environment were consistent with studies under laboratory conditions associating CO exposure with reductions in time to onset of ST-segment depression or angina. The highest personal exposures were measured during activities associated with driving automobiles, and small gasoline appliances used in lawn care or cutting wood. Men with IHD living in Los Angeles frequently experience COHb levels that could place them at risk for cardiac health effects.

14. SUBJECT TERMS

air pollution, human health, carbon monoxide, ischemic heart disease, IHD, angina, Los Angeles, COHb, cardiac health effects, automobiles, gasoline engines, lawn care, gardening, wood cutting

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