Chromium Exposure and Health Projects in the 1990s

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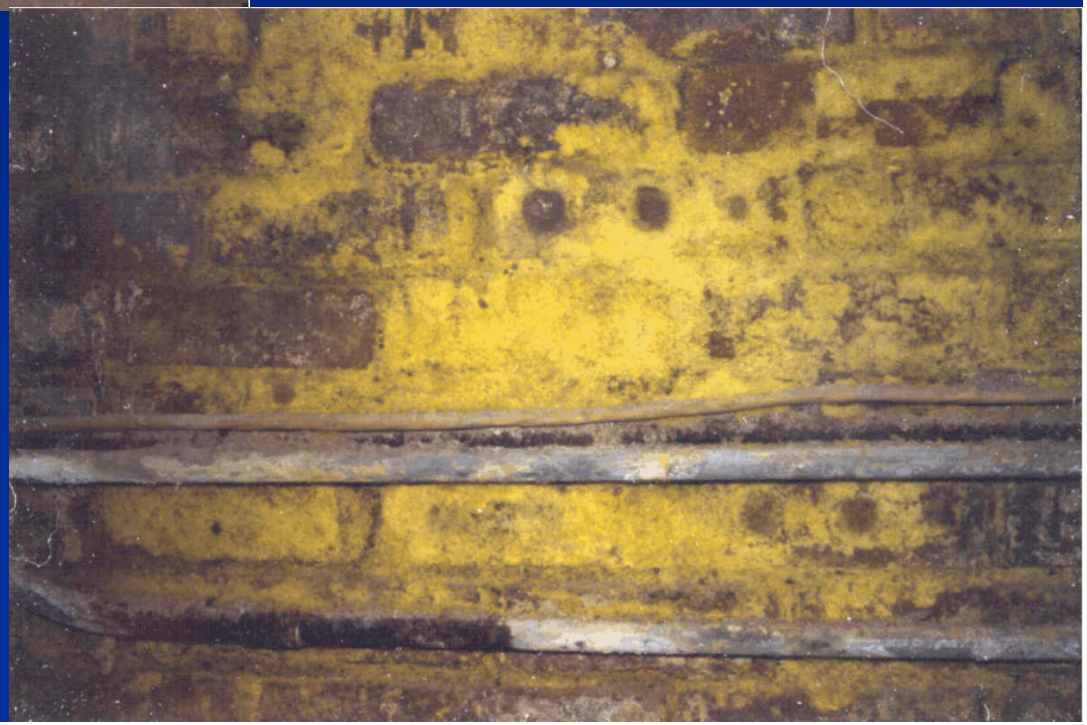
Overview

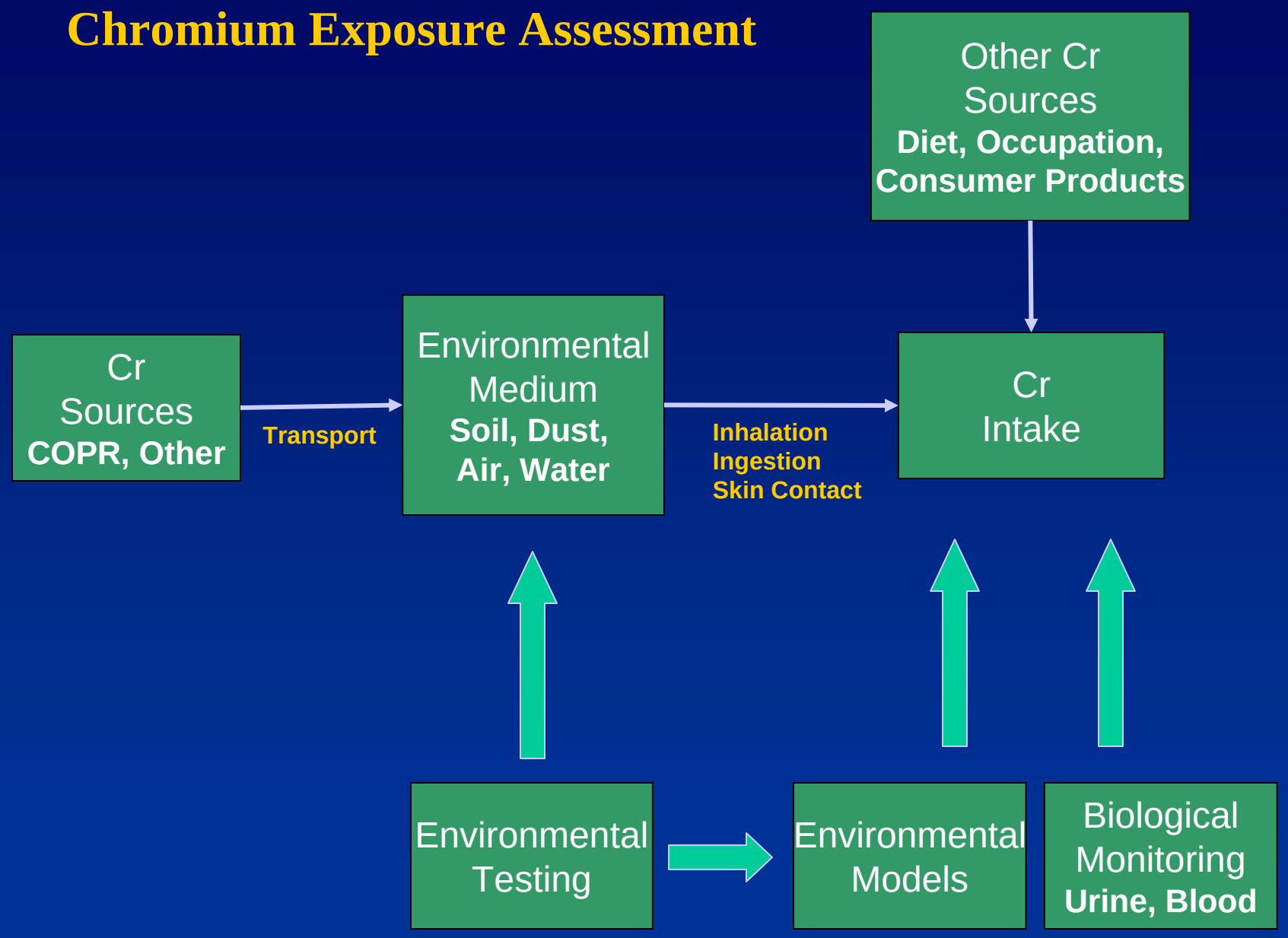
- Background
- Chromium exposure and health screening
- Studies of chromium in household dust

Chromium Chemistry

- Chromium (Cr) can occur in several states
  - Cr (0): metal
  - Cr (III): less toxic, less mobile
  - Cr (VI): more toxic, more mobile
- Chromium in slag contained variable fraction as Cr (VI)
- “Yellow water” and “chromium blooms”



Chromium Exposure Assessment



Health Effects of Exposure to Chromium (VI)

- Dependent on amount and route of exposure

- Increased risk of lung cancer (inhalation)
- Irritation and corrosive of skin, membranes
- Allergic effects
- Reversible kidney effects
- Possible immune system effects

Chromium Exposure and Health Effect Screening 1991-1993

- Purpose: Test for exposure and possible health effects in people living or working near the chromium sites

- Conducted by NJDOH, Jersey City Medical Center, and UMDNJ
- Funded by NJDEP

Initial Screening

- Physical examination of skin, nose and mouth
- History of asthma, allergies, skin problems, nasal ulceration
- Discussion of health concerns
- Urine analysis for Cr
- Referral criteria for follow-up evaluation

Follow-up Evaluation

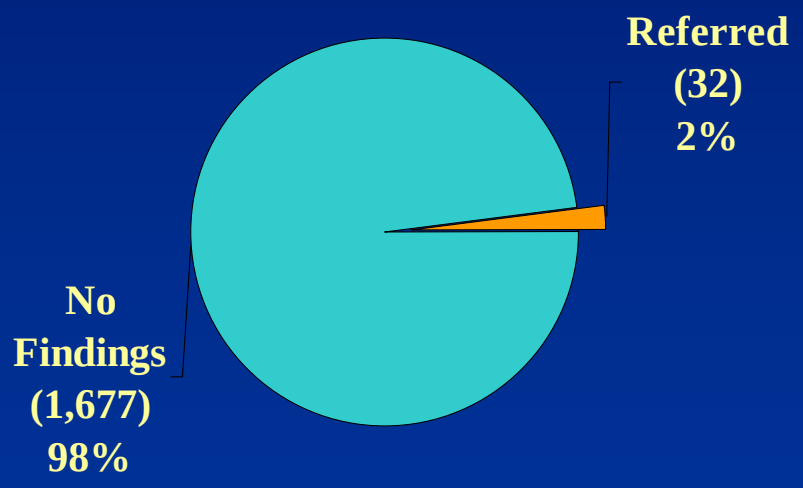
- Detailed physical examination by specialists
- Blood/urine analyses to assess kidney function
- Lung function tests
- Examination by dermatologist
- Spot and 24-hour urine specimens for chromium testing
- Additional medical services

Populations Screened

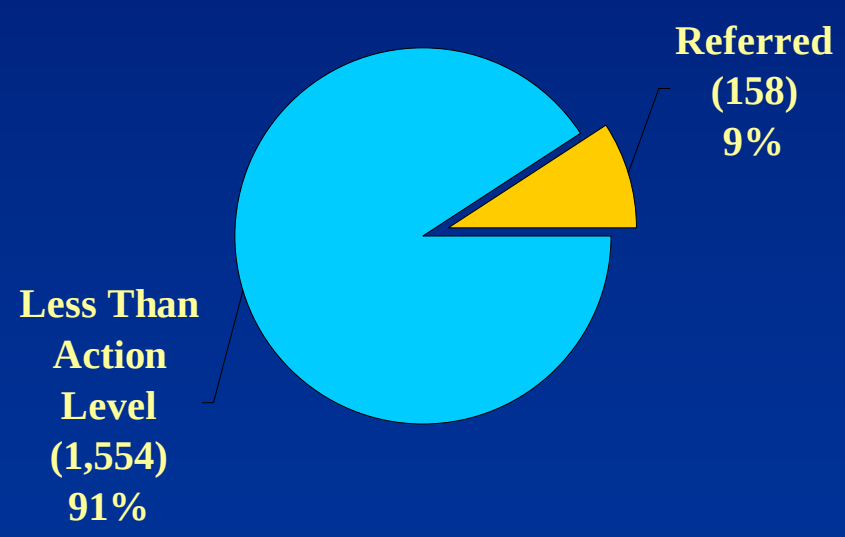
- 806 residents
  - 14 neighborhoods in two cities
- 934 workers
  - 78 workplaces in five cities
- 315 comparison group for urine Cr
  - seven counties outside of Hudson

Results of Individual Screening Evaluations

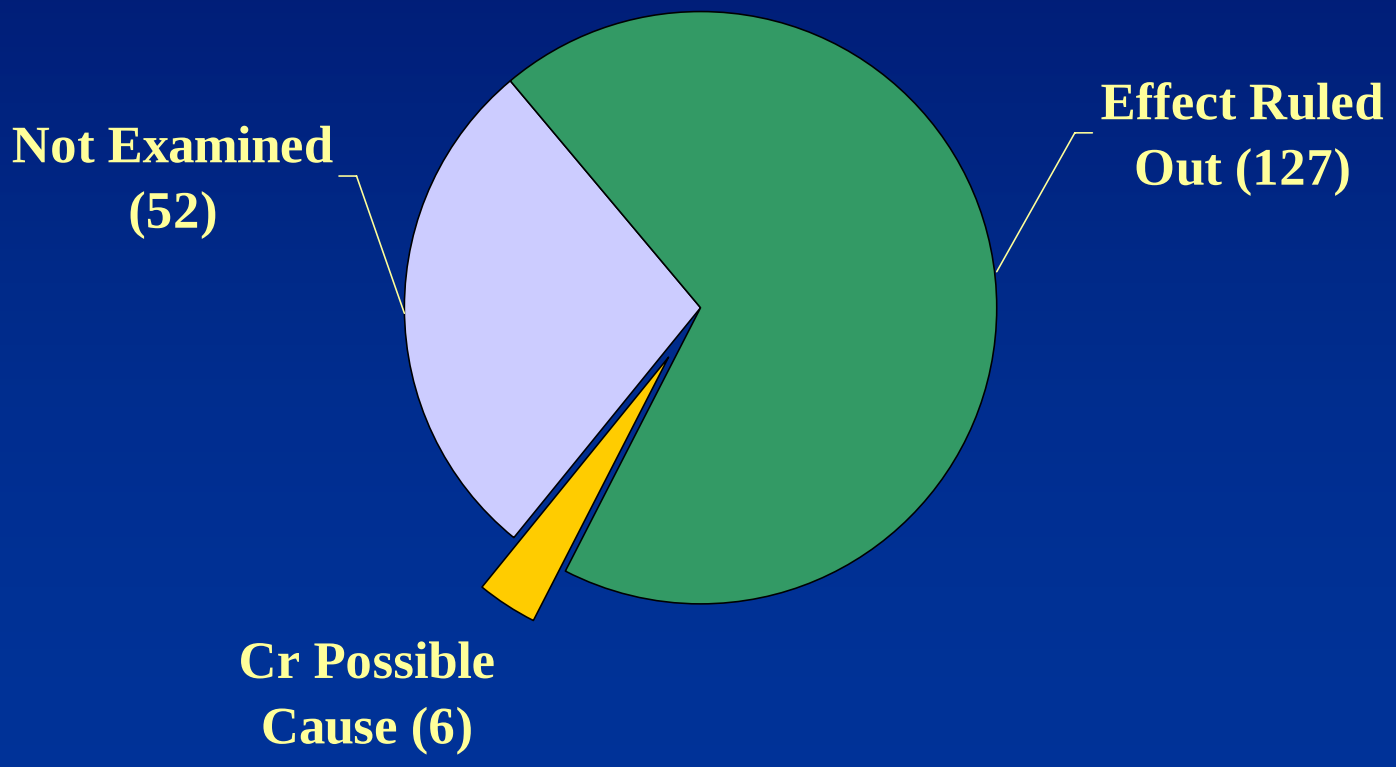
Physical Examinations



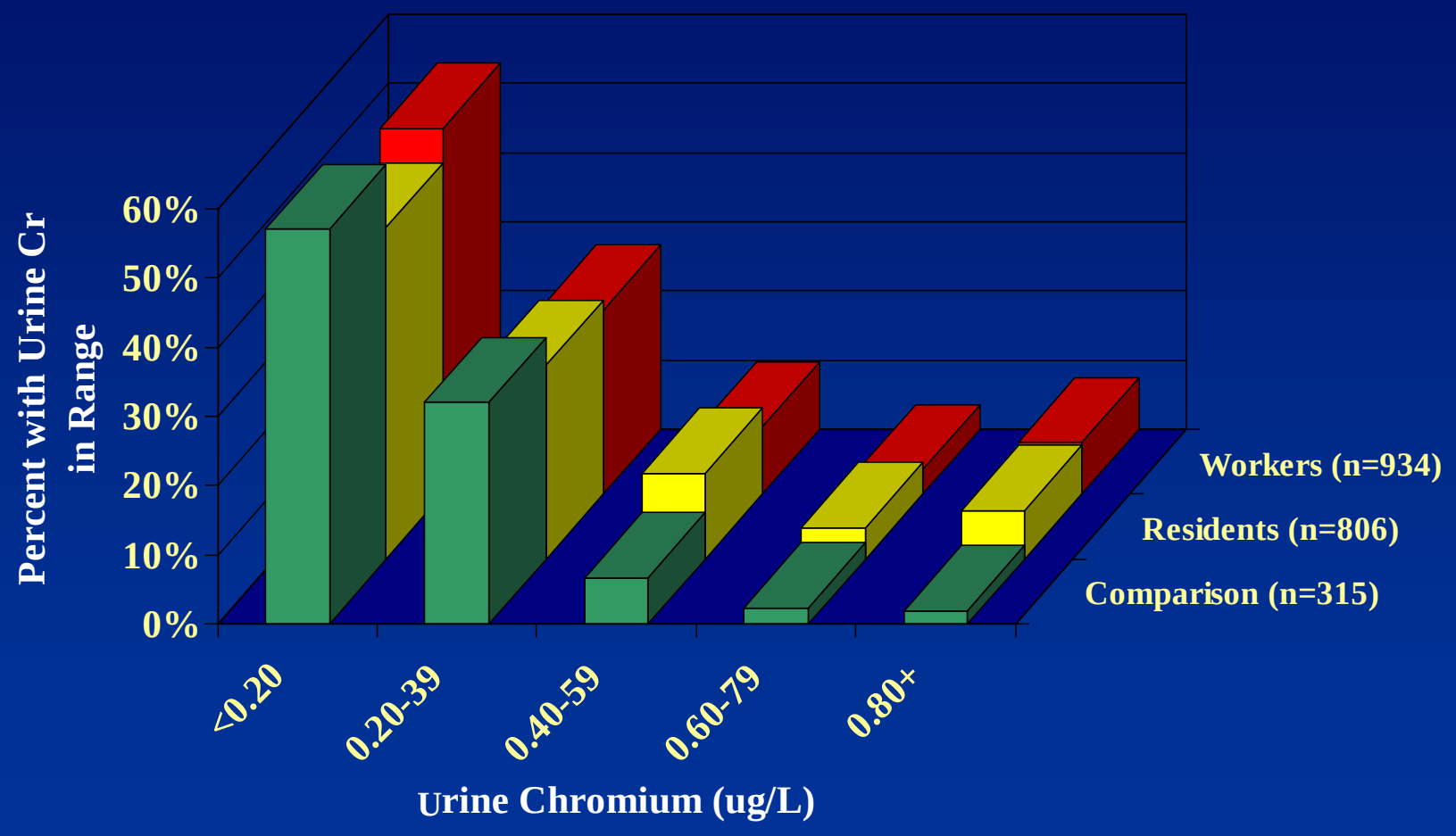
Urine Chromium Tests



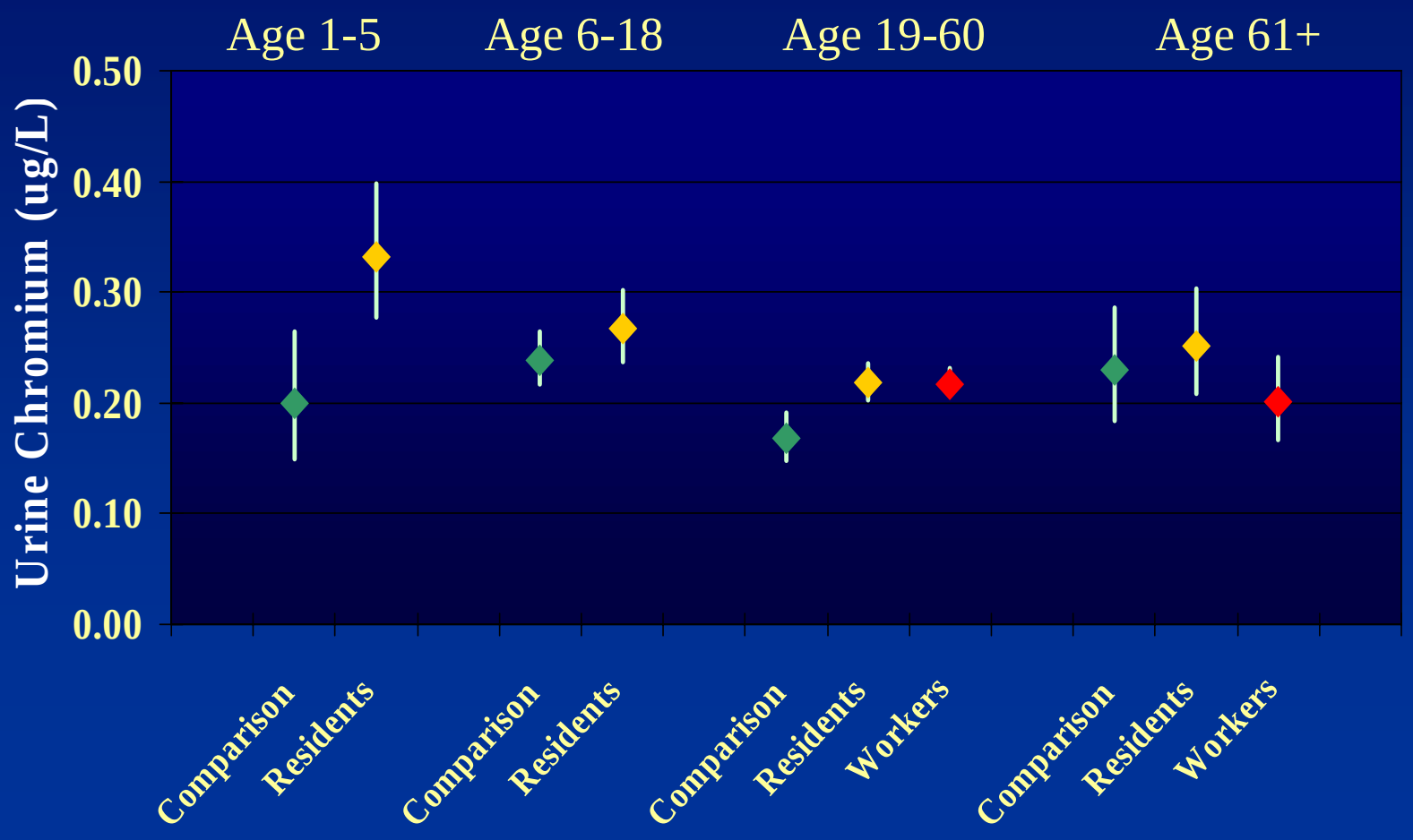
Results of Individual Follow-up Evaluations



Distribution of Urine Chromium Concentrations



Average Urine Chromium Concentrations by Age and Group



Conclusions

- Evidence of Cr exposure in children living near Cr sites (before remediation)
- Two residential areas and seven workplaces identified for further environmental tests
- No apparent Cr-related effects in most individuals undergoing follow-up evaluations; however, for six persons, Cr was a suspected cause or contributor to health conditions

Chromium in Household Dust in Conjunction with the Hudson County Chromium Medical Screening Study

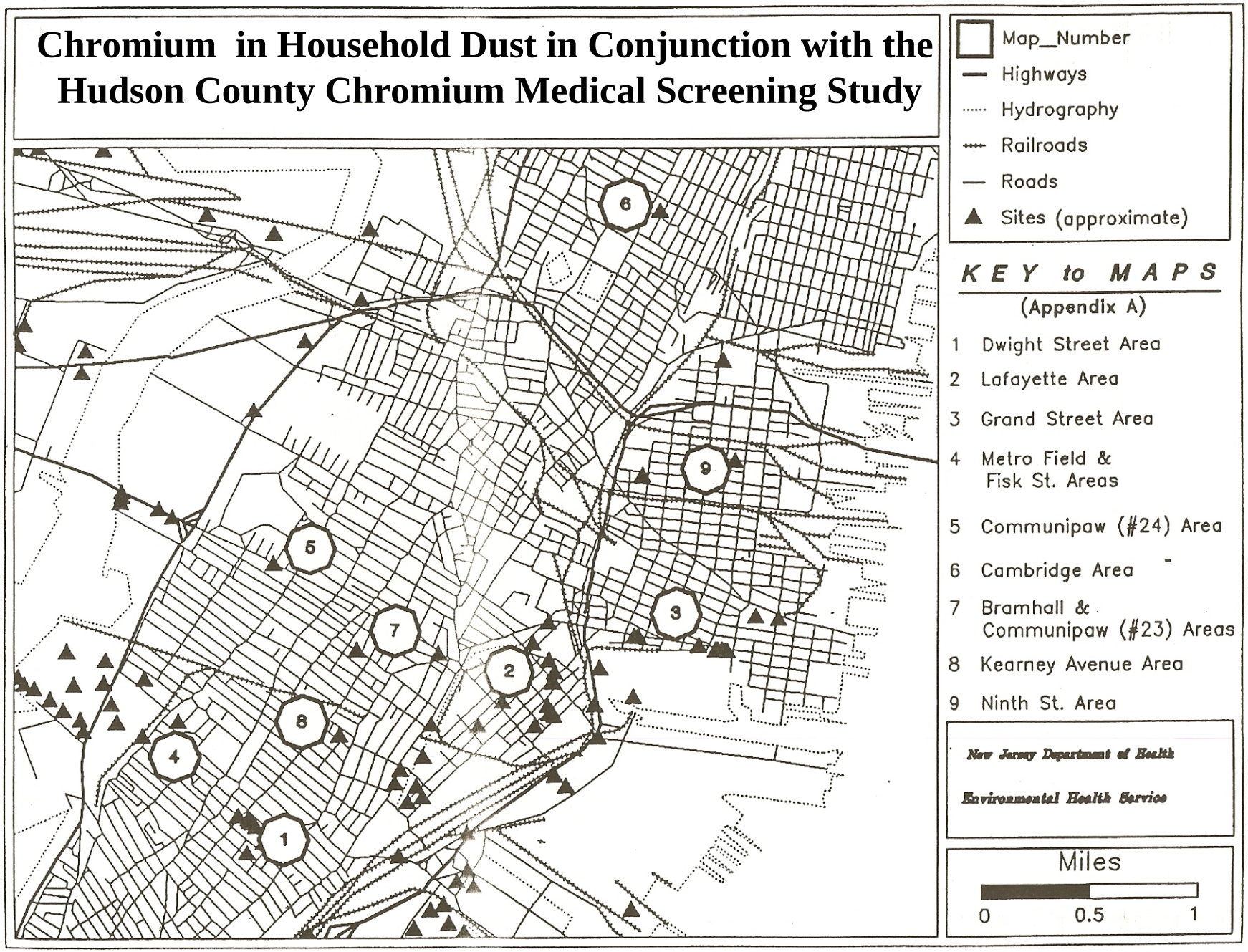


Fig. 1. Jersey City residential areas targeted for chromium screening.

Table 4.—Chromium Levels (*GM*s) in Nine Hudson County Areas

Area	No. homes sampled	Chromium concentration		Chromium loading	
		$\bar{x} \pm SD$	*GM* (μg/g)	$\bar{x} \pm SD$	*GM* (ng/cm^2)
1	49	176 ± 223	110*	23 ± 27	12†
2	28	217 ± 392	108‡	31 ± 53	14†
3	5	181 ± 211	104	17 ± 21	8
4	51	241 ± 263	158§	38 ± 106	9
5	3	167 ± 125	127	5 ± 4	4
6	6	457 ± 421	317*	25 ± 22	19†
7	16	265 ± 297	146†	27 ± 25	17†
8	4	120 ± 70	90	8 ± 7	6
Adjacent	21	267 ± 324	150†	52 ± 66	21†
Other Jersey City areas	20	274 ± 761	89	33 ± 62	13‡
Bayonne	7	125 ± 122	84	5 ± 4	3
Controls	47	111 ± 197	66	14 ± 24	7

Notes: GM = geometric mean. *p* Values indicated are for comparisons between areas and control homes.

*$p \leq .01$.

†$p \leq .05$.

‡$p \leq .10$.

§$p \leq .001$.

Reduction in Residential Chromium in Household Dust Following Site Remediation in Jersey City 1992-1995

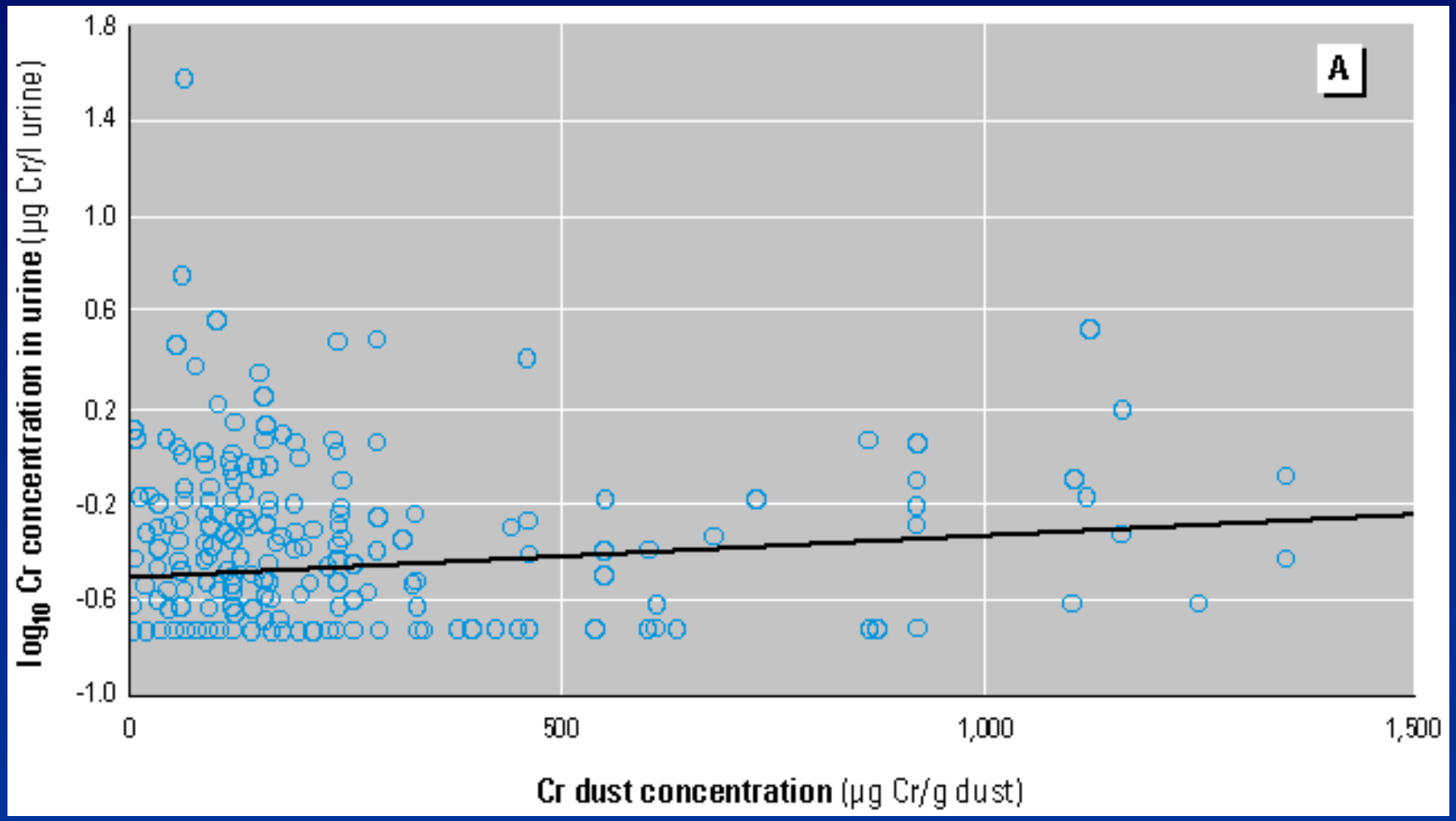
Freeman, Lioy, and Stern

Table 5. Comparison of Cr concentrations (μg/g) in houses by initial Cr category.

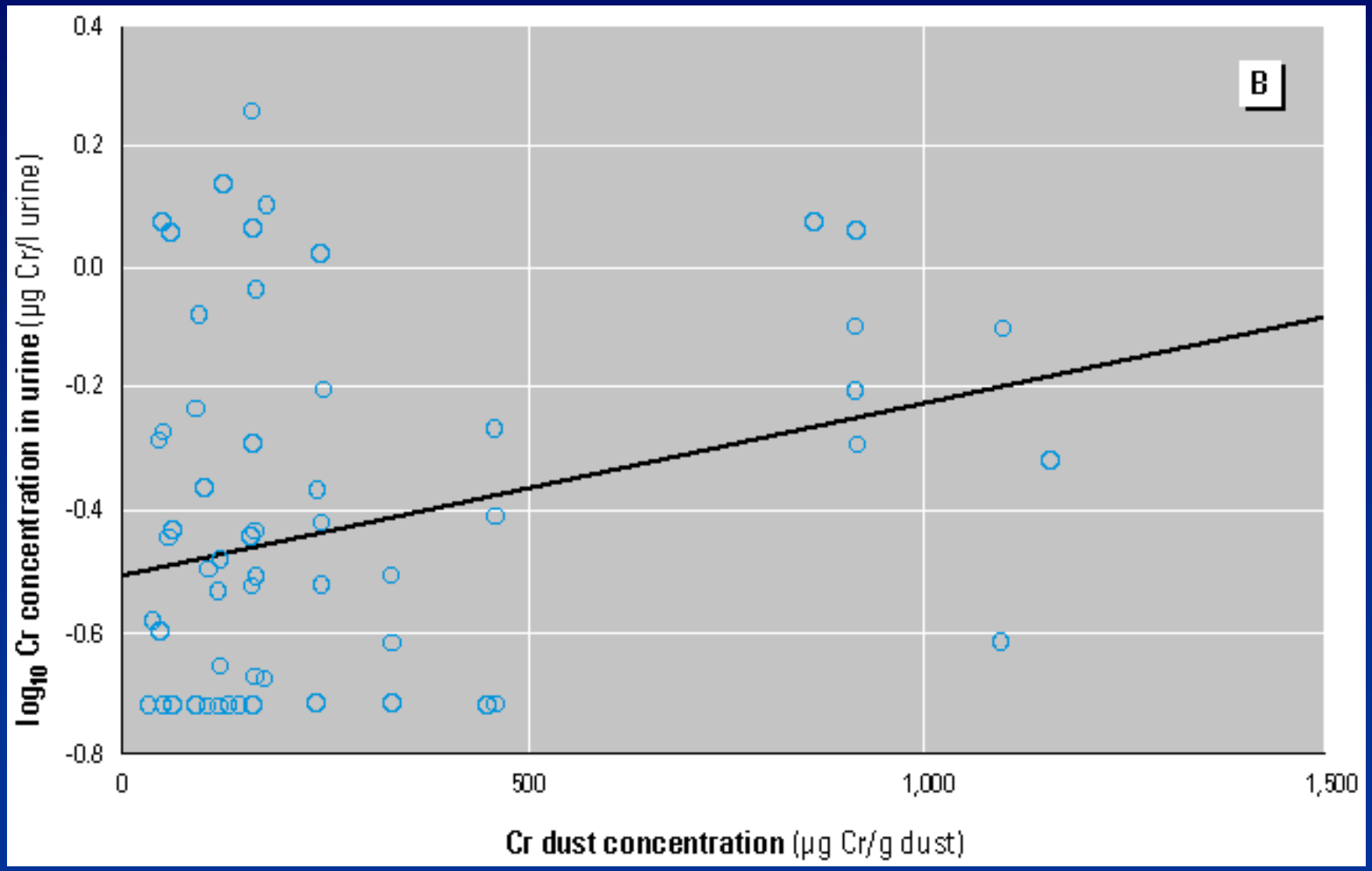
Category	Initial Cr[b]	Visit 1	Visit 2	Visit 3	Visit 4
Low					
Mean ± s.d.	58 ± 33	53 ± 61	61 ± 61	85 ± 53	54 ± 106
Median	48	30	49	105	1
n	7	7	6	5	5
Medium					
Mean ± s.d.	248 ± 76	67 ± 58[a]	49 ± 78[a]	48 ± 34[a]	66 ± 77[a]
Median	245	47	21	45	34
n	8	8	8	8	6
High					
Mean ± s.d.	782 ± 331	97 ± 103[a]	35 ± 27[a]	78 ± 135[a]	55 ± 60[a]
Median	739	75	39	16	50
n	8	8	8	7	7
	$p < 0.001$	ns[c]	ns[c]	ns[c]	ns[c]

Mann-Whitney test used for comparison across categories. Friedman nonparametric analysis of variance and Wilcoxon tests used for comparison across visits. [a]Significantly less than initial visit $p < 0.01$; [b]Cr concentrations significantly different across categories; [c]ns = no significant difference.

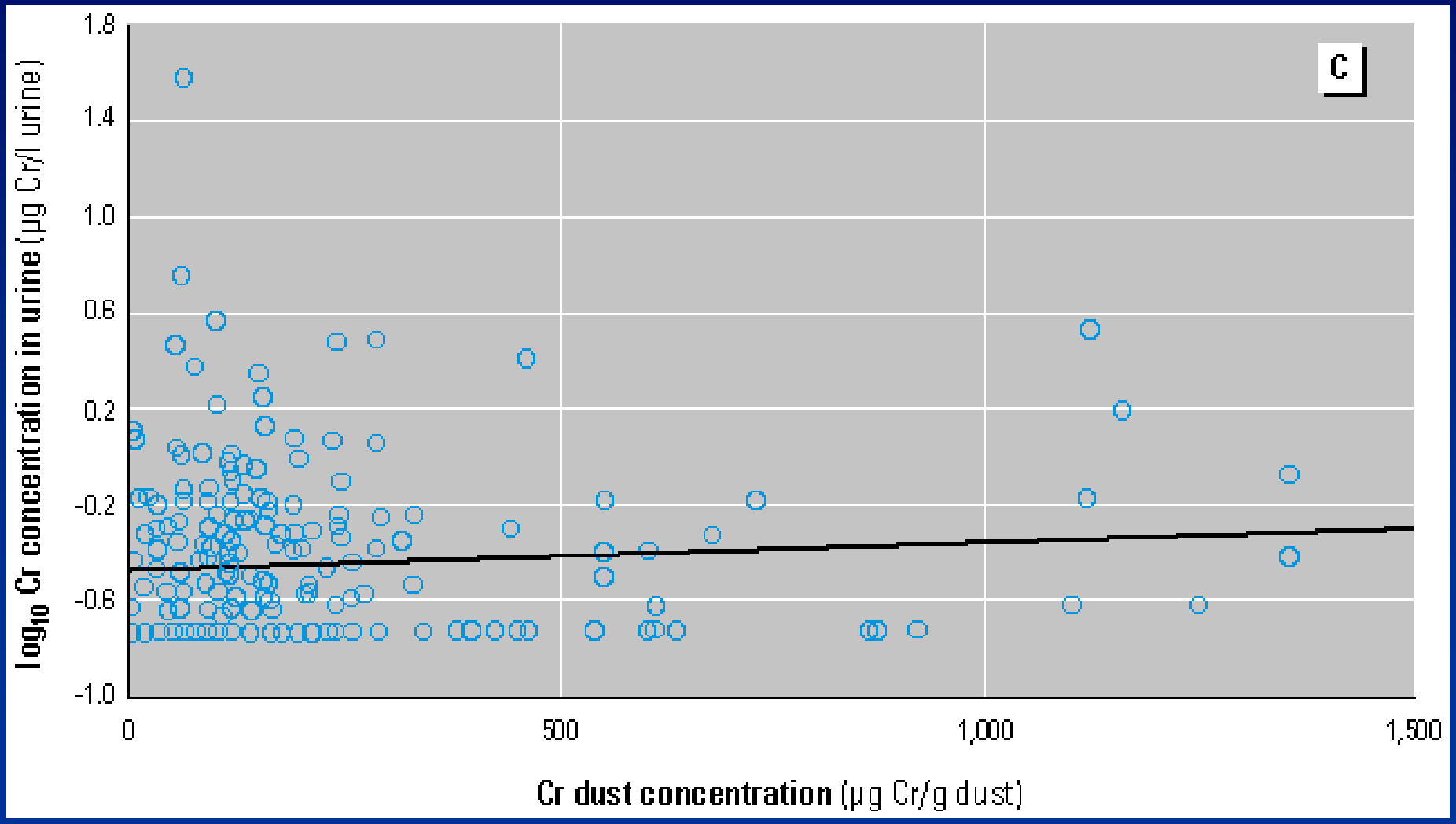
Association of Chromium in Dust and Urine - Total Study Population



Association of Chromium in Dust and Urine - Children 10 Years Old and Younger



Association of Chromium in Dust and Urine – Adults Only



The Association of Chromium in Household Dust with Urinary Chromium in Residences Adjacent to Chromate Production Waste Sites

Table 1. Selected characteristics of the study population

	All ages (n = 329)	10 Years old (n = 67)
Median age	31	6[a]
Percent female	60	45
Percent by race		
Black	63	76
White	21	10
Hispanic	8	7
American Indian	<1	0
Asian	8	6
Percent by residential location		
1	41	51
2	15	16
3	3	1
4	21	12
5	2	3
6	5	4
7	10	12
8	1	0
11	1	0

[a]27% ≤3 years old.