Levels of Chemical Contaminants in Nonoccupationally Exposed U.S. Residents

James W. Holleman
Anna S. Hammors

OAK RIDGE NATIONAL LABORATORY

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**LEVELS OF CHEMICAL CONTAMINANTS IN
NONOCCUPATIONALLY EXPOSED U.S. RESIDENTS**

James W. Holleman and Anna S. Hammons

Information Center Complex

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Archives of Environmental Health
Bulletin of Environmental Contamination and Toxicology
Drug Metabolism and Disposition
Environmental Health Perspectives
Environmental Research
Food and Cosmetics Toxicology
International Journal of Environmental Studies
Journal of Agricultural and Food Chemistry
Journal of Toxicology and Environmental Health
Journal of Occupational Medicine
Pesticides Monitoring Journal
Toxicology
Toxicology and Applied Pharmacology
Toxicology and Environmental Chemistry Reviews

Abstract Journals

Nutrition Abstracts and Reviews
Excerpta Medica
Public Health
Pharmacology and Toxicology
Index Medicus
Chemical Abstracts
Biological Abstracts

Computerized Data Files

TOXLINE
MEDLINE
DIALOG®
Food Science and Technology
Agricola
Commonwealth Agricultural Bureaux
Pollution Abstracts
Chemical Abstracts
Environline
ORNL Data Base
Biological Abstracts/BioResearch Index

Other

National Academy of Science Monographs
Trace Substances in Environmental Health, Volumes I-IX, Proceedings of
Annual Conferences held at the University of Missouri
Document collections of the Information Center Complex, Information
Division, Oak Ridge National Laboratory
Reference document bibliographies

Key to Analytical Terminology

AAS	Atomic absorption spectrometry
ASV	Anodic stripping voltammetry
CC	Column chromatography
Chem.	Chemical
Colorimetry	Colorimetry; spectrophotometry
Electrophoresis	Electrophoresis
ES	Emission spectrometry
Flame photometry	Flame photometry
Fluorometry	Fluorometry
GC	Gas chromatography
GC-EC	Gas chromatography; electron-capture detection
GC/MS	Gas chromatography coupled with mass spectrometry
Histochem.	Histochemistry
IR	Infra-red analysis
ISE	Ion-specific electrode
Microscopy	Microscopy
MS	Mass spectrometry
NAA	Neutron activation analysis
NMR	Nuclear magnetic resonance
Radiometry	Measurement of radioactivity
TLC	Thin-layer chromatography
X-ray spectrometry	Measurement of emitted X-rays

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INTRODUCTION

Preparation of this preliminary report was directed by the Health and Environmental Studies Program, Information Center Complex, Information Division, Oak Ridge National Laboratory, for the Health Effects Research Laboratory, U.S. Environmental Protection Agency, as partial fulfillment of Interagency Agreement DOE No. 40-673-78, EPA No. 78-D-XD205 between the Department of Energy and the U.S. Environmental Protection Agency. The scope of this report is designed to meet the obligation of the U.S. Environmental Protection Agency as specified in Section 403c(1) of the Clean Air Act as amended August 7, 1977. This section provides for the following:

(c)(1) Not later than twelve months after the date of enactment of this Act the Administrator of the Environmental Protection Agency shall publish throughout the United States a list of all known chemical contaminants resulting from environmental pollution which have been found in human tissue including blood, urine, breast milk, and all other human tissue. Such list shall be prepared for the United States and shall indicate the approximate number of cases, the range of levels found, and the mean levels found.

Work under this agreement will continue until a comprehensive final report is prepared which will meet the additional requirements of the following Section 403c(2):

(2) Not later than eighteen months after the date of enactment of this Act the Administrator shall publish in the same manner an explanation of what is known about the manner in which the chemicals described in paragraph (1) entered the environment and thereafter human tissue.

Representative data on the human tissue levels of all chemicals considered pertinent to the intended scope of this initial report are included in the subsequent tables. Demographic data or any other information considered important for understanding the significance of the reported chemical levels are also included. Chemical coverage reflects tissue levels reported over the last 30 years, although imposed time constraints did not allow documentation of every report. A list of the information resources surveyed is provided at the end of this section. The bibliography contains sources used for this report as well as several sources which were reviewed for inclusion in the final report.

Most available data results from specific surveys to determine the tissue levels of chemicals perceived to be potential public health hazards or involved in incidents of gross accidental poisonings. Basic interests

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in the roles of trace elements and recognition of the need to determine baseline levels of chemicals introduced into the environment are additional factors which have motivated surveys by individual investigators. Thus, most data on chemicals in human tissues record levels of pesticides (e.g., DDT and metabolites), levels of trace metals such as lead, cadmium, and mercury, or levels of nutritionally essential elements such as zinc, copper, manganese, and fluoride.

The considerable amount of data available on some essential elements, such as iron and calcium, are not presented in this initial report because their presence in the environment is generally not considered hazardous. Data on several uncommon chemicals, such as indium and ytterbium, are included basically as items of interest and to further document their presence in healthy individuals. Baseline data were presented where available to provide perspective as to chemical levels which might be expected under conditions where exposure could be considered normal or not directly related to a pollutant source.

Nearly 600 cited surveys or investigations, most of which were reported within the past decade, are listed in the following table. Ninety-four different chemical contaminants, primarily trace metals and organochlorine pesticides, were reported. It is estimated that over 75 percent of the data published during the past 30 years on chemical contaminants derived from environmental pollution and found in human tissue in the United States are represented in this report. The post World War II period covered in this survey represents that period when the proliferation of new chemical substances emitted into the environment was increasing at an accelerated pace.

ALDRIN

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	0.26 mg/kg	Not Given	Not Given	None	Hunter et al., 1967
Blood	0.2-0.7 ppb	0.41 ppb	51 pairs	GC	Maternal blood, Louisiana housewives.	Selby et al., 1969
Placenta	3.0-7.2 ppb	4.77 ppb	51 pairs	GC	Childbirth, Louisiana housewives.	Selby et al., 1969

ALUMINUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	62-450 $\mu\text{g/g}$ ash	180 $\mu\text{g/g}$ ash (median)	13	ES		Tipton et al., 1963
Aorta	0.94-51.0 micromole/g ash	Not given	100	ES		Perry, 1968
	0.76-5.2 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	11-140 $\mu\text{g/g}$ ash	29 $\mu\text{g/g}$ ash (median)	104	ES		Tipton et al., 1963
Bladder	Not given	6.0 ppm wet wt.	2	ES	Organs from sudden accident victims (normal)	Kuch et al., 1956
	18-150 $\mu\text{g/g}$ ash	47 $\mu\text{g/g}$ ash (median)	110	ES		Tipton et al., 1963
Blood	Not given	0.0207 $\pm$ 0.0008 mg/100 ml	48	ES	Normal individuals, Los Angeles area	Butt et al., 1964
	0.040 - 0.045 $\pm$ 0.03 mg/100 ml	0.045 mg/100 ml	266	ES	Patients, blood donors, and normal individuals, Los Angeles area. Serum	Butt et al., 1964
	Not given	0.013 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
Body, total content	Not given	61 mg	168	Not given	Autopsy samples from 58 cities and 29 nonurban areas	Schroeder, 1970
Bone	Not given	0.5 mg/100g wet wt.	Not given	ES	Race and country information, diet. Long bone	Kehoe et al., 1940
	Not given	0.24 mg/100g wet wt.	Not given	ES	Race and country information, diet. Rib bone	Kehoe et al., 1940
Brain	Not given	0.004 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940

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ALUMINUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	Not given	8.0 ppm wet wt.	3	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	0.38-10.0 micromole/g ash	Not given	100	ES		Perry, 1968
	0.22-1.4 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	6-38 ug/g ash	15 ug/g ash (median)	127	ES		Tipton et al., 1963
Diaphragm	13-94 ug/g ash	26 ug/g ash (median)	91	ES		Tipton et al., 1963
Esophagus	Not given	20.0 ppm wet wt.	1	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	15-180 ug/g ash	61 ug/g ash (median)	66	ES		Tipton et al., 1963
Hair	2.0-9.0 ppm	4.4 ppm	99	NAA	Children and adults	Saxon and Dyer, 1965
	5.5×10^{-12} - 2.1×10^{-9} dry wt.	Not given	18	ES	White males, 15-70 yrs. old	Goldbaum et al., 1953
	3.7 and 4.6 ug/g dry wt.	Not given	2	AAS; MS		Yurachek, 1969
Heart	Not given	0.056 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
	0.87-20.0 micromole/g ash	Not given	100	ES		Perry, 1968
	0.37-2.1 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	10-70 ug/g ash	20 ug/g ash (median)	140	ES		Tipton et al., 1963

ALUMINUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestine	Not given	0.087 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kelley et al., 1940
	0.0-20.0 ppm wet wt.	8.0 ppm wet wt.	6	ES	Sudden accident victims	Koch et al., 1956
	24-780 ug/g ash	130 ug/g ash (median)	31	ES	Cecum	Tipton et al., 1963
	20-200 ug/g ash	86 ug/g ash (median)	82	ES	Ileum	Tipton et al., 1963
	18-260 ug/g ash	43 ug/g ash (median)	Not given	Not given	Duodenum	Tipton et al., 1963
	18-150 ug/g ash	37 ug/g ash (median)	101	ES	Jejunum	Tipton et al., 1963
	23-340 ug/g ash	107 ug/g ash (median)	107	ES	Sigmoid colon	Tipton et al., 1963
	18-200 ug/g ash	42 ug/g ash (median)	42	ES	Rectum	Tipton et al., 1963
	Not given	0.042 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kelley et al., 1940
Kidney	1.1-31.0 micromole/g ash	Not given	100	ES		Perry, 1968
	0.51-3.0 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	0-15+ mg/100g dry wt.	Not given	Not given	ES		Tietz et al., 1957
	14-82 ug/g ash	25 ug/g ash (median)	141	ES		Tipton et al., 1963

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ALUMINUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Larynx	6-51 $\mu\text{g/g}$ ash	14 $\mu\text{g/g}$ ash (median)	50	ES		Tipton et al., 1961
Liver	Not given	0.16 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
	0.0-12.0 ppm wet wt.	6.0 ppm wet wt.	3	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	1.3-18.0 micromole/g ash	Not given	100	ES		Perry, 1968
	0.62-4.4 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	80.0 - 85.4 $\mu\text{g/g}$ ash	10	ES	5 White and 5 black accident victims, long-term St. Louis residents	Perry et al., 1973
	0-15+ mg/100g dry tissue	Not given	Not given	ES		Tietz et al., 1957
	17-120 $\mu\text{g/g}$ ash	47 $\mu\text{g/g}$ ash (median)	140	ES		Tipton et al., 1961
	Not given	0.69 $\pm$ 0.05 - 0.85 $\pm$ 0.3 ppm	12	ES; chem.	Autopsies; low value for cirrhotic patients (alcoholics) and high value for noncirrhotic	Vallee et al., 1957
	Not given	3.94 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
Lung	6.0-180 ppm wet wt.	50.0 ppm wet wt.	3	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	49-330 micromole/g ash	Not given	100	ES		Perry, 1968

ALUMINUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung (continued)	29-190 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	Min. - 1700 ug Max. - 80,000 ug Retained per yr. - 667 ug	168	Not given	Autopsy samples from 57 cities and 29 nonurban areas	Schroeder, 1970
	0-20+ ug/100g dry wt.	Not given	Not given	ES		Tietz et al., 1957
	170-4,000 ug/g ash	2500 ug/g ash	141	ES	Autopsies, 9 U.S. cities	Tipton et al., 1964
	780-4,000 ug/g ash	2000 ug/g ash (median)	141	ES		Tipton et al., 1963
Muscle	Not given	0.15 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
	0.0-12.0 ppm wet wt.	6.0 ppm wet wt.	7	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	6-77 ug/g ash	16 ug/g ash (median)	136	ES		Tipton et al., 1963
Nails	4.5×10^{-11} - 5.3×10^{-8} dry wt.	Not given	18	ES	White males, 15-70 yrs. old	Goldblum et al., 1953
Ovary	12-150 ug/g ash	36 ug/g ash (median)	16	ES		Tipton et al., 1963
Omentum	68-1100 ug/g ash	180 ug/g ash (median)	75	ES		Tipton et al., 1963
Pancreas	12-160 ug/g ash	27 ug/g ash (median)	138	ES		Tipton et al., 1963

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ALUMINUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Prostate	12-220 $\mu\text{g/g}$ ash	46 $\mu\text{g/g}$ ash (median)	50	ES		Tipton et al., 1963
Skin	5.3×10^{-11} - 4.5×10^{-9} dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1963
	72-1200 $\mu\text{g/g}$ ash	260 $\mu\text{g/g}$ ash (median)	22	ES		Tipton et al., 1963
Spleen	Not given	0.13 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
	0.0-8.0 ppm wet wt.	7.0 ppm wet wt.	3	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	0.95-18.0 micromole/g ash	Not given	100	ES		Perry, 1968
	0.36-4.4 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
Stomach	10-120 $\mu\text{g/g}$ ash	25 $\mu\text{g/g}$ ash (median)	143	ES		Tipton et al., 1963
	Not given	0.073 mg/100g wet wt.	Not given	ES	Race and country information, diet	Kehoe et al., 1940
	7.0-40.0 ppm wet wt.	18.0 ppm wet wt.	3	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	16-110 $\mu\text{g/g}$ ash	35 $\mu\text{g/g}$ ash (median)	130	ES		Tipton et al., 1963
Teeth	1.5-54.0 $\mu\text{g/g}$	14.0 $\pm$ 1.51 $\mu\text{g/g}$	56	MS	<20-year-olds, wide geographic area	Loose et al., 1963
		19.13 $\pm$ 3.48 ppm; 8.34 $\pm$ 1.31 ppm	208	MS	High caries area, New England; low caries area, South Carolina, <20-year-olds. Enamel	Curson and Loose, 1977

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ALUMINUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Testis	16-80 $\mu\text{g/g}$ ash	30 $\mu\text{g/g}$ ash (median)	72	ES		Tipton et al., 1963
Thyroid	35-240 $\mu\text{g/g}$ ash	85 $\mu\text{g/g}$ ash (median)	21	ES		Tipton et al., 1963
Trachea	12-890 $\mu\text{g/g}$ ash	60 $\mu\text{g/g}$ ash (median)	57	ES		Tipton et al., 1963
Urine	Not given	0.078 mg/100g wet wt.	Not given	ES	Race and country information, diet	Keefer et al., 1940
Uterus	12-90 $\mu\text{g/g}$ ash	36 $\mu\text{g/g}$ ash (median)	32	ES		Tipton et al., 1963
Vena cava	Not given	8.0 ppm wet wt.	1	ES	Organs from sudden accident victims (normal)	Koch et al., 1956

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ANTIMONY

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.31 ppm	Not given	39	X-ray Spectrometry	Mean age 35.3 years, Serum	Cofman et al., 1964
	Not given	0.016 $\mu\text{g/ml}$	Not given	Not given	Normal blood level	Rentoul and Smith, 1973
Brain	Not given	0.11 $\mu\text{g/g dry wt.}$	Not given	Not given	Normal brain level	Rentoul and Smith, 1973
Hair	0.5-4.0 ppm	1.5 ppm	33	NAA	Oak Ridge, Tenn. adults and children	Bate and Dyer, 1965
	Not given	0.061 $\pm$ 0.013 ppm	10	NAA	Homogenized hair	Obruenik et al., 1972
	Not given	0.69 $\mu\text{g/g dry wt.}$	Not given	Not given	Normal antimony level in hair	Rentoul and Smith, 1973
Heart	Not given	0.09 $\mu\text{g/g dry wt.}$	Not given	Not given	Normal heart level	Rentoul and Smith, 1973
Kidney	Not given	0.17 $\mu\text{g/g dry wt.}$	Not given	Not given	Normal kidney level	Rentoul and Smith, 1973
Liver	Not given	0.19 $\mu\text{g/g dry wt.}$	Not given	Not given	Normal liver level	Rentoul and Smith, 1973
Lung	<0.010-0.87 $\mu\text{g/g wet wt.}$	0.116 $\mu\text{g/g wet wt.}$	24	NAA	Some cases with lung cancer, some without	Kennedy, 1966
Teeth	0.02-0.34 $\mu\text{g/g dry wt.}$	0.13 $\mu\text{g/g dry wt.}$	56	MS	Less than 20-year-old teeth. Enamel	Loose et al., 1973

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ARSENIC

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.15 mg/100g dry wt.; <1-1 mg/100g dry wt.; trace-4.86 mg/100g dry wt.	0.0529 mg/100g dry wt.; 0.26 mg/100g dry wt.; not given	16 55 107	Colorimetry	Normal children; normal adults; patients with suggestion of chronic arsenic poisoning	Cannon, 1936
	0.00-0.05 ppm	Not given	Not given	X-ray spectrometry		Gofman et al., 1964
	Not given	0.03 µg/ml	Not given	Not given	Normal arsenic level in blood	Rentoul and Smith, 1973
	10-360 ppb	12-251 ppb	53	Not given	6 Oregon cities; correlation of blood arsenic level with arsenic levels in drinking water	Whanger et al., 1977
Brain	Not given	0.016 µg/g dry wt.	Not given	Not given	Normal arsenic level in brain	Rentoul and Smith, 1973
Hair	0.25-0.88 µg/g	0.51 µg/g	43	Chem.		Camp et al., 1949
	Not given	$0.4 \pm 0.26 - 10.6 \pm 7.0$ ppm	168	Colorimetry	Mean level range represents 5 cities - fourth grade boys	Hammer et al., 1971
	20-100 ppm 0-4 ppm	50 ppm 3 ppm	Not given	AAS	Higher values from children living near smelter; lower set from children living 8 miles away	Milham and Streut, 1974
	Not given	0.65 µg/g dry wt.	Not given	Not given	Normal arsenic level in hair	Rentoul and Smith, 1973
	0.06 and 0.31 µg/g dry wt.	Not applicable	2	AAS; ES		Yurachek et al., 1969
Heart	Not given	0.027 µg/g dry wt.	Not given	Not given	Normal arsenic levels in heart	Rentoul and Smith, 1973
Kidney	Not given	0.050 µg/g dry wt.	Not given	Not given	Normal arsenic levels in kidney	Rentoul and Smith, 1973

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ARSENIC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	Not given	0.057 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal arsenic levels in liver	Rentoul and Smith, 1971
Placenta	Not given	0.001 $\pm$ 0.000 $\mu\text{g/g}$ wet wt.	58	Not given	Data from city hospitals in South and Southeast	Karp and Robertson, 1977
Skin	High value: 5.22 mg/100g dry wt.	Not given	Not given	Not given	Samples from patients exhibiting symptoms suggestive of chronic arsenic poisoning	Cannon, 1936
	0.01-3.50 $\mu\text{g/g}$ dry wt.; 0.05-2.30 $\mu\text{g/g}$ dry wt.	0.17 $\mu\text{g/g}$ dry wt.; 0.10 $\mu\text{g/g}$ dry wt.	87	NAA	Arsenic history; no arsenic history	Domonkos, 1959
Urine	Trace to 4.86 mg/100g dry wt.	Not given	107	Colorimetry	Patients exhibiting symptoms suggestive of chronic arsenic poisoning	Cannon, 1936
	Not given	0.130 mg/liter	16	Colorimetry	Normal adults, children	Cannon, 1936
	Not given	0.023 mg/liter	Not given	NAA		Gills et al., 1974
	5-114 $\mu\text{g/liter}$ 8-75.5 $\mu\text{g/24 hr.}$	20 $\pm$ 13.6 and 29.1 $\pm$ 25.3 $\mu\text{g/liter}$ 20.9 $\pm$ 11.3 and 39.1 $\pm$ 23.4 $\mu\text{g/24 hr.}$	28	X-ray spectrometry	Measurements from Denver and Seattle	Mathies, 1974
	0.01-0.3 ppm 0.01-0.05 ppm	0.097 ppm 0.034 ppm	Not given	AAS	Higher values from children living close to smelter; lower values for children 8 miles from smelter	Milham and Strong, 1974
	Not given	0.084 $\mu\text{g/ml}$	Not given	Not given	Normal arsenic level in urine	Rentoul and Smith, 1971

ASBESTOS/FERRUGINOUS BODIES

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	0.0-<210 particles/lung	(a) 14.20 particles/lung (b) 12.89 particles/lung (c) 7.42 particles/lung (d) 10.05 particles/lung (e) 13.55 particles/lung	282 (Duluth) 96 (NYC)	Microscopy	(a) Duluth, 1953-1955 (b) Duluth, 1960-1961 (c) Duluth, 1966-1967 (d) Duluth, 1972-1973 (e) NYC, 1966-1968	Auerbach et al., 1977
	Not Given	Not Given	41 of 100	Histochemical		Cauna et al., 1965
	1-20 particles/5g	Not Given	28	Microscopy	Samples from ages 10-70	Gordon et al., 1976
	Not Given	2.8 and 9.5 mg/g dry wt. 6.5 x 10	23	Not Given	First values - Charleston, SC autopsies and second values - Pittsburg, PA autopsies	Gross et al., 1974
	9-201 fibers/10(-6) of tissue	Not Given	28 of 28	Microscopy	NYC autopsies	Langer et al., 1970; Selikoff et al., 1972
	0.0-57.0% positive	Not Given	1449 of 3000	Microscopy	NYC autopsies	Langer et al., 1970
	3-340 fibers/10(-6) fraction of tissue	Not Given	28 of 28	Microscopy	NYC random autopsies	Langer and Selikoff, 1971
	Not Given	Not Given	24 of 28	Microscopy	NYC autopsies, general population	Langer et al., 1971
	0-251+ ferruginous bodies/ 5g tissue	Not Given	86	Microscopy	No differences due to sex or location	Rosen et al., 1972
	Not Given	Not Given	179 of 355	Microscopy	NYC autopsies	Selikoff and Hammond, 1968

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ASBESTOS/FERRUGINOUS BODIES (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	Not Given	31.6% positive (males) and 20.4% positive (females)	304 males, 196 females	Microscopy	Autopsies in Florida	Thompson et al., 1966
	Not Given	98.2% positive (males) and 95.5% positive (females)	100	Microscopy		Ucidjian et al., 1968

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BARIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Aorta	0.036-0.50 micromoles/g ash	Not given	100	ES		Perry, 1968
	0.018-0.12 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis, Mo.	Perry et al., 1962
Blood	Not given	0.0069 $\pm$ 0.0004 mg/100ml	48	ES	Normal individuals, Los Angeles area. Whole blood.	Butt et al., 1964
	0.005-0.470 mg/100ml	0.171 mg/100ml	266	ES	Patients, blood donors, and normal individuals, Los Angeles. Serum.	Butt et al., 1964
	0.00-0.44 ppm	Not given	39	X-ray spectrometry	Males, mean age 35.1 yrs. Serum.	Gofman et al., 1964
	Not given	0.07 μ g/ml	Not given	Not given		Rentoul and Smith, 1973
Body, total content	Not given	22.0 mg	168	Not given	Autopsy samples from 58 cities and 29 nonurban areas	Schroeder, 1970
Bone	1.9-17.3 ppm	7.0-8.5 ppm	35	NAA	4 groups: 0-3 months to 13-74 years; increased slightly with age	Snowden and Stitch, 1957
Brain	0.015-0.19 micromoles/g ash	Not given	100	ES		Perry, 1968
	<0.001-0.013 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	0.01 μ g/g dry wt.	Not given	Not given		Rentoul and Smith, 1973
Hair	0.034-9.29 μ g/g; 0.121-29.0 μ g/g	0.762 μ g/g; 1.41 μ g/g	267 (children) 197 (adults)	ES	3 New York City areas; lower figures, children; higher figures, adults	Creason, 1975

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BARIIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair (continued)	Not given	0.60 and 0.46 $\mu\text{g/g}$ dry wt.	2	AAS; MS		Yurachek, 1969
Heart	0.017-0.24 micromoles/g ash	Not given	100	ES		Perry, 1968
	<0.001-0.020 micromoles/g ash	Not given	150	Not given	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	0.08 $\mu\text{g/g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
Kidney	0.018-0.170 micromoles/g ash	Not given	100	ES		Perry, 1968
	<0.001-0.029 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	0.06 $\mu\text{g/g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
Liver	<0.001-0.12 micromoles/g ash	Not given	100	ES		Perry, 1968
	<0.001-0.015 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	0.67 $\pm$ 0.40 $\mu\text{g/g}$ ash	10	ES	5 white and 5 black accident victims, long-term St. Louis residents	Perry et al., 1973
	Not given	0.007 $\mu\text{g/g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
Lung	0.068-0.340 micromoles/g ash	Not given	100	ES		Perry, 1968
	0.029-0.290 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	Min. <20 μg . Max. 1000 μg Retained per year: 47 μg	168	Not given	Autopsy samples from 58 cities and 29 nonurban areas	Schroeder, 1970

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BARIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Placenta	Not given	0.053 ± 0.01 μ g/g wet wt.	58	Not given		Karp and Robertson, 1977
Spleen	0.09-0.18 micromoles/g ash	Not given	100	ES		Perry, 1968
	<0.001-0.024 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
Teeth	Not given	6.8 ± 2.26 ppm; 2.1 ± 0.57 ppm	208	MS	Teeth samples from <20-year-olds, High caries area, New England low caries area, South Carolina. Enamel.	Curzon and Lowee, 1977
	0.8-17.0 μ g/g	5.6 μ g/g	56	MS	<20-year-olds, wide geographic area. Enamel.	Lowee et al., 1973

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BERYLLIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	<0.0004 ppm	Not applicable	1	Fluorometry	Cadaver	Forbes et al., 1954
Blood	Not given	0.001 µg/ml	Not given	Not given	Normal blood level	Rentoul and Smith, 1973
Bone	<0.0004 ppm	Not applicable	1	Fluorometry	Cadaver. Skeletal bone.	Forbes et al., 1954
Brain	Not given	0.002 µg/g dry wt.	Not given	Not given	Normal brain level	Rentoul and Smith, 1973
Gastrointestinal tract	<0.0004 ppm	Not applicable	Not given	Fluorometry	Cadaver	Forbes et al., 1954
Heart	Not given	0.002 µg/g dry wt.	Not given	Not given	Normal heart level	Rentoul and Smith, 1973
	<0.0004 ppm	Not applicable	1	Fluorometry	Cadaver	Forbes et al., 1954
Kidney	Not given	0.002 µg/g dry wt.	Not given	Not given	Normal kidney level	Rentoul and Smith, 1973
	0-0.5 mg/100g tissue	Not given	Not given	ES	Cancer patients and autopsy specimens	Tietz et al., 1957
Liver	0-1.0 mg/100g tissue	Not given	Not given	ES	Cancer patients and autopsy specimens	Tietz et al., 1957
	Not given	0.003 µg/g dry wt.	Not given	Not given	Normal liver level	Rentoul and Smith, 1973
	0.001 ppm	Not applicable	1	Fluorometry	Cadaver	Forbes et al., 1954
	0-0.012 µg/100g	Not given	2	Not given	1 white and 1 black male	Forbes et al., 1954

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BERYLLIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	0-0.023 μ g/100g	Not given	2	Not given	1 white and 1 black male	Forbes et al., 1956
	<0.0004 ppm	Not applicable	1	Fluorometry	Cadaver	Forbes et al., 1954
	0-1.0 mg/100g dry wt.	Not given	Not given	ES	Cancer patients and autopsy specimens	Tietz et al., 1957
	0.1-1.1 μ g/100g tissue	Not given	1	MS		Robinson et al., 1968
Placenta	Not given	0.013 $\pm$ 0.007 μ g/g wet wt.	58	Not given	Hospital patients in South and Southeast	Karp and Robertson, 1977
Teeth	0.01-0.97 μ g/g dry wt.	0.090 μ g/g dry wt.	56	MS	Less than 20-year-old teeth	Loose et al., 1973
Urine	Not given	0.0002 μ g/ml	Not given	Not given	Normal urine level	Renzoul and Smith, 1973

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α-BHC

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	<0.03 ppm	25	GC	Samples from Los Angeles	Hayes et al., 1965
	0.0-0.14 ppm	0.01 ppm	1412	GC-EC	35 U.S. cities	Kutz et al., 1974
Blood	0.0-18.0 ppb	<0.07 ppb	1000	GC-EC	General population in Idaho	Watson et al., 1970
Milk	<1.0-104.4 ppb	56.1 ppb	1436	GC-EC	Not detectable in 1426 of 1436 samples. Fat basis.	Savage, 1976

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B-BHC

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	1.23 $\pm$ 0.95 ppm	221	GC-EC	Texas agricultural areas	Burns, 1974
Adipose	0.1-0.5 ppm	0.2 ppm	25	GC-EC	None	Davis et al., 1971
	0.03-2.43 ppm	0.6 $\pm$ 0.1 ppm	25	GC	None	Hayes et al., 1965
	Not given	5.76 and 3.05 ppm	1092 (1973); 898 (1974)	GC-EC, TLC, and MS	98+ % positive; 75 U.S. sites; blacks and whites	Kutz et al., 1977
	0.0-26.9 ppm	0.60 ppm	1412	GC-EC	32 U.S. cities	Kutz et al., 1974
	0.0-26.9 ppm	0.21-0.37 ppm (geometric means; range)	898-1913	GC-EC	75 U.S. sites; a general population; 1970 through 1974 concentration declined	Kutz et al., 1977
	0.37-2.29 ppm	Not given	332	GC-EC	Autopsies in Florida	Radomski et al., 1968
	1.0-2.5 ppb	0.3 ppb	202	GC-EC	Whites in Idaho	Wyllie et al., 1972
Blood			20	GC	General population; 10 males and 10 females; (a) plasma, males (b) plasma, females (c) rbc, males (d) rbc, females (e) whole blood, males (f) whole blood, females	Dale et al., 1967
	(a) 0.0024-0.0184 ppm (b) 0.0008-0.0057 ppm (c) 0.0012-0.0133 ppm (d) 0.0012-0.0054 ppm (e) 0.0013-0.0208 ppm (f) 0.0003-0.0035 ppm	(a) 0.0065 $\pm$ 0.0015 ppm (b) 0.0025 $\pm$ 0.0005 ppm (c) 0.0047 $\pm$ 0.0012 ppm (d) 0.0026 $\pm$ 0.0003 ppm (e) 0.0060 $\pm$ 0.0018 ppm (f) 0.0022 $\pm$ 0.0004 ppm				
	Not given	0.0042 ppm	10	GC-EC	Females, no occupational exposure	Dale et al., 1966

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β-BHC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	(a) 0.0015-0.0002 ppm (b) 0.0019-0.0042 ppm (c) 0.0005-0.0022 ppm (d) 0.0004-0.0094 ppm	(a) 0.0034 ppm (b) 0.0031 ppm (c) 0.0010 ppm (d) 0.0036 ppm	10	GC-EC	(a) plasma (b) whole blood (c) rbc (d) serum	Dale et al., 1966
	1.0-3.0 ppb	Not given	350 pairs	GC	Blood serum. Mother-infant pairs	D'Ercole et al., 1976
	0.0-8.0 ppb	0.46 ppb	1619	GC	General population in Hawaii	Klemmer et al., 1973
	Not given	1.40 ± 0.46 ppb	28	GC-EC	4 male and 4 female, ages 27-49 years, and 20 autopsies	Radomski et al., 1971
	(a) 0.7-2.0 ppb (b) 1.0-3.2 ppb	(a) 1.4 ± 0.46 ppb (b) Not given	8+	GC	None	Radomski et al., 1971
	Not given	0.7 ± 1.5 ppb	3568	Not given	General population in Hawaii	Rashad et al., 1976
	0.0-15.0 ppb	<0.07 ppb	1000	GC-EC	Blood serum. General population in Idaho.	Watson et al., 1970
	0.0-15.0 ppb	0.3 ppb	202	GC-EC	Blood serum. Whites in Idaho.	Wyllie et al., 1972
	0.0-trace	Not given	332	GC-EC	Autopsies in Florida	Radomski et al., 1968
Liver	0.06 ± 0.10 - 0.12 ± 0.18 ppm	Not given	332	GC-EC	Autopsies in Florida	Radomski et al., 1968
Milk	trace-38.0 ppb	5.6 ppb (fat basis)	40	GC	Females.	Savage et al., 1973
	<1.0-9,216.6 ppb	193.1 ppb (fat basis)	1436	GC-EC	National Study.	Savage, 1976

8-BHC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Milk (continued)	trace-0.01 ppm	0.005 ppm	57	GC-EC and GC/MS	Missouri and Arkansas	Straussman and Kutz, 1977

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γ-BHC (Lindane)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	<0.1-12.3 ppm	0.56 ppm	282	GC	None	Hoffman et al., 1964
	0.0-12.3 ppm	0.48 ppm	994	GC	Autopsies	Hoffman et al., 1967
	0.0-0.18 ppm	0.01 ppm	1412	GC-EC	32 U.S. cities	Kutz et al., 1974
	0.10 ppm (max.)	Not given	1092 (1973); 898 (1974)	GC-EC	75 U.S. cities, whites and blacks; 1.562 (1973) and 0.562 (1974) positive	Kutz et al., 1977
Blood	0.0-23.0 ppb	4.71, 2.79, and 3.60 ppb	86	GC-EC	Blood plasma; values respectively are for males, females, and combined	Burns and Miller, 1975
	(a) <0.0005-0.0132 ppm (b) <0.0003-0.0019 ppm (c) <0.0003-0.0023 ppm (d) 0.0007-0.0019 ppm (e) <0.0005-0.0080 ppm (f) 0.0007-0.0018 ppm	(a) 0.0057 ± 0.0019 ppm (b) 0.0008 ± 0.0002 ppm (c) 0.0008 ± 0.0002 ppm (d) 0.0012 ± 0.0001 ppm (e) 0.0015 ± 0.0008 ppm (f) 0.0014 ± 0.0001 ppm	20	GC	General population; 10 males and 10 females; (a) plasma, males (b) plasma, females (c) rbc, males (d) rbc, females (e) whole blood, males (f) whole blood, females	Hale et al., 1967
	0.0-37.0 ppb	7.2 ppb	28	GC	Blood serum, Texas females	Dyment et al., 1971
	Not given	0.1 and 11.5 ppb	80	Not given	First value - nonexposed controls and second value - exposed occupationally	Milby and Samuel, 1971
	0.1-6.0 ppb	0.39 ppb	53 pairs	GC-EC	General population in Louisiana; Mother-infant pairs	Selby et al., 1969
	0.0-24.0 ppb	<0.07 ppb	1000	GC-EC	General population in Indiana;	Watson et al., 1970

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Lindane (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.2-7.4 ppb	0.48 ppb	53 pairs	GC-EC	General population in Louisiana; Mother-infant pairs; total BHC	Selby et al., 1969
Feces	Trace - 0.12 ug/day/person	Not given	32	GC	None	Price et al., 1972
Milk	0.0-10.2 ppb	1.6 ppb	28	GC	Blood serum. Texas females.	Dymant et al., 1971
	0.03-3.20 mg/kg	0.115 mg/kg fat basis	53	GC	Milk fat, nursing mothers in Pennsylvania	Kroger, 1970
	71.0-247.2 ppb	57.1 ppb fat basis	23	GC-EC	γ -BHC, not detectable in 1413 of 1436 samples	Savage, 1976
	<1.0-1444.4 ppb	77.7 ppb fat basis	663	GC-EC	Total BHC, not detectable in 773 of 1436 samples	Savage, 1976
Placenta	0.1-6.0 ppb	1.19 ppb	53 pairs	GC-EC	General population in Louisiana; Mother-infant pairs	Selby et al., 1969
Urine	Trace - 0.06 ug/day/person	Not given	32	EC	None	Price et al., 1972

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A - BHC

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.0-1.11 ppm	0.01 ppm	1412	GC-EC	32 cities	Kutz et al., 1974

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BISMUTH

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bladder	10 $\mu\text{g/g}$ ash	Not applicable	8	Not given	Males, bismuth found in only one bladder	Koch et al., 1956
Blood	0.00-0.20 ppm	Not given	39	X-ray spectrometry	Males; mean age 35.3 yr. Serum.	Gofman et al., 1964
Blood	Not given	0.01 $\mu\text{g/ml}$	Not given	Not given	Normal blood level. Whole blood.	Rentoul and Smith, 1973
Brain	Not given	0.1 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal brain level	Rentoul and Smith, 1973
Heart	Not given	0.08 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal heart level	Rentoul and Smith, 1973
Kidney	Not given	0.09 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal kidney level	Rentoul and Smith, 1973
Liver	Not given	0.07 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal liver level	Rentoul and Smith, 1973
Lung	<20-2600 μg (total lung)	Not given	168	Not given	Samples from 58 cities and 29 nonurban areas	Schroeder, 1970
Teeth	0.02-0.07 $\mu\text{g/g}$ dry wt.	0.006 $\mu\text{g/g}$ dry wt.	56	MS	Less than 20-year-old teeth	Loose et al., 1973

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MORON

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0-0.21 ppm	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.074 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
Alimentary tract	0.18-0.10 ppm	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
Blood	Not given	0.141 ppm	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
	2.0-38.0 ug/100g	9.85 ug/100g	154	ES	Adult males from various cities and farms	Imbus et al., 1963
	Not given	0.13 ug/ml	Not given	Not given		Rentoul and Smith, 1973
Bone	Not given	0.9 ppm	1	Colorimetry; ES	Autopsy of 46-year-old. Skeletal bone.	Forbes et al., 1954
	0.59-0.89 ppm	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male. Skeletal bone.	Forbes et al., 1956
Brain	Not given	0.6 ug/g dry wt.	Not given	Not given		Rentoul and Smith, 1973
Gastrointestinal tract	Not given	0.078 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
Hair	0.03-22.0 ug/g (children)	0.881 ug/g (children)	267 (children)	ES	3 New York metropolitan community samples	Creason, 1975
	0.037-25.0 ug/g (adults)	0.981 ug/g (adults)	197 (adults)			
	0.0002-0.0008% dry tissue	Not given	18	ES	18 white males, ages 15-70 yrs.	Goldblum et al., 1953

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BORON (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart	Not given	0.044 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
	0.28-0.51 ppm wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.2 ug/g dry wt.	Not given	Not given		Rentoul and Smith, 1973
Kidney	0.17-0.46 ppm wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.248 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
	Not given	0.5 ug/g dry wt.	Not given	Not given		Rentoul and Smith, 1973
Liver	0.03-0.15 ppm wet wt.	Not given	2	Colorimetry	One white (age 60) and one black (age 48) male	Forbes et al., 1956
	Not given	0.114 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
	Not given	0.48 ug/g dry wt.	Not given	Not given		Rentoul and Smith, 1973
Lung	0.12-0.19 ppm wet wt.	Not given	2	Colorimetry	One white (age 60) and one black (age 48) male	Forbes et al., 1956
	Not given	0.067 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
Muscle	Not given	0.071 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old. Striated muscle.	Forbes et al., 1954
	0.17-0.4 ppm wet wt.	Not given	2	Colorimetry	One white (age 60) and one black (age 48) male. Striated muscle.	Forbes et al., 1956

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BORON (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Nail	0.0007-0.0060% dry wt.	Not given	18	ES	18 white males, ages 15-70 yrs.	Goldblum et al., 1953
Nerve	0.0-0.1 ppm wet wt.	Not given	2	Colorimetry	One white (age 60) and one black (age 48) male	Forbes et al., 1956
	Not given	0.106 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
Placenta	Not applicable	0.0	58	Not given	City hospitals in South and Southeast	Karp and Robertson, 1977
Skin	0.34-0.45 ppm wet wt.	Not given	2	Colorimetry	One white (age 60) and one black (age 48) male	Forbes et al., 1956
	Not given	0.119 ppm wet wt.	1	Colorimetry; ES	Autopsy of 46-year-old	Forbes et al., 1954
	0.0017-0.0172% dry wt.	Not given	18	ES	18 white males, ages 15-70 yrs.	Goldblum et al., 1953
Spleen	Not given	0.08 ppm wet wt.	1	Colorimetry	One white (age 60) and one black (age 48) male	Forbes et al., 1956
Teeth	0.5-69.0 µg/g	18.2 µg/g	56	MS	<20 years old, wide geographic area	Louise et al., 1973
Urine	0-6800 µg/liter	715 µg/liter	154	ES	Adult males from various cities and farms	Imbus et al., 1963

BROMINE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	Not given	4.12 ppm	39	X-ray spectrometry	Males, average 35.3 yr. Serum.	Gofman et al., 1964
Hair	0.17 and 1.10 $\mu\text{g/g}$ dry wt.	Not given	2	AAS; MS		Yurachek et al., 1969
Teeth	<0.10-2.90 $\mu\text{g/g}$	1.09 $\mu\text{g/g}$	56	MS	<20 years old; wide geographic area	Losee et al., 1973

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CADMIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	<50-150 $\mu\text{g/g}$ ash	50 $\mu\text{g/g}$ ash (median)	11 of 15	ES	Adults	Tipton and Cook, 1963
Aorta	<0.3-12.3 $\mu\text{g/g}$ dry wt.	0.3-5.5 $\mu\text{g/g}$ dry wt.	46	AAS	Autopsies. Chicago area.	Marko et al., 1972
	<0.4-1.3 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	<50-60 micromoles/g ash	<50 micromoles/g ash (median)	19 of 105	ES	Adults	Tipton and Cook, 1963
Bladder	<50-56 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	34 of 112	ES	Adults. Urinary bladder.	Tipton and Cook, 1963
Blood	Not given	0.091 $\pm$ 0.115 $\mu\text{g/g}$ dry wt.	83	AAS	Nashville, Tennessee hospital patients. Maternal blood.	Baglan et al., 1974
	Not given	0.076 $\pm$ 0.109 $\mu\text{g/g}$ dry wt.	123	AAS	Nashville, Tennessee hospital patients. Fetal blood.	Baglan et al., 1974
	Not given	1.2 $\pm$ 1.1 - 16.4 $\pm$ 6.3 mg/liter	520	AAS	Kansas City, Missouri and Kansas; soft and hard water areas respectively. Serum.	Bierbaum et al., 1975
	0.0-2.8 $\mu\text{g}/100$ ml	0.3 $\mu\text{g}/100$ ml	369	AAS	Newark, N.J. children 1-8 yrs.	Bogden et al., 1974
	Not given	0.209 $\pm$ 0.005 mg/100 ml	47	ES	Normal Los Angeles residents	Bull et al., 1964
	Not given	0.034 $\pm$ 0.002 - 0.048 $\pm$ 0.001 mg/100 ml	266	ES	Los Angeles residents-blood donors, surgical patients, diseased and normal individuals. Serum.	Bull et al., 1964
	0.00-0.23 ppm	Not given	39	X-ray spectrometry	Men, mean age 35.3 yrs. Serum.	Gofman et al., 1964

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.42 ± 0.7 µg/100 ml	Not given	40	AAS	Lumberyard workers in vicinity of fertilizer plant. Plasma.	Hammer et al., 1971
	<0.1-9.6 µg/100 ml	1.71 µg/100 ml	100	ASV	18 to 58-year-old Ann Arbor, Mich. residents	Hecker et al., 1974
	0.3-3.4 µg/100 g	0.70 µg/100 g	154	ES	Adult men	Inhara et al., 1961
	Not given	0.4 ± 0.44 - 0.9 ± 1.1 µg/100 ml	216	AAS		Johnson et al., 1975
	0.50-14.16 µg/100 ml	1.77 µg/100 ml	243	AAS	19 cities	Kubota et al., 1968
	0.22-1.70 µg/100 g	0.66 µg/100 g	60	AAS	Children 2 mo. - 13 yrs. White, middle and upper class.	Smith, 1976
	0.04-1.77 µg/100 ml	0.12 µg/100 ml	355	AAS	250 people live in vicinity of cadmium smelter	Wynowski, 1978
Brain	0.0-0.144 µg/g wet wt.	0.140 µg/g wet wt.	36	AAS	Fetus brain	Chaube et al., 1971
	Not given	Trace, ppm wet wt.	8	ES	Males	Koch et al., 1956
	Not given	2.55 µg/g dry wt.	Not given	Not given	Normal brain level	Rentoul and Smith, 1971
	<50 - <50 µg/g ash	<50 µg/g ash (median)	0 of 129	ES	Not found within detection limits. Adults.	Tipton and Cook, 1961
Diaphragm	<50 - <50 µg/g ash	<50 µg/g ash (median)	6 of 91	ES	Adults	Tipton and Cook, 1961
Esophagus	Not given	Trace	1	ES	Males	Koch et al., 1956

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CADMIUM (continued)

Location	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Esophagus (continued)	<50 - 550 µg/g ash	<50 µg/g ash (median)	4 of 68	ES	Adults	Tipton and Cook, 1963
Feces	Not given	0.19 ± 0.07 - 0.30 ± 0.21 µg/g	216	AAS	Controls included	Johnson et al., 1975
Hair	0.14-6.90 and 0.08-8.73 µg/g	0.58 and 0.76 µg/g	482	AAS	Ranges and means-281 children and 201 adults respectively, 3 New York suburbs	Greenen, 1975
	0.1-9.3 ppm	1.0 and 2.2 ppm	50	AAS	Means represent 25 women and 25 men respectively	Eads and Lambdin, 1973
	0.0-10.5 ppm	0.9-4.5 ppm	168	AAS	Means and range representative of fourth grade boys from 5 U.S. cities	Hammer et al., 1971
	0.6-6.9 µg/g	2.3 µg/g	12	AAS	Males and females, various ages	Hinnens et al., 1974
	Not given	0.0 ± 0.41 - 2.2 ± 2.10 µg/g	216	AAS	Controls included in case studies	Johnson et al., 1975
	Not given	1.98 ± 0.14 ppm ash	220	AAS	Mean only for men, 220 cases include occupational exposed men and maybe women	Oleru, 1975
	30.60-530.47 ppm ash	158.38 ppm ash	50	AAS	Correlation with age studied. Mean age of 54.	Oleru, 1976
	0.8-2.0 ppm	Not given	178	AAS	95 males age 2-88 and 83 females age 14-84	Petering et al., 1973
	Not given	2.76 ± 0.48 and 1.77 ± 0.24 µg/g	129	AAS	82 males (higher value) and 47 females (lower value)	Schroeder and Nason, 1969

CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	1.92 $\pm$ 0.02 $\mu\text{g/g}$	Not applicable	1	AAS		Sorenson et al., 1973
	0.34 and 0.96 $\mu\text{g/g}$ dry wt.	Not applicable	2	AAS and MS		Yurachek et al., 1969
Heart	0.4-1.3 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	3.34 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal heart level	Rentoul and Smith, 1973
Intestine	<50 - <50 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	3 of 140	ES	Adults	Tipton and Cook, 1963
	Not given	0.6 ppm wet wt.	7	ES	Males. Small intestine.	Koch et al., 1956
	<50-85 $\mu\text{g/g}$ ash	50 $\mu\text{g/g}$ ash (median)	38 of 68	ES	Adults. Duodenum.	Tipton and Cook, 1963
	<50-100 $\mu\text{g/g}$ ash	50 $\mu\text{g/g}$ ash (median)	60 of 104	ES	Adults. Jejunum.	Tipton and Cook, 1963
	<50-60 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	21 of 84	ES	Adults. Ileum.	Tipton and Cook, 1963
	<50-50 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	5 of 31	ES	Adults. Cecum.	Tipton and Cook, 1963
	<50-60 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	25 of 109	ES	Adults. Sigmoid colon.	Tipton and Cook, 1963
	<50-50 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	5 of 42	ES	Adults. Rectum.	Tipton and Cook, 1963

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	0.0-0.062 $\mu\text{g/g}$ wet wt.	0.05 $\mu\text{g/g}$ wet wt.	36	AAS	Fetus kidneys	Chaube et al., 1973
	21-4771 ppm ash wt.	1500 ppm ash wt.	120	AAS	Autopsies. 14 cases, 4-6 yr old. 106 cases, 16-19 yr old. Black and white. Cortex.	Hammer et al., 1973
	400-5400 and 690-5300 $\mu\text{g/g}$ ash	1700 and 3000 $\mu\text{g/g}$ ash	24	AAS	Autopsies. Control (12) and emphysema (12) cadavers respectively.	Hirst et al.,
	Not given	25 ppm wet wt.	6	ES	Male accident victims	Koch et al., 1956
	17.5 $\pm$ 311.4 and 4.0-93.2 $\mu\text{g/g}$ dry wt.	Not determined	10	ES	5 normal and 4 diseased patients respectively	Koch et al., 1957
	Not given	26.2 $\pm$ 1.3 $\mu\text{g/g}$ wet wt.	160	AAS	Males. Smokers and nonsmokers.	Lewis et al., 1972
	185-460 ppm dry wt.	Not applicable	1	NAA	4 samples	Lieberman and Kramer, 1970
	0.04-0.29 and 16-305 $\mu\text{g/g}$ dry wt.	0.14 $\pm$ 0.10 and 104 $\pm$ 73 $\mu\text{g/g}$ dry wt.	18	NAA	Autopsies. 6 children and 32 adults respectively. Cortex.	Livingstone, 1971
	795-7550, 995-3785, 899-3802, and 719-9832 $\mu\text{g/g}$ ash	2467, 2527, 2240, and 3624, $\mu\text{g/g}$ ash	80	AAS	Control (traumatic or infectious diseases), chronic hypertensives, cardiac or cerebrovascular disease, and malignant disease, respectively	Morgan, 1969
	Not given	2512 $\pm$ 1427 and 2921 $\pm$ 1252 - 3478 $\pm$ 1639 $\mu\text{g/g}$ ash	104	AAS	Control (35 males and 1 female) and emphysematic and cancerous lung patients (all male), respectively	Morgan et al., 1971

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney (continued)	109-9832 $\mu\text{g/g}$ ash	2539 $\mu\text{g/g}$ ash	100	AAS	Autopsies. 32 blacks, 68 whites 99 men. Whites higher.	Morgan, 1972
	602.56-5350.51 ppm ash	1548.82 ppm ash	30	AAS		Oleru, 1976
	0-4300 $\mu\text{g/g}$ ash	0-2150 $\mu\text{g/g}$ ash	157	ES	St. Louis children and adults. Age correlation.	Perry et al., 1961
	13-45 micromoles/g ash	Not given	150	ES	St. Louis adults	Perry et al., 1962
	Not given	2940 $\pm$ 120 and 4220 $\pm$ 390 $\mu\text{g/g}$ ash	134	ES	Accident victims (117) and hyper- tensives (17), respectively	Perry, 1968
	Not given	1720 $\pm$ 1470 and 2950 $\pm$ 1340 $\mu\text{g/g}$ ash	24	AAS	Control (12 cases) and emphysema- tic (12 cases) patients, respectively	Perry et al., 1972
	Not given	66.4 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal kidney level	Rentoul and Smith, 1973
	Not given	2660 $\pm$ 270 - 4220 $\pm$ 390 ppm ash	187	ES	Adults. Accidental deaths. 10 cities.	Schroeder, 1965
	1500-5100 $\mu\text{g/g}$ ash	2900 $\mu\text{g/g}$ ash	145	ES	Adults	Tipton and Cook, 1963
Larynx	<50 - <50 $\mu\text{g/g}$ ash	<50 $\mu\text{g/g}$ ash (median)	1 of 50	ES	Adults	Tipton and Cook, 1963
Liver	0.0-0.133 $\mu\text{g/g}$ wet wt.	0.114 $\mu\text{g/g}$ wet wt.	36	AAS	Fetus livers	Chaube et al., 1973
	8-1720 ppm ash wt.	180 ppm ash wt.	120	AAS	Autopsies. 14 cases, 4-6 yr old. 106 cases, 16-91 yr old. Black and white.	Hammer et al., 1973

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver (continued)	14-150 and 19-530 $\mu\text{g/g}$ ash	63-230 $\mu\text{g/g}$ ash	24	AAS	Control (12 cases) and emphysematic (12 cases), respectively	Hirat et al., 1973
	Not given	4 ppm wet wt.	5	ES	Males. Accident victims.	Koch et al., 1956
	4.1-32.6 and 1.9-6.7 $\mu\text{g/g}$ dry wt.	15.1 $\mu\text{g/g}$ dry wt.	8	ES	Mean - normal patients. Range - normal and diseased patients, respectively. 5 normals, 3 diseased.	Koch et al., 1957
	Not given	1.81 $\pm$ 0.09 $\mu\text{g/g}$ wet wt.	161	AAS	Males	Lewis et al., 1972
	51-440, 66-489, 69-397, and 28-3293 $\mu\text{g/g}$ ash	171, 204, 182, and 304 $\mu\text{g/g}$ ash	80	AAS	Control (traumatic or infectious diseases), chronic hypertensives, cardiac or cerebrovascular disease patients, and malignant disease patients, respectively	Morgan, 1969
	Not given	170 $\pm$ 95 and 249 $\pm$ 142 - 290 $\pm$ 155 $\mu\text{g/g}$ ash	104	AAS	Control (35 males and 1 female) and emphysematic and cancerous lung patients (all males), respectively	Morgan et al., 1971
	31.20-414.95 ppm	104.83 ppm	50	AAS		Oleru, 1976
	0-2000 $\mu\text{g/g}$ ash	0-335 $\mu\text{g/g}$ ash	157	ES	St. Louis children and adults. Age correlations.	Perry et al., 1961
	<0.4-6.7 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	0.53-3.0 micromoles/g ash	Not given	150	ES	St. Louis adults	Perry et al., 1972

CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver (continued)	Not given	61.4 $\pm$ 37.3 and 228 $\pm$ 188 μ g/g ash	24	AAS	Control (12 cases) and emphysematic (12 cases) individuals, respectively	Perry et al., 1972
	Not given	310 $\pm$ 140 μ g/g ash	10	ES	St. Louis males, 5 black and 5 white	Perry et al., 1973
	Not given	6.38 μ g/g dry wt.	Not given	Not given	Normal liver level	Rantoul and Smith, 1973
	0-2 mg/100 g dry wt.	Not given	Not given	ES	Cancer patients and autopsy specimens.	Tietz et al., 1957
	60-340 μ g/g ash	180 μ g/g ash (median)	146 of 150	ES	Adults	Tipton and Cook, 1963
	71-1720 and 21-1000 ppm ash	288 and 139 ppm ash	90	AAS	Heart disease (28 cases) and other individuals, respectively, over 30 yr	Voors and Shuman, 1977
Lung	2.2-48 and 20-230 μ g/g ash	19 and 83 μ g/g ash	24	AAS	Control (12 cases) and emphysematic (12 cases), respectively	Hirst et al., 1973
	Not given	2 ppm wet wt.	3	ES	Males. Accident victims.	Koch et al., 1956
	Not given	0.41 $\pm$ 0.03 μ g/g wet wt.	153	AAS	Males. Smokers and nonsmokers.	Lewis et al., 1972
	3.5-4.9 ppm dry wt.	Not given	1	NAA	3 samples	Lieberman and Kramer, 1970
	10.80-143.45 ppm ash wt.	38.93 ppm ash wt.	50	AAS		Oleru, 1976
	<0.4-0.89 micromoles/g ash	Not given	150	ES	St. Louis adults	Perry et al., 1962

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung (continued)	0.4-1.3 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	19.6 $\pm$ 13.4 and 81.5 $\pm$ 58.3	24	AAS	Normal men (12) and emphysematic men (12), respectively	Perry et al., 1972
	5.9-16.1 and 3.3 and 4.8 ug/g dry wt.	9.4 ug/g dry wt.	5	ES	Mean - 3 normal subjects; Range - normal subjects and 2 diseased patients, respectively	Koch et al., 1957
	58-930 ug/g	Not given	168	Not given	Autopsies. 58 cities, 29 rural areas	Schroeder, 1970
	0-1.0 ug/100 g dry wt.	Not given	Not given	ES	Cancer patients and autopsy specimens	Tietz et al., 1955
	<50-100 ug/g ash	<50 ug/g ash (median)	71 of 141	ES	Adults	Tipton and Cook, 1963
Milk	0.0088-0.1335 ppm	0.0111 ppm	14	AAS	12 wk breast feeding average	Pinkerton et al., 1972
Muscle	Not given	0.2 ppm wet wt.	6	ES	Males	Koch et al., 1956
	0.27-1.00 ppm dry wt.	Not given	1	NAA	5 samples	Lieberman and Kramer, 1970
	<50 - <50 ug/g ash	<50 ug/g ash (median)	3 of 137	ES	Adults	Tipton and Cook, 1963
Myocardium	<0.2-4.0 ug/g dry wt.	0.4-1.9 ug/g dry wt.	26	AAS	Autopsies. Chicago area.	Marks et al., 1972
Ovary	<50-78 ug/g ash	<50 ug/g ash (median)	5 of 16	ES	Adults	Tipton and Cook, 1963

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Omentum	<50-100 µg/g ash	<50 µg/g (median)	31 of 74	ES	Adults	Tipton and Cook, 1963
Pancreas	<50-200 µg/g ash	80 µg/g ash (median)	120 of 139	ES	Adults	Tipton and Cook, 1963
	Not given	2 ppm wet wt.	2	ES	Males	Koch et al., 1956
Placenta	Not given	$0.27 \pm 0.10 - 0.63 \pm 0.15$ micromoles/g tissue wt.	554	AAS	12 month study	Dawson et al., 1968
	Not given	0.48 ± 0.43 micromoles/g dry wt.	554	AAS	Houston women. Normal births.	Dawson, 1969
	Not given	0.037 ± 0.003 µg/g wet wt.	58	Not given	South and southeast city hospitals	Karp and Robertson, 1977
Prostate	Not given	0.2 ppm wet wt.	4	ES	Males	Koch et al., 1956
	<50-95 µg/g ash	<50 µg/g ash (median)	20 of 50	ES	Adults	Tipton and Cook, 1963
Skin	<50 - <50 µg/g ash	<50 µg/g ash (median)	0 of 22	ES	Adults	Tipton and Cook, 1963
Spleen	Not given	0.3 ppm wet wt.	3	ES	Males	Koch et al., 1956
	0.1-3.8 µg/g dry wt.	0.6-1.8 µg/g dry wt.	26	AAS	Autopsies. Chicago area.	Marks et al., 1972
	<0.4-0.46 micromoles/g ash	Not given	150	ES	St. Louis adults	Perry et al., 1962
	<0.4-1.1 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	N.D.-2.2 µg/g dry wt.	0.7 µg/g dry wt.	3	ES	Normal individuals	Roch et al., 1957

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen	<50-50 µg/g ash	<50 µg/g ash (median)	18 of 143	ES	Adults	Tipton and Cook, 1963
Stomach	Not given	0.4 ppm wet wt.	4	ES	Males	Koch et al., 1956
	<50-80 µg/g ash	<50 µg/g ash (median)	49 of 131	ES	Adults	Tipton and Cook, 1963
Teeth	0.03-6.70 µg/g dry wt.	0.99 ± 0.15 µg/g dry wt.	56	MS	Less than 20-yr-old teeth. Enamel.	Loose et al., 1973
Testis	Not given	0.4 ppm wet wt.	1	MS	Males	Koch et al., 1956
	<50-50 µg/g ash	<50 µg/g ash (median)	11 of 72	MS	Adults	Tipton and Cook, 1963
Thyroid	Not given	0.8 ppm wet wt.	2	MS	Males	Koch et al., 1956
	<50-190 µg/g ash	50 µg/g ash (median)	14 of 21	MS	Adults	Tipton and Cook, 1963
Trachea	<50-50 µg/g ash	<50 µg/g ash (median)	7 of 60	MS	Adults	Tipton and Cook, 1963
Urine	Not given	1.04 µg/liter	40	AAS	Lumberyard workers near fertilizer plant	Hammer et al., 1971
	0.4-3.0 µg/liter	1.15 µg/liter	154	ES	Adult men	Inbus et al., 1973
	Not given	0.5 ± 0.23 - 1.4 ± 1.05 µg/liter	216	AAS	6 groups, 36 each	Johnson et al., 1975

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CADMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	<7-22 µg/liter	<12.7 and <13.0 µg/liter	32	ES	Black and white men, black and white females; range - 24 normal individuals; mean - 24 normals and 8 cholesterolemic patients, respectively	Perry and Perry, 1959
	Not given	0.77, 40, and 6 ppb	38	ES	Normal (15 cases) hypertensive (15), and treated hypertensives (8), respectively	Perry, 1968
	<0.04-0.81 <0.04-1.11, and <0.04-0.94 µg/100 ml	0.14, 0.34, and 0.21 µg/100 ml	43	AAS	1 km, 1-2 km and 13 km distance from cadmium smelter, respectively	Wysowski, 1978
Uterus	<50-50 µg/g ash	<50 µg/g ash (median)	5 of 32	ES	Adults	Tipton and Cook, 1963
Vena cava	Not given	Trace	1	ES	Male	Koch et al., 1956

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CERIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.55 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gufman et al., 1964
Teeth	0.02-0.19 $\mu\text{g/g}$ dry weight	0.070 $\mu\text{g/g}$ dry weight	56	MS	<20-year-olds: wide geographic area. Enamel.	Lowe et al., 1973

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CESIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.52 ppm	Not given	39	X-ray spectrometry	Healthy males; mean age 35.3 yr. Serum.	Gofman et al., 1964
Teeth	0.02-0.10 ug/g dry wt.	0.04 ug/g dry wt.	56	MS	20-year-olds, wide geographic area. Enamel	Lopez et al., 1973

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CHROMIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	2.0-16.0 $\mu\text{g/g}$ ash	9.4 $\mu\text{g/g}$ (median)	13	ES		Tipton and Cook, 1963
Aorta	0.002-0.190 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	0.0-19.5 $\mu\text{g/g}$ ash	Not given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	<0.1-10.0 $\mu\text{g/g}$ ash	2.0 $\mu\text{g/g}$ ash (median)	90 of 103	ES		Tipton and Cook, 1963
Bladder	Not given	0.2 ppm wet wt.	2	ES	Organs from sudden accident victims (normal)	Koch et al., 1956
	0.4-13.0 $\mu\text{g/g}$ ash	3.4 $\mu\text{g/g}$ ash (median)	103 of 110	ES		Tipton and Cook, 1963
Blood	Not given	0.012-0.002 mg/liter; 0.043-0.007 mg/liter	520	AAS	One-half samples in soft-water area; one-half in hard water area. Blood serum.	Bierenbaum et al., 1975
	3.48-9.67 ng/g	Not given	5	GC		Black and Sievers, 1976
	Not given	0.0015-0.013 ^a mg/100 ml	116	ES	Patients, blood donors, and normal individuals, Los Angeles	Mutt et al., 1964
	0.00-0.04 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Blood serum.	Gofman et al., 1964
	1.0-6.0 $\mu\text{g/g}$	2.65 $\mu\text{g/g}$	154	ES	Adult males from cities and farms	Imbus et al., 1956
	0.7-5.2 $\mu\text{g}/100\text{ ml}$	2.2 $\mu\text{g}/100\text{ ml}$	17	ES	Sudden accident victims (normal)	Koch et al., 1956
	0.5-5.0 $\mu\text{g}/\text{liter}$	Not given	Not given	Not given		Mertz et al., 1974

CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	Not Given	0.28 ppm wet wt.	1	ES	Sudden accident victims (normal)	Koch et al., 1956
	0.002-0.038 micromoles/g ash	Not Given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	<0.1-2.0 µg/g ash	0.2 µg/g ash	84 of 128	ES ¹		Tipton and Cook, 1963
Diaphragm	0.4-6.4 µg/g ash	2.3 µg/g ash (median)	90 of 91	ES		Tipton and Cook, 1963
Esophagus	0.8-11.0 µg/g ash	3.0 µg/g ash (median)	63 of 66	ES		Tipton and Cook, 1963
Hair	0.06-5.30 µg/g	0.56 and 0.62 µg/g	261 children; 192 adults	ES	Three NY metropolitan community samples; low value-children and high value-adults	Cresson, 1975
	Not Given	1,061, 350, and 331 ppb	101	ES	Values for, respectively, newborn, 1-year-olds, and 1-40 year-olds	Hamridge and Barum, 1972
	0.20-2.81 and 0.04-1.14 µg/g	0.75 and 0.22 µg/g	21	AAS	Values from age 20-40 years	Hamridge and Rogerson, 1969
	52-692 ppb	Not Given	47	ES	Normal children and young adults ages 4-32 years	Hamridge et al., 1972
	0.530-0.138 ppm	Not Given	10	NAA		Obornik et al., 1972
	Not Given	0.70-0.06 and 0.96-0.05 µg/g	1-1	AAS	Low value for males and high value for females aged 10 mos. to 102 yrs.; none dyed or bleached	Schroeder and Mason, 1969

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CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	0.65 and 5.9 $\mu\text{g/g}$ dry wt.	Not given	2	MS		Yurachek, 1969
Heart	0.002-0.160 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	0.0-82.4 $\mu\text{g/g}$ ash	Not given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	<0.1-8.2 $\mu\text{g/g}$ ash	1.5 $\mu\text{g/g}$ ash (median)	125 of 140	ES		Tipton and Cook, 1963
Intestine	Not given	0.5 ppm wet wt.	1	ES	Sudden accident victims (normal). Large intestine.	Koch et al., 1956
	Not given	1.2 ppm wet wt.	7	ES	Sudden accident victims (normal).	Koch et al., 1956
	0.4-6.4 $\mu\text{g/g}$ ash	2.3 $\mu\text{g/g}$ ash (median)	63 of 67	ES	Duodenum	Tipton and Cook, 1963
	<0.1-6.4 $\mu\text{g/g}$ ash	1.7 $\mu\text{g/g}$ ash (median)	88 of 101	ES	Jejunum	Tipton and Cook, 1963
	0.5-12.0 $\mu\text{g/g}$ ash	4.0 $\mu\text{g/g}$ ash (median)	80 of 84	ES	Ileum	Tipton and Cook, 1963
	1.7-20.0 $\mu\text{g/g}$ ash	6.2 $\mu\text{g/g}$ ash (median)	31	ES	Cecum	Tipton and Cook, 1963
	0.5-16.0 $\mu\text{g/g}$ ash	3.9 $\mu\text{g/g}$ ash (median)	101 of 108	ES	Sigmoid colon	Tipton and Cook, 1963
	1.1-13.0 $\mu\text{g/g}$ ash	4.1 $\mu\text{g/g}$ ash (median)	42	ES	Rectum	Tipton and Cook, 1963

CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	0.0-2.9 $\mu\text{g/g}$ dry wt.	1.2 $\mu\text{g/g}$ dry wt.	5	ES		Koch et al., 1957
	Not given	0.16 ppm wet wt.	5	ES	Sudden accident victims (normal)	Koch et al., 1956
	0.002-0.087 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	2.0-57.5 $\mu\text{g/g}$ ash	Not given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	0.0-1.0+ mg/100g dry wt.	Not given	Not given	ES		Tietz et al., 1957
	<0.1-4.5 $\mu\text{g/g}$ ash	1.0 $\mu\text{g/g}$ ash (median)	117 of 142	ES		Tipton and Cook, 1963
Larynx	<0.1-6.0 $\mu\text{g/g}$ ash	0.1 $\mu\text{g/g}$ ash (median)	27 of 49	ES		Tipton and Cook, 1963
Liver	0.0-11.3 $\mu\text{g/g}$ dry wt.	3.3 $\mu\text{g/g}$ dry wt.	4	ES		Koch et al., 1957
	Not given	1.5 ppm dry wt.	4	ES	Sudden accident victims (normal)	Koch et al., 1956
	Not given	16.0, 14.6, 9.5, and 9.2 $\mu\text{g/g}$ ash	104 males	AAS	Values for, respectively, normal, emphysema, emphysema/cancer and cancer patients	Morgan, 1972
	0.002-0.071 micromoles/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962

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CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver (continued)	Not Given	1.38-1.24 ug/g ash	10	ES	5 white and 5 black male accident victims; long-term residents of St. Louis	Perry et al., 1975
	1.1-17.9 ug/g ash	Not Given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	0.0-1.0+ mg/g dry wt.	Not Given	Not Given	ES		Tiers et al., 1957
	<0.1-3.7 ug/g ash	0.7 ug/g ash (median)	115 of 146	ES		Tipton and Cook, 1963
Lung	1.8-9.6 ug/g dry wt.	3.7 ug/g dry wt.	3	ES		Koch et al., 1957
	Not Given	0.6 ppm wet wt.	3	ES	Sudden accident victims (normal)	Koch et al., 1956
	0.63-0.95 micromole/g ash	Not Given	130	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not Given	Min.-3.0 ug Max.-2000 ug Retained per year - 4.0 ug	168	Not Given	Autopsy samples from 58 cities and 29 nonurban areas	Schroeder, 1970
	1.1-85.2 ug/g ash	Not Given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	0.0-1.0+ mg/100g dry wt.	Not Given	Not Given	ES		Tiers et al., 1957
	3.4-50.0 ug/g ash	13.0 ug/g ash (median)	139	ES		Tipton and Cook, 1963

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CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle	Not Given	0.1 ppm wet wt.	7	ES	Sudden accident victims (normal)	Koch et al., 1956
	<0.1-5.0 µg/g ash	1.0 µg/g ash (median)	120 of 136	ES		Tipton and Cook, 1963
Ovary	0.7-150.0 µg/g ash	2.2 µg/g ash (median)	16	ES		Tipton and Cook, 1963
Omentum	2.3-32.0 µg/g ash	12.0 µg/g ash (median)	75	ES		Tipton and Cook, 1963
Pancreas	Not Given	0.3 ppm wet wt.	3	ES	Sudden accident victims (normal)	Koch et al., 1956
	0.9-6.5 µg/g ash	Not Given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	<0.1-6.8 µg/g ash	1.6 µg/g ash (median)	122 of 139	ES		Tipton and Cook, 1963
Placenta	Not Given	0.145±0.090 µg/g wet wt.	58	Not Given		Karp and Robertson, 1977
Prostate	Not Given	0.2 ppm wet wt.	4	ES	Sudden accident victims (normal)	Koch et al., 1956
	<0.1-6.0 µg/g ash	0.9 µg/g ash (median)	41 of 50	ES		Tipton and Cook, 1963
Spleen	Not Given	1.4 µg/g dry wt.	2	ES		Koch et al., 1957
	Not Given	0.3 ppm wet wt.	2	ES	Sudden accident victims (normal)	Koch et al., 1956

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CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen (continued)	0.002-0.062 micromole/g ash	Not Given	150	ES	Adults who died unexpectedly, St. Louis	Ferry et al., 1962
	0.3-27.0 µg/g ash	Not Given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	<0.1-3.2 µg/g ash	0.5 µg/g ash (median)	113 of 143	ES		Tipton and Cook, 1963
Stomach	Not Given	0.35 ppm wet wt.	3	ES	Sudden accident victims (normal)	Koch et al., 1956
	0.1-6.6 µg/g ash	2.0 µg/g ash (median)	22	ES		Tipton and Cook, 1963
Teeth	<1.0-31.0 µg/g	2.30±0.69 µg/g	56	MS	<20-year-olds, wide geographic area	Losee et al., 1973
Testis	Not Given	0.2 ppm wet wt.	1	ES	Sudden accident victims (normal)	Koch et al., 1956
	1.0-3.6 µg/g ash	Not Given	150	Colorimetry	High levels in children, especially infants	Schroeder et al., 1962
	0.1-6.3 µg/g ash	1.6 µg/g ash (median)	66 of 72	ES		Tipton and Cook, 1963
Thyroid	Not Given	1.3 ppm wet wt.	2	ES	Sudden accident victims	Koch et al., 1956
	<0.1-5.0 µg/g ash	1.5 µg/g ash (median)	18 of 21	ES		Tipton and Cook, 1963
Trachea	<0.1-8.8 µg/g ash	1.6 µg/g ash (median)	53 of 60	ES		Tipton and Cook, 1963

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CHROMIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	Not Given	0.026 ug/liter	Not Given	NAA		Gills et al., 1974
	1.5-11.5 ug/liter	3.77 ug/liter	154	ES	Adult men from various cities and farms	Imbus et al., 1963
	Not Given	1.0 and 2.3-3.0 ppb	38	ES	Low value for normals and high values for hypertensive patients	Perry, 1968
Uterus	<0.1-10.0 ug/g ash	1.6 ug/g ash (median)	28 of 32	ES		Tipton and Cook, 1963

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COBALT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.010-0.012 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male	Verbes et al., 1956
	Not given	0.008 ppm	1	Colorimetry	46-year-old cadaver	Verbes et al., 1954
	Not given	1.24 ug/g wet wt.	1	ES		Schroeder et al., 1967
Adrenal	Not given	0.1 ppm wet wt.	1	NAA	Accident victims, age $\leq$ 36 yrs.	Koch et al., 1956
	<2-11 ug/g ash	<2 ug/g ash (median)	6 of 14	ES		Tipton et al., 1963
Alimentary tract	0.017-0.025 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male	Verbes et al., 1956
Aorta	Not given	0.40 ug/g wet wt.	1	ES	Autopsies	Schroeder et al., 1967
	<2-6 ug/g ash	<2 ug/g ash (median)	21 of 104	ES		Tipton et al., 1963
Bladder	Not given	0.04 ppm wet wt.	1	NAA	Sudden accident victims, age $\leq$ 36 yrs.	Koch et al., 1956
	Not given	<0.06 ug/g wet wt.	1	ES	Autopsy	Schroeder et al., 1967
	<2-2 ug/g ash	<2 ug/g ash (median)	12 of 110	ES		Tipton et al., 1963
Blood	Not given	0.00 $\pm$ 0.00 mg/liter 0.146 $\pm$ 0.026 mg/liter	520	AAS	Adults; half in hard-water area; half in soft-water area. Low figures, Kansas; high figures, Missouri. Serum.	Stierenbaum et al., 1975

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	0.0061-0.0063 mg/100 ml	Not given	48	ES	Los Angeles area. Serum.	Hutt et al., 1964
	Not given	0.0238 mg/ml	48	ES	Los Angeles area. Whole blood.	Hutt et al., 1964
	0.00-0.05 ppm	Not given	39	X-ray spectrometry	Males; mean age 35.3 yrs.	Gofman et al., 1964
Bone	0.026-0.031 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male. Skeleton	Forbes et al., 1956
	Not given	0.038 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
	11.0-22.9 ug/g dry wt.	16.9 $\pm$ 6.01 ug/g dry wt.	121	AAS	40 normal; 81 osteogenic sarcomas	Jones et al., 1972
Brain	Not given	0.02 ppm wet wt.	1	NAA	Sudden accident victim.	Koch et al., 1954
	Not given	0.02 ppm wet wt.	1	NAA	Sudden accident victim.	Koch et al., 1956
	0.05-0.37 ug/g wet wt.	Not given	2	ES	Autopsies	Schroeder et al., 1967
	<2-<2 ug/g ash	<2 ug/g ash (median)	2 of 129	ES		Tipton et al., 1963
	Not given	0.14 ug/g wet wt.	1	ES	Autopsy	Schroeder et al., 1967
Diaphragm	<2-<2 ug/g ash	<2 ug/g ash (median)	5 of 91	ES		Tipton et al., 1963

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Esophagus	Not given	0.025 ppm wet wt.	2	NAA	Sudden accident victims	Koch et al., 1956
	<2-<2 ug/g ash	<2 ug/g ash (median)	5 of 67	ES		Tipton et al., 1963
Gastrointes- tinal tract	Not given	0.008 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
Hair	Not given	0.084 $\pm$ 0.009 ppm	10	NAA		Ohruanik et al., 1972
	Not given	0.17 $\pm$ 0.02 ug/g; 0.28 $\pm$ 0.04 ug/g	126; 55	AAS	Males; females; age 10 months to 102 years. Scalp hair.	Schroeder et al., 1969
	0.24-0.34 ug/g dry wt.	Not given	2	MS; AAS		Yurachek et al., 1969
Heart	0.033-0.035 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male.	Forbes et al., 1956
	Not given	0.032 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
	0.16-0.23 ug/g wet wt.	Not given	2	ES	Autopsies	Schroeder et al., 1967
	<2-5 ug/g ash	<2 ug/g ash (median)	39 of 140	ES		Tipton et al., 1963
Intestines	Not given	0.05 ppm wet wt.	5	NAA	Sudden accident victims.	Koch et al., 1956
	Not given	0.08 ug/g wet wt.	1	ES	Autopsy. Ileum.	Schroeder et al., 1967

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestines (continued)	0.04-0.17 ug/g wet wt.	Not given	2	ES	Autopsies. Jejunum.	Schroeder et al., 1967
	Not given	0.01 ug/g wet wt.	1	ES	Autopsy. Sigmoid colon.	Schroeder et al., 1967
	<2-8 ug/g ash	<2 ug/g ash (median)	10 of 31	ES	Cecum.	Tipton et al., 1963
	<2-10 ug/g ash	<2 ug/g ash (median)	18 of 83	ES	Ileum.	Tipton et al., 1963
	<2-<2 ug/g ash	<2 ug/g ash (median)	6 of 67	ES	Duodenum.	Tipton et al., 1963
	<2-<2 ug/g ash	<2 ug/g ash (median)	7 of 102	ES	Jejunum.	Tipton et al., 1963
	<2-11 ug/g ash	<2 ug/g ash (median)	21 of 108	ES	Sigmoid colon.	Tipton et al., 1963
	<2-11 ug/g ash	<2 ug/g ash (median)	10 of 42	ES	Rectum.	Tipton et al., 1963
Kidney	0.032-0.037 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.64 ppm wet wt.	2	NAA	Sudden accident victims.	Koch et al., 1956
	0.05-0.11 ug/g wet wt.	Not given	3	ES	Autopsies.	Schroeder et al., 1967
	<2-2 ug/g ash	<2 ug/g ash (median)	21 of 144	ES		Tipton et al., 1963

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Larynx	<2-<2 ug/g ash	<2 ug/g ash (median)	3 of 50	ES		Tipton et al., 1963
Liver	0.064-0.126 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.056 ppm	1	Colorimetry	46-year-old cadaver.	Forbes et al., 1954
	Not given	0.25 ppm wet wt.	2	NAA	Sudden accident victims.	Koch et al., 1956
	Not given	8.58 $\pm$ 5.55 ug/g ash	10	ES	5 white and 5 black males; accident victims.	Perry et al., 1973
	0.12-0.28 ug/g wet wt.	Not given	2	ES	Autopsies	Schroeder et al., 1967
	<2-10 ug/g ash	<2 ug/g ash (median)	63 of 149	ES		Tipton et al., 1963
Lung	0.028-0.039 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.018 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
	<20-1400 ug/g	Not given	169	Not given	Autopsies; 58 cities and 29 nonurban areas	Schroeder 1970
	0.06-7.13 ug/g wet wt.	Not given	2	ES	Autopsies.	Schroeder et al., 1967
	<2-9 ug/g ash	<2 ug/g ash (median)	26 of 141	ES		Tipton et al., 1963

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle	0.006-0.008 ppm	Not given	2	Chem.	1 white (age 60) and 1 black (age 48) male. Striated muscle.	Forbes et al., 1956
	Not given	0.006 ppm	1	Colorimetry	46-year-old cadaver. Striated muscle.	Forbes et al., 1954
	Not given	0.05 ppm wet wt.	4	NAA	Sudden accident victims.	Koch et al., 1956
	<2-<2 µg/g ash	<2 µg/g ash (median)	6 of 136	ES		Tipton et al., 1963
Nerve	Not given	0.015 ppm	2	Chem.	1 white (age 60) and 1 black (age 48) male.	Forbes et al., 1956
	Not given	0.011 ppm	1	Colorimetry	46-year-old cadaver.	Forbes et al., 1954
Ovary	<2-<2 µg/g ash	<2 µg/g ash (median)	0 of 16	ES		Tipton et al., 1963
Omentum	<2-12 µg/g ash	<2 µg/g ash (median)	26 of 75	ES		Tipton et al., 1963
Pancreas	0.07-0.12 µg/g wet wt.	Not given	2	ES	Autopsies.	Schroeder et al., 1967
	<2-<2 µg/g ash	<2 µg/g ash (median)	13 of 139	ES		Tipton et al., 1963
Placenta	Not given	Not given	858	NAA	Subjects from 4 large hospitals, Nashville, Tenn.	Baglan et al., 1974
	Not given	Not given	58	Not given	City hospitals in South and Southeast.	Karp and Robertson, 1977

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Prostate	Not given	0.11 ug/g wet wt.	1	ES	Autopsy	Schroeder et al., 1967
	<2-<2 ug/g ash	<2 ug/g ash (median)	3 of 50	ES		Tipton et al., 1963
Pancreas	0.05-0.22 ug/g wet wt.	Not given	2	ES	Autopsies.	Schroeder et al., 1967
Skin	0.016-0.023 ppm	Not given	2	Chem.	1 white male (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	0.050 ppm	1	Colorimetry	46-year-old cadaver.	Forbes et al., 1954
	<2-11 ug/g ash	<2 ug/g ash (median)	5 of 22	ES		Tipton et al., 1963
Spleen	Not given	0.025 ppm wet wt.	1	MAA	Sudden accident victims.	Koch et al., 1956
	0.06-0.30 ug/g wet wt.	Not given	2	ES	Autopsies.	Schroeder et al., 1967
	<2-<2 ug/g ash	<2 ug/g ash (median)	8 of 143	ES		Tipton et al., 1963
Stomach	0.04-0.22 ug/g wet wt.	Not given	2	ES	Autopsies.	Schroeder et al., 1967
	<2-2 ug/g ash	<2 ug/g ash (median)	15 of 131	ES		Tipton et al., 1963
Teeth	0.01-0.26 ug/g dry wt.	0.006 ug/g dry wt.	56	MS	Wide geographic area.	Lowee et al., 1973

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COBALT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Testis	0.14-0.15 $\mu\text{g/g}$ wet wt.	Not given	2	ES	Autopsies.	Schrueder et al., 1967
	<2-<2 $\mu\text{g/g}$ ash	<2 $\mu\text{g/g}$ ash (median)	6 of 72	ES		Tipton et al., 1963
Thyroid	<1-3 $\mu\text{g/g}$ ash	<2 $\mu\text{g/g}$ ash (median)	3 of 21	ES		Tipton et al., 1963
Trachea	<2-4 $\mu\text{g/g}$ ash	<2 $\mu\text{g/g}$ ash (median)	13 of 60	ES		Tipton et al., 1963
Uterus	<2-<2 $\mu\text{g/g}$ ash	<2 $\mu\text{g/g}$ ash (median)	3 of 32	ES		Tipton et al., 1963
Vena cava	Not given	0.025 ppm wet wt.	1	NAA	Sudden accident victims.	Koch et al., 1956

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COPPER

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	Not given	2.6 ppm wet wt.	2	Colorimetry	Accident victims	Koch et al., 1956
	0.4-7.9 mg/g dry wt.	4.2 mg/g dry wt.	2	Colorimetry		Koch et al., 1957
	160-250 μ g/g ash	200 μ g/g ash (median)	12	ES		Tipton and Cook, 1963
Aorta	Not given	3.5 ppm wet wt.	1	Colorimetry	Accident victims	Koch et al., 1956
	1.9-12.0 micromoles/g ash	Not given	100	ES	None	Perry, 1968
	0.79-2.20 micromoles/g ash	Not given	150	ES	None	Perry et al., 1962
	50-140 μ g/g ash	90 μ g/g ash (median)	103	ES	None	Tipton and Cook, 1963
Bladder	Not given	1.0 ppm wet wt.	2	Colorimetry	Accident victims	Koch et al., 1956
	76-180 μ g/g ash	110 μ g/g ash (median)	110	ES	None	Tipton and Cook, 1963
Bone	5.0-7.3 μ g/g dry wt.	6.6 $\pm$ 1.74 μ g/g dry wt.	40	AAS	None	Janew et al., 1972
	Not given	0.410 and 1.190 mg/100 g wet wt.	Not given	ES	Low value -- rib bone; high value -- long bone	Kehoe et al., 1940
	Not given	0.4 ppm wet wt.	1	Colorimetry	Sudden accident victims	Koch et al., 1956
	4.5 mg/g dry wt.	Not given	1	Colorimetry	None	Koch et al., 1957

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	Not given	144.60 $\pm$ 3.95 μ g/100 ml; 172.1 $\pm$ 4.76 μ g/100 ml	520	AAS	One-half sample from soft water area (Kansas City, MO) and other half from water area (Kansas City, KA, low value). Blood serum.	Bierenbaum et al., 1975
	0.0711-0.110 mg/100 ml	0.0711 and 0.102 mg/100 ml	266	ES	Patients, blood donors, and normal individuals, Los Angeles area. Low value -- serum; high value -- whole blood	Butt et al., 1964
	Not given	1.29 $\pm$ 0.13 ppm	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Blood serum.	Gofman et al., 1964
	Not given	91.6 $\pm$ 2.6 μ g/100 ml; 107.4 $\pm$ 5.1 μ g/100 ml	Not given	ES	Low value -- males; high value -- females	Hambridge and Droegemueller, 1974
	31-281 μ g/100 ml	100 μ g/100 ml	100	ASV	None	Hecker et al., 1974
	82-147 μ g/100 ml	107 μ g/100 ml	164	AAS	119 males and 45 females	Henkin, 1971
	950-1280 μ g/liter; 950-1420 μ g/liter	1120 μ g/liter; 1170 μ g/liter	48	AAS	Low values -- male; high values -- female	Hohnadel et al., 1973
	Not given	0.114 mg/100 g	Not given	ES	None	Kehoe et al., 1940
	Not given	98 μ g/100 ml	58	Colorimetry	Accident victims	Koch et al., 1956
	16-348 mg/ml	89 mg/ml	243	AAS	Males	Kubota et al., 1968
	Not given	6.40 μ g/ml; 139 μ g/100 ml	17	AAS	First value -- liver blood; second value -- heart blood	Owen et al., 1977

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given	1.2 μ g/ml	Not given	Not given		Rentoul and Smith, 1973
	91-128 μ g/ml	111 μ g/ml	6	AAS	Matern. Red blood cell analysis	Robbins et al., 1975
	12-67 mg/100 ml; 118-302 mg/100 ml	36 mg/100 ml; 216 mg/100 ml	27 pairs	Not given	First value -- umbilical cord plasma; second value -- maternal plasma	Scheinberg et al., 1954
	0.22-1.70 μ g/100 g	0.66 μ g/100 g	60	AAS	White children ages 2 mos. to 13 yrs.	Smith, 1976
	Not given	142 $\pm$ 24.82 μ g/100 ml; 120.40 $\pm$ 19.68 μ g/100 ml	558	AAS	First value -- 6 year-olds; second value -- 12 year-olds	Tenamer et al., 1973
Brain	Not given	0.40 mg/100 g wet wt.	Not given	ES	None	Kahon et al., 1940
	Not given	3.6 ppm wet wt.	3	Colorimetry	Accident victims	Koch et al., 1956
	19.3-35.1 mg/g dry wt.	30.0 mg/g dry wt.	3	Colorimetry	None	Koch et al., 1957
	Not given	1.23 $\pm$ 0.16 mg/100 g; 2.07 $\pm$ 0.16 mg/100 g	10 and 75	ES	First value -- 0 to 3 mos.; second value -- above 12 mos.	Musbaum et al., 1958
	4.7-10.0 micromoles/g ash	Not given	100	ES	None	Perry, 1968
	3.8-8.0 micromoles/g ash	Not given	150	ES	None	Perry et al., 1962
	Not given	23.9 μ g/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1974

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain (continued)	240-500 ug/g ash	360 ug/g ash (median)	127	ES	None	Tipton and Cook, 1963
Diaphragm	110-200 ug/g ash	140 ug/g ash (median)	91	ES	None	Tipton and Cook, 1963
Esophagus	Not given	3.5 ppm wet wt.	2	Colorimetry	Accident victims	Koch et al., 1956
	84-200 ug/g ash	120 ug/g ash (median)	66	ES	None	Tipton and Cook, 1963
Feces	Not given	1.3 $\pm$ 0.2 mg/day; 1.3 $\pm$ 0.1 mg/day	2	ES	Healthy males, 23 and 25 yrs. old, University of Cincinnati	Tipton et al., 1969
Fetal membranes	17.5-21.5 ug/100 g	Not given	249	Not given	Compared to specimens from lead mining region; difference insignificant	Fahim et al., 1976
Hair	7.8-234.0 ppm	34.1 ppm	33	NAA	Children and adults, Oak Ridge, Tenn.	Bates and Dyer, 1965
	Not given	17.9 ug/g; 13.0 ug/g; 10.9 ug/g	50	AAS	From hospital delivery ward, Cincinnati, Ohio; 68% black, 32% white; values respectively for maternal scalp hair, maternal pubic hair and neonatal scalp hair.	Baumslag et al., 1974
	1.01-144.0 ug/g; 2.22-184.0 ug/g	12.11 ug/g; 18.25 ug/g	229 children; 204 adults	AAS	Three New York metropolitan community samples	Cronan, 1975
	10.7-41.6 ppm; 11.4-61.4 ppm	22.6 ppm; 23.0 ppm	50	AAS	Low values -- males; high values -- females	Eads and Lambdin, 1973

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair (continued)	0.00312-0.01280 % dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	Not given	11.8, 12.6, 15.3, 22.5, and 25.7 ppm	165	AAS	Fourth-grade boys from 5 cities	Hammer et al., 1971
	9.4-31.0 $\mu\text{g/g}$	16.7 $\mu\text{g/g}$	12	AAS	Both sexes, varied ages, and diverse geographic areas	Hinner et al., 1974
	Not given	13.27 $\mu\text{g/g}$	13	NAA	None	Mahler et al., 1970
	16.0-19.5 $\mu\text{g/g}$	Not given	20	ES	None	Martin, 1964
	8-50 $\mu\text{g/g}$; 5-60 $\mu\text{g/g}$	Not given	211	AAS	First values - males; second values - females	Petering et al., 1971
	Not given	23.1 $\mu\text{g/g}$ dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	Not given	16.1 $\pm$ 1.2 $\mu\text{g/g}$; 55.6 $\pm$ 10.2 $\mu\text{g/g}$	117 and 47	AAS	No dyes or bleaches	Schroeder and Nasen, 1969
	Not given	70.7 $\pm$ 0.9 $\mu\text{g/g}$	1	AAS	None	Sorenson et al., 1973
	Not given	8.7 $\mu\text{g/g}$ ash; 16.2 $\mu\text{g/g}$ ash	2	AAS and MS	None	Yurachek, 1969
Heart	Not given	0.190 mg/100 g wet wt.	Not given	ES	None	Kehoe et al., 1940
	Not given	2.35 $\pm$ 0.27 mg/100 g; 1.81 $\pm$ 0.09 mg/100 g	21 and 137	ES	First value - 0 to 3 mos.; second value - above 12 mos.	Musbaum et al., 1958
	3.4-8.5 micromoles/g ash	Not given	100	ES	None	Perry, 1968

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart (continued)	3.9-7.0 micromole/g ash	Not given	150	ES	None	Perry et al., 1962
	Not given	16.5 µg/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	250-460 µg/g ash	350 µg/g ash (median)	140	ES	None	Tipton and Cook, 1963
Intestine	Not given	0.110 mg/100 g wet wt.	Not given	ES	None	Kelroe et al., 1940
	Not given	0.4 and 4.0 ppm wet wt.	1 and 9	Colorimetry	Accident victims	Koch et al., 1956
	9.5-46.3 mg/g dry wt.	29.7 mg/g dry wt.	9	Colorimetry	None	Koch et al., 1957
	160-420 µg/g ash	260 µg/g ash (median)	67	ES	Duodenum	Tipton and Cook, 1963
	160-330 µg/g ash	230 µg/g ash (median)	101	ES	Jejunum	Tipton and Cook, 1963
	170-400 µg/g ash	240 µg/g ash (median)	84	ES	Ileum	Tipton and Cook, 1963
	150-280 µg/g ash	220 µg/g ash (median)	31	ES	Cecum	Tipton and Cook, 1963
	150-340 µg/g ash	210 µg/g ash (median)	108	ES	Sigmoid colon	Tipton and Cook, 1963
	110-270 µg/g ash	170 µg/g ash (median)	42	ES	Rectum	Tipton and Cook, 1963

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	Not given	0.166 mg/100 g wet wt.	Not given	ES	None	Kehoe et al., 1940
	Not given	4.1 ppm wet wt.	8	Colorimetry	Accident victims	Koch et al., 1956
	12.4-54.3 mg/g dry wt.	30.9 mg/g dry wt.	8	Colorimetry	None	Koch et al., 1957
	34-68 μ g/g ash	34 μ g/g ash	46	AAS	None	Morgan, 1972
	Not given	2.63 $\pm$ 0.34 mg/100 g; 0.84 mg/100 g; 1.77 $\pm$ 0.09 mg/100 g	67, 3, and 201	ES	First value -- 0 to 3 mos.; second value -- 3 to 12 mos.; and third value -- above 12 mos.	Hunbaum et al., 1958
	3.1-16.0 micromoles/g ash	Not given	100	ES	None	Perry, 1968
	3.0-5.4 micromoles/g ash	Not given	150	ES	None	Perry et al., 1962
	Not given	14.9 μ g/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	190-340 μ g/g ash	260 μ g/g ash (median)	143	ES	None	Tipton and Cook, 1963
Larynx	14-150 μ g/g ash	33 μ g/g ash (median)	50	ES	None	Tipton and Cook, 1963
Liver	Not given	0.710 mg/100 g wet wt.	Not given	ES	None	Kehoe et al., 1940
	Not given	9.0 ppm wet wt.	8	Colorimetry	Accident victims	Koch et al., 1956
	1.85-63.0 mg/g dry tissue	41.2 mg/g dry tissue	8	Colorimetry	None	Koch et al., 1957

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver (continued)	Not given	408 $\mu\text{g/g}$ ash	Not given	AAS	Males	Morgan, 1972
	292-420 $\mu\text{g/g}$ ash	394 $\mu\text{g/g}$ ash	46	AAS	None	Morgan, 1972
	Not given	32.49 $\pm$ 1.91 mg/100 g; 2.35 mg/100 g; 2.76 mg/100 g	67, 3, and 199	ES	First value - 0 to 3 mos.; second value - 3 to 12 mos.; and third value - above 12 mos.	Musbaum et al., 1958
	3.5-8.9 $\mu\text{g/g}$ wet wt.	5.8 $\mu\text{g/g}$ wet wt.	17	AAS	None	Owen et al., 1977
	7.7-32.0 micromoles/g ash	Not given	100	ES	None	Perry, 1968
	5.0-21.0 micromoles/g ash	Not given	150	ES	None	Perry et al., 1962
	Not given	1070 $\pm$ 628 $\mu\text{g/g}$ ash	10	ES	Males	Perry et al., 1973
	Not given	25.3 $\mu\text{g/g}$ dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	320-1300 $\mu\text{g/g}$ ash	510 $\mu\text{g/g}$ ash (median)	148	ES	None	Tipton and Cook, 1963
	Not given	5.3 $\pm$ 1.3 ppm wet wt.	7	ES or Chem.	None	Vallee et al., 1957
	Not given	0.110 mg/100 g wet wt.	Not given	ES		Kelwa et al., 1940
Lung	Not given	3.0 ppm wet wt.	5	Colorimetry	Accident victims	Koch et al., 1956
	10.5-27.8 mg/g dry wt.	17.7 mg/g dry wt.	5	Colorimetry		Koch et al., 1957

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung (continued)	Not given	0.98 ± 0.21 mg/100 g; 1.21 ± 0.08 mg/100 g	6 and 72	ES	First value -- 0 to 3 mon.; second value -- above 12 mon.	Munbaum et al., 1958
	1.6-8.5 micromoles/g ash	Not given	100	ES		Perry, 1968
	1.4-2.8 micromoles/g ash	Not given	150	ES		Perry et al., 1962
	500-2500 μ g		168	Not given	Autopsies from cities and non- urban areas	Schroeder, 1970
	92-180 μ g/g ash	120 μ g/g ash (median)	141	ES		Tipton and Cook, 1963
	50-250 μ g/g ash	130 μ g/g ash	141	ES	Autopsies, 9 cities	Tipton et al., 1964
Milk	Not given	0.245 ± 0.077 μ g/ml	50	AAS	None	Picciano, 1976
Muscle	Not given	0.125 mg/100 g wet wt.	Not given	ES	None	Kehoe et al., 1940
	Not given	4.0 ppm wet wt.	11	Colorimetry	Accident victims	Koch et al., 1956
	8.0-30.3 mg/g dry wt.; 4.2-17.7 mg/g dry wt.	31.0 mg/g dry wt.; 12.4 mg/g dry wt.	6 and 5	Colorimetry	High values -- cardiac muscle; low values -- striated muscle	Koch et al., 1957
	50-120 μ g/g ash	74 μ g/g ash (median)	136	ES	None	Tipton and Cook, 1963
	0.00094-0.00810 $\times$ dry tissue	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
Nail	17.32-91.53 μ g/g; 42.59-170.00 μ g/g	51.13 ± 22.84 μ g/g; 86.36 ± 44.51 μ g/g	18	NAA	Low values -- adults; high values children	Kanabrocki et al., 1968

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Nail (continued)	Not given	13.27 $\mu\text{g/g}$	13	NAA	None	Mahler et al., 1970
	7.7-7.8 $\mu\text{g/g}$; 10.6-14.8 $\mu\text{g/g}$	Not given	20	ES	Low values -- toe nails; high values -- finger nails	Martin, 1964
Ovary	85-180 $\mu\text{g/g}$ ash	120 $\mu\text{g/g}$ ash (median)	16	ES	None	Tipton and Cook, 1963
Omentum	110-280 $\mu\text{g/g}$ ash	190 $\mu\text{g/g}$ ash (median)	75	ES	None	Tipton and Cook, 1963
Pancreas	Not given	2.8 ppm wet wt.	4	Colorimetry	Accident victims	Koch et al., 1956
	5.7-27.0 mg/g dry wt.	12.2 mg/g dry wt.	4	Colorimetry	None	Koch et al., 1957
	92-210 $\mu\text{g/g}$ ash	140 $\mu\text{g/g}$ ash (median)	138	ES	None	Tipton and Cook, 1963
Placenta	Not given	14.40 $\pm$ 12.58 micromoles/g dry wt.	554	AAS	One year collection from normal deliveries, Houston, Tx.	Dawson, 1969
	Not given	8.13 $\pm$ 0.54-28.54 $\pm$ 2.54 micromoles/g	554	AAS	Seasonal variation	Dawson et al., 1968
	17.0-22.0 $\mu\text{g/100 g}$	Not given	249	Not given	Compared to specimens from lead mining region; difference insignificant	Fahim et al., 1976
	Not given	1.598 $\pm$ 0.177 $\mu\text{g/g}$ wet wt.	58	Not given	City hospitals in South and Southeast	Karp and Robertson, 1977
Prostate	Not given	7.4 ppm wet wt.	4	Colorimetry	Accident victims	Koch et al., 1956

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Prostate (continued)	57-140 $\mu\text{g/g}$ ash	100 $\mu\text{g/g}$ ash (median)	50	ES	None	Tipton and Cook, 1963
Saliva	2.93-15.61 $\mu\text{g}/100$ ml	7.53 ± 3.45 $\mu\text{g}/100$ ml	21	NAA	None	Kanabrocki et al., 1965
Skin	0.00074-0.00880 % dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	80-150 $\mu\text{g/g}$ ash	100 $\mu\text{g/g}$ ash (median)	22	ES	None	Tipton and Cook, 1963
Spleen	Not given	0.085 mg/100 g wet wt.	Not given	ES	None	Kehoe et al., 1940
	Not given	2.0 ppm wet wt.	5	Colorimetry	Accident victims	Koch et al., 1956
	4.9-13.4 mg/g dry wt.	9.2 mg/g dry wt.	5	Colorimetry	None	Koch et al., 1957
	Not given	3.06 ± 1.45 mg/100 g; 1.03 ± 0.15 mg/100 g	8 and 73	ES	First value -- 0 to 3 mos.; second value -- above 12 mos.	Musbaum et al., 1958
	1.2-3.8 micromoles/g ash	Not given	100	ES	None	Perry, 1968
	1.1-2.0 micromoles/g ash	Not given	150	ES	None	Perry et al., 1962
	67-120 $\mu\text{g/g}$ ash	89 $\mu\text{g/g}$ ash (median)	143	ES	None	Tipton and Cook, 1963
Stomach	Not given	0.107 mg/100 mg wet wt.	Not given	ES	None	Kehoe et al., 1940
	Not given	5.0 ppm wet wt.	4	Colorimetry	Accident victims	Koch et al., 1956

COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Stomach (continued)	13.3-25.4 mg/g dry wt.	19.8 mg/g dry wt.	4	Colorimetry	None	Koch et al., 1957
Sweat	30-1440 µg/liter; 590-2280 µg/liter	550 ± 350 µg/liter; 1480 ± 610 µg/liter	48	AAS	Low values -- male; high values -- female	Hohnadel et al., 1973
Teeth	Not given	0.51 ± 0.06 ppm	208	MS	Teeth samples from <20 year-olds. Enamel. Correlation of high caries with high level; low caries with low level.	Curzon and Lowe, 1977
	0.07-208.0 µg/g	6.80 ± 4.01 µg/g	56	MS	<20 year-olds	Lowe et al., 1973
Testis	Not given	2.6 ppm wet wt.	3	Colorimetry	Accident victims	Koch et al., 1956
	58-110 µg/g ash	80 µg/g ash (median)	71	ES	None	Tipton and Cook, 1963
Thyroid	Not given	2.6 ppm wet wt.	8	Colorimetry	Accident victims	Koch et al., 1956
	43-240 µg/g ash	94 µg/g ash (median)	20	ES	None	Tipton and Cook, 1963
Trachea	25-96 µg/g ash	56 µg/g ash (median)	60	ES	None	Tipton and Cook, 1963
Umbilical cord	16.5-22.0 µg/100 g	Not given	249	Not given	Compared to specimens from lead mining region; difference insignificant	Farhim et al., 1976
Urine	Not given	0.028 mg/l	Not given	NAA	None	Gillis et al., 1974

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COPPER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine (continued)	Not given	50.37 ± 11.14 µg/day	16	NAA and Colorimetry	None	Kanabrocki et al., 1965
	Not given	0.034 mg/l	Not given	ES	None	Kehon et al., 1940
	Not given	0.04 µg/ml	Not given	Not given	None	Rentoul and Smith, 1973
	Not given	0.022 ± 0.001 mg/day; 0.042 ± 0.013 mg/day	2	ES	Healthy males, 23 and 25 years old, University of Cincinnati	Tipton et al., 1969
Uterus	77-130 µg/g ash	98 µg/g ash (median)	32	ES	None	Tipton and Cook, 1963
Vena cava	Not given	5.2 ppm wet wt.	2	Colorimetry	Accident victims	Koch et al., 1956

p,p'-DDA

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	8.1-19.0 ppb	14.2 ppb	12	GC-EC	General population, Florida	Cranmer et al., 1969

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DDD

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	0.10 + 0.11 ppm	221	GC-EC	Texas agricultural area	Burns, 1974
	Not Given	(a) 0.02 ppm (b) 0.08 ppm (c) 0.03 ppm	30 of 44	GC and GC-EC	(a) Perirenal fat (b) Mesenteric fat (c) Panniculus fat	Casaret et al., 1968
	0.21-0.34 ppm	Not Given	215	GC-EC	Autopsies Dade County, Florida; diseased and normals	Deichmann et al., 1968
	0.09-0.99 ppm	0.45 ppm	25	GC	New Orleans, Louisiana	Hayes et al., 1965
	0.0-1.84 ppm	Not Given	332	GC-EC	Autopsies Miami, Florida; diseased and normal	Radomski et al., 1968
	0.0-1.2 ppm	0.10 ppm	202	GC-EC	Surgical biopsies in Idaho	Wyllie et al., 1972
Adrenal	Not Given	0.94 ppm of extracted lipid	18 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret, et al., 1968
Blood	(a) 0.0029-0.0199 ppm (b) 0.0015-0.0066 ppm (c) 0.0018-0.0425 ppm (d) 0.0078-0.0319 ppm (e) 0.0057-0.0448 ppm (f) 0.032-0.0150 ppm	(a) 0.0083 ppm (b) 0.0037 ppm (c) 0.0171 ppm (d) 0.0139 ppm (e) 0.0189 ppm (f) 0.0079 ppm	20	GC	(a) Plasma, males (b) Plasma, females (c) Red blood cells, males (d) Red blood cells, females (e) Whole blood, males (f) Whole blood, females	Dale et al., 1967
	2.0-5.5 ppb	Not Given	350 pairs	GC	Mother-infant pairs in Mississippi	D'Ercole et al., 1976
	0.5-2.4 ppb	1.58 (geometric mean)	53 pairs	GC-EC	Louisiana housewives; general population; maternal blood	Selby et al., 1969
	0.0-27.0 ppb	0.24 ppb	1000	GC-EC	General population of Idaho	Watson et al., 1970
	0.0-4.0 ppb	0.10 ppb	202	GC-EC	Surgical biopsies in Idaho	Wyllie et al., 1972

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DDP

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bone	Not Given	1.45 ppm of extracted lipid	30 of 44	GC and GC-EC	General population in Hawaii; autopsies ages 28 wk.-88 yr.; bone marrow	Casaret et al., 1968
Brain	Not Given	0.22 ppm of extracted lipid	32 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968
Gonad	Not Given	0.18 ppm of extracted lipid	36 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968
Human tissue	1.0-76 ppb	Not Given	115	GC-EC	General population in Hawaii	Klemmer et al., 1977
Kidney	Not Given	0.12 ppm of extracted lipid	38 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968
Liver	Not Given	2.43 ppm of extracted lipid	42 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968
	0.08-0.40 ± 0.10 ppm	Not Given	132	GC-EC	Autopsies Miami, Florida; diseased and normal	Kadowaki et al., 1968
Lung	Not Given	0.05 ppm of extracted lipid	25 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968
Lymph nodes	Not Given	0.03 ppm of extracted lipid	11 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968
Milk	0.04-0.30 mg/kg (fat)	0.17 mg/kg	53	GC	Nursing mothers in Pennsylvania	Kroger, 1972
	Trace-3.0 ppb (fat)	0.70 mg/kg	40	GC	Females, rural Colorado	Savage et al., 1973
Placenta	0.1-17.2 ppb	0.62 (geometric mean)	53 pairs	GC-EC	Louisiana housewives; general population	Selby et al., 1969
Spleen	Not Given	0.49 ppm of extracted lipid	27 of 44	GC and GC-EC	General population of Hawaii; autopsies ages 28 wk.-88 yr.	Casaret et al., 1968

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DDO

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	0.25-0.43 ppb	0.34 ppb	12	GC-EC	General population in Florida	Cramer et al., 1969

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o,p' - DDE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.03-0.53 ppm	0.29 ppm	25	GC	New Orleans, 1964	Hayes et al., 1965
Blood	<0.0003-0.0045 and <0.0003-0.0025 ppm	0.0022 and 0.0010 ppm	10 M 10 F	GC	Men and women, general population, Whole	Dale et al., 1967
	<0.0006-0.0096 and <0.0006-0.0023 ppm	0.0036 and 0.0012 ppm	10 M 10 F	GC	Men and women, general population, Plasma	Dale et al., 1967
Red blood cells	<0.0007-0.0031 and <0.0003-0.0039 ppm	0.0012 and 0.0016 ppm	10 M 10 F	GC	Men and women, general population	Dale et al., 1967

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p,p'-DDT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	17.37 ± 10.90 ppm	221	GC-EC	Agricultural area, Texas; tissues from surgery, 1969-72	Burns, 1974
	Not Given	4.40 ppm, whole tissue 10.26 ppm, fat	29	GC-EC	Autopsies, Hawaii; 28 wks.-88 yrs. Mesenteric	Casaret et al., 1968
	Not Given	4.48 ppm, whole tissue 9.86 ppm, fat	30	GC-EC	Autopsies, Hawaii; 28 wks.-88 yrs. Panniculus	Casaret et al., 1968
	Not Given	4.64 ppm, whole tissue 11.47 ppm, fat	30	GC-EC	Autopsies, Hawaii; 28 wks.-88 yrs. Perirenal	Casaret et al., 1968
	1.9-13.2 ppm	6.92 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	0.44-23.4 ppm	Not Given	159	GC-EC	Autopsies, Florida; general population	Davies et al., 1968
	Not Given	5.5 ppm	90	GC-EG	Autopsies, Florida, whites and blacks, respectively	Davies, 1969
	Not Given	Not Given	35	GC-EG		
	0.9-13.80 ppm	5.5 ppm	90	GC-EC	Controls for anticonvulsant therapy study	Davies et al., 1969
	3.5-20.8 ppm	10.5 ppm	11	GC-EC	Controls for experiment on reduction of pesticide residues with diphenylhydantoin	Davies et al., 1971
	Not Given	6.69 ppm	42	GC-EC	Autopsies; controls Range of means, various diseases. (Hypertension high)	Deichmann et al., 1968
	Not Given	7.33-17.91 ppm	173	GC-EC		
	Not Given	(a) 7.4 ± 2.8 and 3.4 ± 1.0 ppm (b) 8.4 ± 2.9 and 3.5 ± 1.0 ppm (c) 9.3 ± 1.4 and 5.9 ± 1.4	143 males	GC	(a) Female smokers, black and white (b) Female nonsmokers, black and white (c) Male smokers, black and white	Domanski et al., 1977

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p,p'-DDE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	(d) 11.6 ± 2.8 and 4.3 1.5 ppm	143 males	GC	(d) Male nonsmokers, black and white Smoking may induce enzymes which metabolize DDT!	Domanski et al.,
	2-13 ppm	6.1 ppm	61	Colorimetry	General population, U.S. 1954	Hayes et al., 1956
	0.56-21.17 ppm	6.85 ppm	25	GC	People in New Orleans	Hayes et al., 1965
	2.6-21.7 ppm	12.5 ppm	43	Colorimetry	Prison inmates, before experimen- tal oral doses of DDT, 1956	Hayes et al., 1971
	Not Given	7.4 ± 5.3 ppm	282	GC	Study of progression of storage of DDT metabolites in general population, 1963	Hoffman et al., 1964
	0-50 ¹ ppm	7.0 ppm	994	GC	Autopsies; no outstanding dif- ferences between normals and persons dying of a variety of diseases	Hoffman et al., 1967
	0.1-0.4 ppm	Not Given	3	Colorimetry	Autopsy tissues from 1918-40	Mattison et al., 1953
	n.d.-49 ppm	Not Given	50	Colorimetry	Autopsy tissues, 1952	
	Not Given	4.58 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Roan, 1970
	1.7-30.8 ppm	7.8 ppm	130	Colorimetry	332 biopsy, 72 autopsy; general population, U.S., 1961-62	Quinby et al.,
	3.66 ± 7.64 to 19.27 ± 6.35 ppm (normals 6.69 ± 4.07); range of means in various diseases; metastatic malignancy highest.		332	GC-EC	Autopsies, Florida, 1964-67	Radomski et al., 1968
	1.8-13.5 $\mu\text{g/g}$	5.1 $\mu\text{g/g}$	64	GC-EC	Autopsy tissues	Rappolt and Hale, 1968

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p,p'-DDE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose (continued)	Not Given	5.0 ppm	103	GC	Utah, 1967-70	Warnick, 1972
	0.2-30 ppb	7.2 ppb	202	GC-EC	141 females, 61 males, surgical tissues, Idaho, 1970	Wyllie et al., 1972
Adrenal	Not Given	0.87 ppm, whole Tissue	18	GC-EC	Autopsies, Hawaii. 28 wks.- 88 yrs	Canaret et al., 1968
	Not Given	8.57 ppm, fat	18			
Bile	0.5-5.1 ppb	2.3 ppb	5	GC-EC	Elderly men; evidence of excretion of pesticide metabolites by liver	Panchal et al., 1974
Blood	6.75-34.83 ppb	20.56 ppb	960	GC-EC	Michigan counties, 1968-70	Bloomer et al., 1977
	Not Given	0.0152 ppm	10	GC-EC	Women with no occupational exposure to insecticides, Serum	Dale et al., 1966 Meeting abstract
	0.0045-0.0235 ppm	0.0114 ppm	10	GC-EC	Blood Plasma Serum Extension of above study	Dale et al., 1966
	0.0069-0.0499 ppm	0.0257 ppm	10	GC-EC		
	0.0055-0.0475 ppm	0.0198 ppm	10	GC-EC		
	0.0062-0.0367 ppm	0.0178 ppm	10	GC-EC	Males, general population	Dale et al., 1966
	0.0068-0.0107 ppm	0.0068 ppm	10	GC-EC	Females, general population	
	0.0101-0.0416 ppm	0.0257 ppm	10	GC-EC	Males, general population, Plasma	
	0.0039-0.0344 ppm	0.0135 ppm	10	GC-EC	Females, general population, Plasma	
	2-54 ppb	Not Given	119	GC-EC	General population, Florida	Davies et al., 1968
	Not Given	8 ppm	68	GC-EC	General population, Florida, 1967-68; whites and blacks respectively	Davies et al 1969
	Not Given	16 ppm	51			

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Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	(a) 1-78 ppb (b) 18-67 ppb (c) 3-163 ppb (d) 4-180 ppb	(a) 24.3 ppb (b) 31.2 ppb (c) 35.3 ppb (d) 46.8 ppb	800	GC-EC	(a) Whites, higher social class (b) Blacks, higher social class (c) Whites, lower social class (d) Blacks, lower social class	Dayton et al., 1973
	1-55 ppb	9.1 ppb	199	GC-EC	Controls for anticonvulsant therapy study	Dayton et al., 1969
	Not given	(a) 90 ppb (b) 30 ppb (c) 35 ppb (d) 20 ppb	209 pairs 130 pairs	GC	(a) Mothers, Black (b) newborn, Black (c) mothers, White (d) newborn, White Agricultural area, 1972, Miss. Serum.	Pflicke et al., 1976
	6.1-114.0 ppb	39.5 ppb	28	GC	Rural and urban areas, Texas - relation to POP in milk. Serum.	Dement et al., 1971
	10-41 ppb; 2-7 ppb	21 ppb; 3 ppb	9; 14	GC-EC	Study of release of POP by tissue washing and stress, patients and nonpatients, respectively.	Hesselberg and Scherer, 1974
	Not given	24.6 ± 14.2 ppb; 55.2 ± 29.5 ppb	96; 96	GC-EC	White children, age 6-9 yrs., 1970, S.C.; Black children, age 6-9 yrs., S.C. Plasma.	Kell et al., 1972
	1-140 ppb	16.4 ppb	1619	GC	1130 subjects from urban Honolulu; 489 from rural Lanai, 1968-1970. Serum.	Kleinert et al., 1973
	6.6-34.4 ppb; 2-13 ppb	19.5 ppb; 5.8 ppb	24; 44	GC	Premature infants, Florida; Term infants, Florida	Waters et al., 1970
	Not given	15.72 ± 6.51 ppb	8	GC-EC	Florida	Kadomaki et al., 1973
	0.0-25.9 µg/g fat	5.1 µg/g fat	10	GC-EC	Newborns (fetal cord)	Rappolt and Hale, 1968

p,p'-DDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given	25.4 26.7 ppb	3568	Not given	Hawaii, community at large, 1969-70. Presence of p,p'-DDE may stimulate synthesis or release of cholesterol in liver, leading to an elevated serum cholesterol. Serum.	Rashad et al., 1976
	0.3-32.4 ppb	2.65 ppb (geometric mean)	53 pairs	GC-EC	53 mothers, Louisiana, 36 rural, 16 urban, 1966-67	Selby et al., 1969
	0.005-0.022	0.011 ppm	40	GC-EC	Eskimo children, age 6-17 yrs., 20 males, 20 females. 1972. Maternal blood.	Serfat et al., 1977
	Not given	19.8 ppb	1417	GC	Utah, 1967-70. Serum.	Warnick, 1972
	0-383 ppb, males 1-121 ppb, females	22.0 ppb 18.8 ppb	1000	GC-EC	Idaho, 1967-68, ages 3-90 yrs. Goes up with age. Serum.	Watson et al.,
	26-78 ppb 23-98 ppb	45.5 ppb 57.5 ppb	24 24	GC-EC	Male agricultural workers, Idaho, 1970 and 1970, respectively. Serum.	Watson et al., 1973
	2-70 ppb	15.5 ppb	202	GC-EC	141 females, 61 males, surgical patients, Idaho, 1970. Serum.	Wyllie et al., 1972
	Not given	0.0831 ppm 1.59 ppm	32; 32	GC-EC	Whole tissue and fat, respectively; autopsies, Hawaii, 28 wks. - 88 yrs.	Canaret et al.,
Brain	0.13-0.57 ppm	0.30 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	Not given	0.084 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Roan, 1970

p,p'-DDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain (continued)	Trace to 0.20 ± 0.18 ppm (normals 0.12 ± 0.19); range of means in various diseases, no disease outstanding.		332	GC-EC	Autopsies, Florida, 1964-67	Radomski et al., 1968
Gonad	Not given	0.068 ppm 7.78 ppm	36 36	GC-EC	Autopsies, Hawaii, 28 wks. - 88 yrs. Whole tissue and fat, respectively.	Casaret et al., 1968
	0.03-0.66 ppm	0.27 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
Kidney	Not given	5.209 ppm 6.32 ppm	38 38	GC-EC	Autopsies, Hawaii, 28 wks. - 88 yrs. Whole tissue and fat, respectively.	Casaret et al., 1968
	0.08-1.2 ppm	0.35 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	Not given	0.133 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Roan, 1970
Liver	Not given	0.200 ppm 12.93 ppm	42 42	GC-EC	Autopsies, Hawaii, 28 wks. - 88 yrs. Whole tissue and fat, respectively.	Casaret et al., 1968
	0.11-4.8 ppm	1.01 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	Not given	0.432 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Roan, 1970
	0.29 to 2.44 ± 9.16 ppm (normals 0.35 ± 0.01); range of means in various diseases. Metastatic malignancy highest.		332	GC-EC	Autopsies, Florida, 1964-67	Radomski et al., 1968
Lung	Not given	0.0585 ppm 8.78 ppm	25	GC-EC	Autopsies, Hawaii, 28 wks. - 88 yrs. Whole tissue and fat, respectively.	Casaret et al., 1968

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p,p'-DDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lymph nodes	Not given	1.38 ppm	11	GC-EC	Autopsies, Hawaii, 28 wks. - 88 yrs. Whole tissue and fat, respectively	Casaret et al., 1968
tracheo-bronchial		8.31 ppm	11			
Narrow, bone	Not given	2.08 ppm	19	GC-EC	Autopsies, Hawaii, 28 wks. - 88 yrs. Whole tissue and fat, respectively.	Casaret et al., 1968
		18.47 ppm	30			
Milk	15.4-236.0 ppb	84.1 ppb	28	GC	Mothers in rural and urban areas in Texas. Milk higher than blood. Hazard for infant.	Dyment et al., 1971
	0.074-0.214 ppm	Not given	6	GC-EC	Mothers in Arizona, 1972	Hagyard et al., 1973
	0.63-4.05 ug/kg fat	2.32 ug/kg fat	53	GC	Nursing mothers, Philadelphia area, 1970.	Kroger, 1972
	<0.3-4.5 ppm	1.4 ppm, fat basis	10	Colorimetry	Normal mothers, 4 cities, 1960-61	Quinby et al., 1965
	19-386 ppb	111.6 ppb, fat basis	40	GC	Normal mothers, rural Colorado, 1971-72	Savage et al., 1973
	125-214, 100 ppb	3,520.9 ppb, fat basis	1434	GC-EC	Five areas, national study, 1973-76	Savage, 1976
	0.01-1.72 ppm	0.227 ppm	57	GC-EC; GC/MS	Mothers from Arkansas and Mississippi, 1973-74.	Strassman and Kutz, 1977
Placenta	1.8-13.5 ug/g fat	5.0 ug/g fat	39	GC-EC		Reppolt and Hale, 1968
	0.6-65.8 ppb	10.42 ppb (geometric mean)	53	GC-EC	Newborns from 52 mothers, Louisiana, 1966-67, 36 rural, 16 urban	Selby et al., 1969
Red blood cells	0.0024-0.0137 ppm	0.0063 ppm	10	GC-EC	Emphasis on methodology	Dale et al., 1966

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p,p'-DDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Red blood cells (continued)	0.0046-0.0138 ppm 0.0061-0.0151 ppm	0.0090 ppm 0.0091 ppm	20	GC-EC	10 males and 10 females, respectively; general population	Dale et al., 1967
Spleen	Not given	0.0305 ppm 6.05 ppm	27 27	GC-EC	Autopsies, Hawaii, 28 yrs. - 88 yrs. Whole tissue and fat, respectively.	Casaret et al., 1968
Urine	0.41-0.55 ppb	0.42 ppb	12	GC-EC	General population, Florida	Cranmer et al., 1969

o,p'-DDT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	0.24 ± 0.28 ppm	221	GC-EC	Texas agricultural area	Burns et al., 1974
	<0.01-0.67 ppm	0.06 ppm	25	GC	General population in Louisiana	Mayes et al., 1965
	0.0-1.0 ppm	0.10 ppm	202	GC-EC	Surgical biopsies in Idaho	Wyllie et al., 1972
Bile	0.0-0.2 ppb	0.06 ppb	5	GC-EC	Elderly men; bile duct drainage; evidence of excretion by liver	Paschal et al., 1974
Blood	(a) 0.0014-0.0129 ppm (b) 0.0014-0.0039 ppm (c) 0.0025-0.0054 ppm (d) <0.0003-0.0037 ppm (e) 0.0014-0.0336 ppm (f) 0.0016-0.0065 ppm	(a) 0.0060 ppm (b) 0.0024 ppm (c) 0.0044 ppm (d) 0.0022 ppm (e) 0.0082 ppm (f) 0.0033 ppm	20	GC	(a) Plasma, males (b) Plasma, females (c) Red blood cells, males (d) Red blood cells, females (e) Whole blood, males (f) Whole blood, females	Dale et al., 1967
	Not Given	0.0016 ppm	10	GC-EC	Females, no occupational exposure.	Dale et al., 1966
	(a) <0.0001-0.0036 ppm (b) 0.0005-0.0017 ppm (c) 0.0002-0.0002 ppm (d) 0.0003-0.0014	(a) 0.0013 ppm (b) 0.0010 ppm (c) 0.0004 ppm (d) 0.0002 ppm	10	GC-EC	(a) Plasma (b) Whole blood (c) Red blood cells (d) Serum	Dale et al., 1966
	0.5-6.0 ppb	Not Given	350 pairs	GC	Mother-infant pairs in Mississippi	D'Ercolo et al., 1976
	0.4-2.0 ppb 0.7-2.2 ppb	Not Given	8	GC		Radomski et al., 1971
	0.0-2.0 ppb	<0.1 ppb	202	GC-EC	Serum	Wyllie et al., 1972
	0.003-0.036 ppm	Not Given	6	GC-EC	From pesticide use	Magyard et al., 1973
	Trace-13.0 ppb (fat)	1.8 ppb, fat basis	40	GC	Females, rural Colorado	Savage et al., 1973

o,p'-DDT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Milk (continued)	<1.0-6333.3 ppb	191.1 ppb, fat basis	920 of 1436	GC-EC	Nursing mothers; fat basis	Savage 1976

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Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	3.48 ± 2.54 ppm	221	GC-EC	Agricultural areas; Mexican-Americans higher content	Burns, 1974
	Not given	(a) 2.5 ± 1.1 ppm (b) 0.8 ± 0.2 ppm (c) 2.4 ± 0.8 ppm (d) 0.8 ± 0.4 ppm	143	GC	(a) female, black (b) female, white (c) male, black (d) male, white	Domanski et al., 1977
	0.15-3.99 ppm	2.73 ppm	25	GC	General population in Los Angeles	Hayes et al., 1965
	0.0-7.7 ± 8.0 ppm	Not given	332	GC-EC	Autopsies, Miami, Florida; diseased and normal	Domanski et al., 1968
Bile	0.1-30.3 µg/g	4.8 µg/g	64	GC-EC	Autopsies	Rappolt and Male, 1968
	0.1-6.6 ppb	1.9 ppb	202	GC-EC	Surgical biopsies in Idaho	Wyllie et al., 1972
	0.0-0.7 ppb	0.32 ppb	5	GC-EC	Elderly men - bile duct drainage. Evidence of excretion by liver	Peschel et al., 1974
	6.75-34.83 ppb	20.56 ppb	960	GC-EC	County of residence most significant factor; increase with age	Bloomer et al., 1977
Blood	(a) 0.0114-0.0490 ppm (b) 0.0024-0.0164 ppm (c) 0.0030-0.0343 ppm (d) 0.0023-0.0265 ppm (e) 0.0068-0.0844 ppm (f) 0.0057-0.0199 ppm	(a) 0.0253 ppm (b) 0.0086 ppm (c) 0.0153 ppm (d) 0.0136 ppm (e) 0.0248 ppm (f) 0.0131 ppm	20	GC	(a) plasma, males (b) plasma, females (c) red blood cells, males (d) red blood cells, females (e) whole blood, males (f) whole blood, females	Male et al., 1966
	(a) 0.0034-0.0305 ppm (b) 0.0024-0.0106 ppm (c) 0.0008-0.0049 ppm (d) 0.0042-0.0290 ppm	(a) 0.0119 ppm (b) 0.0058 ppm (c) 0.0026 ppm (d) 0.0105 ppm	10	GC-EC	(a) plasma (b) whole blood (c) red blood cells (d) serum	Male et al., 1966

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p,p'-DDT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given	0.0077 ppm	10	GC-EC	Females, no occupational exposure	Dale et al., 1966
	<2.0-23.0 and 3.0-53.0 ppb	5.1 and 10.4 ppb	800	GC-EC	General population, Dade County, Florida, increase with age, blacks higher levels. Serum.	Davies et al., 1973
	2.0-20.0 ppb	Not given	350 pairs	GC	Mother-infant pairs	D'Ercole et al., 1976
	0.5-23.9 ppb	9.7 ppb	28	GC	Rural and urban areas in Texas	Dymont et al., 1971
	0.0-27 ppb	3.91 ppb	1619	GC	Urban and rural in Hawaii	Klemmer et al., 1973
	(a) 3.6-8.9 ppb (b) 5.6-16.5 ppb	4.18 ± 1.83 ppb	8	GC	(a) whole blood (b) plasma	Radomski et al., 1971
	Not given	4.18 ± 1.83 ppb	28	GC-EC	Autopsies and lab workers, Miami, Florida	Radomski et al., 1971
	Not given	5.1 ± 5.1 ppb	3568	Not given	General population in Hawaii. Serum	Rashed et al., 1976
	(a) 3.0-18.0 ppb (b) 4.0-40.0 ppb	(a) 8.5 ppb (b) 13.4 ppb	24	GC-EC	Male adults, ages 33-68 yrs. Serum. (a) 1970, (b) 1971	Watson et al., 1973
	0.0-86.0 ppb	4.7 ppb	1000	GC-EC	General population in Idaho	Watson et al., 1970
	0.0-14.0 ppb	4.0 ppb	202	GC-EC	Surgical biopsies in Idaho	Wyllie et al., 1972

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p,p'-DDT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	0.0-0.04 ± 0.01 ppm	Not given	332	GC-EC	Autopsies, Miami, Florida; diseased and normal	Radomski et al., 1968
Liver	0.0-0.53 ± 0.14 ppm	Not given	332	GC-EC	Autopsies, Miami, Florida; diseased and normal	Radomski et al., 1968
Milk	4.0-47.8 ppb	23.4 ppb	28	GC	Rural and urban areas in Texas	Dymont et al., 1971
	0.017-0.383 ppm	Not given	6	GC-EC	From pesticide use	Hagyard et al., 1973
	<1.0-34,369.3 ppb	552.7 ppb	1436	GC-EC	11 of 1436, none detected. Fat basis.	Savage, 1976
	7.0-109.0 ppb	20.8 ppb	40	GC	Females, rural county. Fat basis.	Savage et al., 1973
	0.01-0.84 ppm	0.092 ppm	57	GC-EC; GC/MS	Mississippi and Arkansas females	Strassman and Kutz, 1977
Urine	8.1-19.0 ppb	14.2 ppb	221	GC-EC	General population in Florida	Cramer et al., 1969

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DDT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	0.8-7.4 ppm	Not given	Not given	USA, 1955 to 1967	Bevenius, 1967
	0.9-4.2 ppm	0.21 ppm	11	GC-EC	Control group	Davin et al., 1971
	2.11-6.54 ppm	Not given	215	GC-EC	Autopsies, Florida	Deichmann et al., 1968
	2-12 ppm	4.9 ppm	61	Colorimetry	1954-1956, general population	Hayes et al., 1956
	2.0-12.5 ppm	5.0 ppm	43	Colorimetry	Prison inmates, 24-29 years; 1956	Hayes et al., 1971
	0-20 ppm	2.9 ppm	282	GC	Autopsies; Chicago; 1963	Huffman et al., 1964
	0-19.0 ppm	2.6 ppm	994	GC	Autopsies; 1962-1967	Huffman et al., 1967
	Not applicable	17 ppm	1	Chemical	1948; Subject: male, 37, had worked experimentally with DDT and consumed it in food especially milk.	Howell, 1948 Note date: DDT previously found in tissues of cattle
	0-34.0 ppm	5.1 ppm	35	Colorimetry	Appears to be first report of DDT in human milk and fat from nonoccupational exposure	Laug et al., 1950
	<0.1-34 ppm	5.3 ppm	75	Colorimetry	Follow-up of Laug et al., 1950	Laug et al., 1951
	0-40 ppm	Not given	50	Colorimetry	Samples taken in 1952	Mattson et al., 1953
	0.3-0.6 ppm	Not given	3	Colorimetry	Samples taken in 1938-40	Mattson et al., 1953

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DDT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose (continued)	Not given	1.54 ppm	70	GC-EC	Autopsies; Arizona; 1966-68	Morgan and Rean, 1970
	0.7-25.4 ppm	4.0 ppm	130	Colorimetry	91% biopsy; 7% autopsy; 4 cities in U.S., 1961-62	Quinby et al., 1963
	2.2-31.0 ppm	8.8 ppm	19	GC-EC	Autopsies from accidental deaths, 18-76 years old; Ohio, 1964-65	Schafer and Campbell, 1966
	Not given	1.5 ppm	103	GC	Heath, 1967-70	Wernick, 1972
Adrenal	Not given	0.98 ppm, fat 0.125 ppm, whole tissue	18	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Cassaret et al., 1968
Blood	Not given	5.76 ppb	960	GC	Michigan general population, 1968-70	Bloomer et al., 1977
(Plasma)	Not given	6.6 ± 6.5 ppb 18.5 ± 11.0 ppb	96	GC-EC	Children, 6-9, South Carolina, whites (low values) and nonwhites	Kell et al., 1972
(Plasma)	Not given	(a) 7.8-8.9 ppb (b) 4.7-4.8 ppb (c) 16.5-17.7 ppb (d) 19.9-20.5 ppb	192	GC-EC	Children 6-9, South Carolina 1970 (a) white males (b) white females (c) nonwhite males (d) nonwhite females	Kell et al., 1972
	1-29 and 3-92 ppb;	11 and 15 ppb	152	Not given	Whites and blacks, normal pregnancies, Florida	O'Leary et al., 1970
	1-28 and 2-47 ppb	9 and 12 ppb	101	Not given	Whites and blacks, spontaneous abortions, Florida	O'Leary et al., 1970
	2-94 ppb	20.3 ppb	19	GC-EC	Autopsies from accidental deaths, 18-76 years old, Ohio, 1964-65	Schafer and Campbell, 1966
	0.2-12.3 ppb	1.62 ppb (geometric mean)	53	GC-EC	51 white, 2 black housewives; Louisiana, 36 rural, 16 urban. Maternal blood.	Selby et al., 1969

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DDT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	<0.002 ppm; 0.002-0.003 ppm	Not given	29; 9	GC-EC	Rukimo children, Alaska, 4-17 years, 20 males and 20 females. Serum.	Serfat et al., 1977
	Not given	6.2 ppb	1417	GC	Utah, 1967-70	Warnick, 1972
Brain	Not given	0.12 ppm, fat 0.0103 ppm, whole tissue	32	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Casaret et al., 1968
	0.08-0.44 ppm	0.24 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	Not given	0.022 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Rean, 1970
Endometrium	Not given	Trace	15	GC-EC	Hawaii. Maternal	Klemmer et al., 1977
Fat	Not given	3.14 ppm, fat 1.33 ppm, whole tissue	30	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs. Perirenal.	Casaret et al., 1968
	Not given	2.85 ppm, fat 1.35 ppm, whole tissue	29	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs. Mesenteric.	Casaret et al., 1968
	Not given	2.81 ppm, fat 1.16 ppm, whole tissue	30	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs. Panniculus.	Casaret et al., 1968
	0.42-6.6 ppm	3.79 ppm	30	GC-EC	Autopsies, Florida	Davies et al., 1965
Fetal	0-4.9 ppb	0.4 ppb	15	GC-EC	Hawaii	Klemmer et al., 1977
Gonad	Not given	1.53 ppm, fat 0.0150 ppm, whole tissue	36	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Casaret et al., 1968
	0.04-0.40 ppm	0.21 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965

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DDT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	Not given	1.66 ppm, fat 0.0827 ppm, whole tissue	38	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Casaret et al., 1968
Kidney	0.07-0.42 ppm	0.21 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	Not given	0.030 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Ream, 1970
Liver	Not given	1.75 ppm, fat 0.0467 ppm, whole tissue	42	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Casaret et al., 1968
	0.17-1.2 ppm	0.38 ppm	11	GC-EC	Autopsies, Florida	Davies et al., 1965
	Not given	0.101 ppm	70	GC-EC	Autopsies, Arizona, 1966-68	Morgan and Ream, 1970
Lung	Not given	2.62 ppm, fat 0.0147 ppm, whole tissue	27 25	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Casaret et al., 1968
Lymph nodes	Not given	3.73 ppm, fat 0.892 ppm, whole tissue	11	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs. Tracheobronchial.	Casaret et al., 1968
Marrow	Not given	4.48 ppm, fat 0.411 ppm, whole tissue	30 19	GC-EC	Autopsies, Hawaii, 28 wks-88 yrs.	Casaret et al., 1968
Milk	0-200 ppb	30 ppb	6	GC-EC	Hawaii	Klemmer et al., 1977
	0.04-0.77 ppm	0.14 ppm	24	Colorimetry	Appears to be first report of DDT in human milk and fat from non-occupational exposure	Laug et al., 1950
	<0.01-0.77 ppm	0.13 ppm	24	Colorimetry	Follow-up of Laug et al., 1950	Laug et al., 1951

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DDT (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Milk (continued)	<0.3-7.7 ppm, fat	2.5 ppm	14	Colorimetry	Normal mothers, 4 cities in U.S.	Quinby et al., 1965
Placenta	1.1-157.0 ppb	13.82 ppb	53	GC-EC	Childbirth, 51 white, 2 black mothers, housewives, Louisiana; 36 rural, 16 urban; 1966-67	Selby et al., 1969
Spleen	Not given	2.62 ppm, fat 0.0112 ppm, whole tissue	27	GC-EC	Autopsies, Hawaii, 28 wk-88 yrs.	Canaret et al., 1968
Whole body	11-1350 ppb	Not given	77	GC-EC	Autopsies, Hawaii, 1964-1973	Klemmer et al., 1977
	22-300 mg, total body burden	Not given	19	GC-EC	Autopsies from accidental deaths, 18-76 years old, Ohio, 1964-65	Schafer and Campbell, 1966

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DDT - TOTAL EQUIVALENT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	23.18-15.36 ppm	221	GC-EC	Tissues from surgery, agricultural area, Texas, 1969-72	Burns, 1974
	1.9-21.1 ppm	7.9 ppm (median)	90	GC-EC	Patients in Florida hospital	Davis et al., 1969
	Not Given	9.7 ppm	42	Not Given	Accidental deaths	Beichman and MacDonald, 1971
	Not Given	9.4 ppm	31	Not Given	Sparing users of home pesticides	Beichman and MacDonald, 1971
	Not Given	19.4 ppm	65	Not Given	Moderate users	Beichman and MacDonald, 1971
	Not Given	27.0 ppm	22	Not Given	Careless users	Beichman and MacDonald, 1971
	0.0-270.05 ppm	11.65 ppm	1412	GC-EC	National summary, 32 cities, FY 1970	Kutz et al., 1974
	Not Given	7.88 (1970), 7.95 (1971) 6.88 (1972), 5.89 (1973) 5.02 (1974) ppm	898 - 1920	GC-EC	National Summary, FY 1970-74, effect of reducing use on storage. Most marked decline in youngest age group. Blacks have almost twice as much as whites.	Kutz et al., 1977
	270.05 ppm (max)	7.88 ppm (geometric mean)	1412	GC-EC	Same study as above, but review article, FY 1970-74. Frequency remains high	Kutz et al., 1977
	207.33 ppm (max)	7.95 ppm (geometric mean)	1615	GC-EC		
	173.22 ppm (max)	6.88 ppm (geometric mean)	1913	GC-EC		
	329.77 ppm (max)	5.88 ppm (geometric mean)	1095	GC-EC		
	89.06 ppm (max)	4.99 ppm (geometric mean)	398	GC-EC		
Blood	9.93-46.89 ppb	28.86 ppb	960	GC-EC	Michigan counties, 1968-70	Bloomer et al., 1977
	Not Given	110 and 40 ppb	209 pairs	GC	Rural area, Mississippi, 1972 Black mothers and newborns	D'Eusele et al., 1976

DDT - TOTAL EQUIVALENT

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not Given	45 and 20 ppb	130 pairs	GC	White mothers and newborns. Serum	D'Ercole et al., 1976
	0.005-0.030 ppm	0.017 ppm	Not given	GC-EC	Cotton-growing area, Mississippi mosquito spraying and house use of insecticides. 1968. Serum	Perron and Barrentine, 1970
	0.8-50.4 ppb	5.01 ppb (geometric mean)	53	GC-EC	Maternal blood. 1966-67; 53 mothers, Louisiana; 36 rural, 16 urban	Selby et al., 1969
Feces	Trace-3.7 ug/day/person	Not Given	32	GC	Preadolescent girls	Price et al., 1972
Hair	0.01-0.10 ppm	0.06 ppm (median)	9	GC	Excretion of DDT and metabolites in hair lipids	Matthews et al., 1976
Milk	0.093-0.575 ppm	Not Given	6	GC-EC	Mothers in Arizona	Magyard et al., 1973
	0.02-2.76 ppm	0.344 ppm	57	GC-EC; GC/MS	Mothers in Arkansas and Mississippi, 1973-74	Strassman and Kutz, 1977
Placenta	1.8-179.1 ppb	24.07 ppb (geometric mean)	53	GC-EC	53 Newborns, Louisiana, 1966-67	Selby et al., 1969
Urine	Trace-2.1 ug-day/person	Not Given	32	GC	Preadolescent girls	Price et al., 1972

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DIELDRIN

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	0.35 ± 0.23 ppm	221	GC-EC	Agricultural area, no sex differences; Mexican-Americans higher content	Burns, 1974
	Not given	0.06-0.17 ppm	30	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
	0.03-0.17 ppm	0.16 ppm	25	GC-EC	None	Davis et al., 1971
	0.21-0.73 ppm	Not given	215	GC-EC	Autopsies, Dade County, Florida	Deichman et al., 1968
	0.20 ± 0.07 - 0.25 ± 0.03 ppm	(a) 0.23 ppm (b) 0.21 ppm	143	GC	Blacks and whites, above 35 yr.; (a) females; (b) males	Romanski et al., 1977
	<0.05-0.77 ppm	0.22 ppm	146	GC-EC	Autopsies in Florida	Edmundson et al., 1968
	0.03-1.15 ppm	0.29 ± 0.05 ppm	25	GC	None	Hayes et al., 1965
	0.05-1.00 ppm	0.11 ppm	64	GC	None	Hoffman et al., 1964
	0.01-0.49 ppm	0.14 ppm	221	GC	118 of 221 positives	Hoffman et al., 1967
	Not given	0.26 mg/kg	Not given	Not given	None	Hunter et al., 1967
	0.0-15.2 ppm	0.27 ppm	Not given	GC-EC	32 U.S. cities	Kutz et al., 1974
	Not given	5.64 ppm (1973) and 2.21 ppm (1974)	1092 (1973); 858 (1974)	GC-EC, TLC, and MS	75 U.S. sites; 99% positive	Kutz et al., 1977

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DIELDRIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose (continued)	Not given	0.18-0.22 ppm (geometric mean)	1913+ (1970-1974)	GC-EC	75 U.S. sites; 96-99% positive	Kutz et al., 1977
	Not given	0.140 ppm	70	GC-EC	Autopsies in Arizona	Morgan and Roan, 1970
	Not given	0.21 $\pm$ 0.16 and 0.73 $\pm$ 0.59 ppm	332	GC-EC	Autopsies in Florida	Radomski et al., 1968
	Not given	1.8 ppb	103	GC	None	Warnick, 1972
	0.0-0.7 ppb	0.2 ppb	202	GC-EC	Surgical biopsies in Idaho	Wyllie et al., 1972
Adrenal	Not given	0.62 ppm	18	CC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
Blood	0.0-0.33 ppb	0.23 ppb	960	GC-EC	Reflect pesticide usage in Missouri	Bloomer et al., 1977
	(a) <0.0012-0.0363 ppm (b) <0.0012-0.0622 ppm (c) 0.0021-0.0069 ppm (d) 0.0014-0.0108 ppm (e) 0.0010-0.0129 ppm (f) 0.0006-0.0043 ppm	(a) 0.0028 ppm (b) 0.0009 ppm (c) 0.0043 ppm (d) 0.0049 ppm (e) 0.0055 ppm (f) 0.0018 ppm	20	GC	(a) plasma, males (b) plasma, females (c) rbc, males (d) rbc, females (e) whole blood, males (f) whole blood, females	Dale et al., 1967
	Not given	0.0013 ppm	10	GC-EC	Blood serum	Dale et al., 1966
	(a) 0.0034-0.0305 ppm (b) 0.0024-0.0106 ppm (c) 0.0008-0.0049 ppm (d) 0.0042-0.0290 ppm	(a) 0.0119 ppm (b) 0.0058 ppm (c) 0.0026 ppm (d) 0.0105 ppm	10	GC-EC	(a) plasma (b) whole blood (c) rbc (d) serum	Dale et al., 1966

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DIELDRIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	(a) <1.0-11.0 ppb (b) <1.0-5.0 ppb	(a) 1.40 ppb (b) 1.05 ppb	800	GC-EC	General population, Dade County, Florida: (a) whites; (b) blacks	Davies et al., 1973
	0.1-0.7 ppb	Not given	350 pairs	GC	Blood serum. Mississippi blacks and whites; mother-infant pairs	D'Ercole et al., 1976
	0.0-6.0 ppb	1.2 ppb	28	GC	Blood serum	Dymont et al., 1971
	Not given	2.15 ppb	115	GC-EC	General population in Hawaii. Blood serum.	Klemmer et al., 1977
	0.0-26.0 ppb	1.5 ppb	116	GC	None	Klemmer et al., 1973
	(a) 0.5-1.4 ppb (b) 0.7-3.3 ppb	1.49 $\pm$ 1.0 ppb	28	GC	(a) whole blood (b) plasma	Radomski et al., 1971
	Not given	2.4 $\pm$ 14.3 ppb	3568	Not given	General population in Hawaii	Rashad et al., 1976
	0.1-1.9 ppb	0.26 ppb (geometric mean)	53 pairs	GC-EC	Maternal blood. Mother-infant pairs in Louisiana	Selby et al., 1969
	Not given	0.17 ppm	1417	GC	Blood serum	Warnick, 1972
	0.0-25.0 ppb	(a) 0.5 ppb (b) 0.3 ppb (c) 1.3 ppb	1000	GC-EC	Blood serum. (a) overall mean (b) males (c) females	Watson et al., 1970
	0.0-10.0 ppb	0.9 ppb	202	GC-EC	Blood serum. Surgical patients in Idaho.	Wyllie et al., 1972
Bone	Not given	0.41 ppm	30	CC	Random samples, ages 28 wk-88 yr. Marrow.	Casaret et al., 1968

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DIFLDRIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	Not given	0.04 ppm	32	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
	Not given	0.04 ± 0.01 ppm	332	GC-EC	Autopsies in Florida	Radomski et al., 1968
Endometrium	0.0-7.8 ppb	0.6 ppb	15	GC-EC	General population in Hawaii	Klemmer et al., 1977
Fetal tissue	0.0-4.9 ppb	0.7 ppb	15	GC-EC	Infants in Hawaii	Klemmer et al., 1977
Gonad	Not given	0.62 ppm	36	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
Hair	Not given	≤ 0.01 ppm	5	GC	None	Matthews et al., 1976
Human tissue	2.0-63.0 ppb	Not given	77	GC-EC	General population in Hawaii	Klemmer et al., 1977
Kidney	Not given	0.66 ppm	38	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
Liver	Not given	0.43 ppm	42	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
	Not given	0.10 ± 0.19 ppm	332	GC-EC	Autopsies in Florida	Radomski et al., 1968
Lung	Not given	0.16 ppm	25	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968
Lymph nodes	Not given	0.11 ppm	11	GC	Random samples, ages 28 wk-88 yr.	Casaret et al., 1968

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DIELDRIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Milk	0.0-21.0 ppb	3.3 ppb	28	GC	Milk not good indicator source	Dymont et al., 1971
	3.0-12.0 ppb	3.0 ppb	6	GC-EC	Females in Hawaii	Klemmer et al., 1977
	0.0-11.0 ppb	1.7 ppb (fat basis)	40	GC	Females in Colorado	Savage et al., 1973
	1.0-2294 ppb	164.2 ppb (fat basis)	1160	GC-EC	1160 of 1436 positives	Savage, 1976
	trace-0.05 ppm	0.012 ppm	57	GC-EC and GC/MS	Mississippi and Arkansas females	Strassman and Kutz, 1977
Spleen	Not given	1.8 ppm	27	GC	Random samples, ages 28 wk-88 yr.	Cassaret et al., 1968

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DIETHYLNEXYLPHTHALATE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	0.0-91.5 ug/g dry wt.	Not given	12	TLC	From blood transfusion plastic devices	Jaeger and Rubins, 1973

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DYSPROSIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.26 ppm	Not given	39	X-ray spectrometry	Healthy males. Mean age 35.3. Serum.	Gofman et al., 1964

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ERBIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.04 ppm	Not given	19	X-ray spectro-chemistry	Healthy males, mean age 35.3 yrs. Serum	Gofman et al. 1964

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EUROPIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.52 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum	Gofman et al., 1964

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FLUORIDE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Aorta	0.79-65.7 ppm wet wt.	2.13-37.9 ppm wet wt.	23	Not given	Autopsy of normal; first mean value -- zero P in water and second mean value -- 4.0 ppm P in water	Hodge and Smith, 1965
	2.64-166.3 ppm dry wt.	22.04 ppm dry wt. (median)	16-23	Not given	None	Smith et al., 1960
	0.0-20.3 and 0.0-165.1 ppm	6.0 and 40.6 ppm	23	Chem.	First values -- less calcified aortas; second values -- calcified aortas	Waldbott, 1966
Blood	Anesthesia - (a) 0.8-26.5 μ V (b) 1.0-5.1 μ V (c) 2.3-327.0 μ V (d) 4.7-36.0 μ V Anesthesia - (e) 0.9-25.2 μ V (f) 1.3-3.3 μ V (g) 0.1-445.0 μ V (h) 1.7-35.0 μ V	(a) 11.3 μ V (b) 2.86 μ V (c) 99.7 μ V (d) 16.8 μ V (e) 10.7 μ V (f) 2.1 μ V (g) 150.0 μ V (h) 12.3 μ V	8 maternal 7 infant	ISE	Methoxyflurane anesthesia and anesthesia. Blood serum (a) maternal, inorganic P (b) infant, inorganic P (c) maternal, organic P (d) infant, organic P Anesthesia -- higher dose: (e) maternal, inorganic P (f) infant, inorganic P (g) maternal, organic P (h) infant, organic P	Pry and Taven, 1974
	Not given	0.165 $\pm$ 0.07 and 0.75 $\pm$ 0.05 ppm	Not given	Not given	Fetal blood. First value -- low P intake; second value -- high P intake	Gedalia, 1970
	Not given	0.150 $\pm$ 0.06 and 0.234 $\pm$ 0.10 ppm	Not given	Not given	Maternal blood. First value -- low P intake; second value -- high P intake	Gedalia, 1970
	0.08-4.17 and 0.18-6.80 μ V	0.78 and 1.57 μ V	Not given	ISE	Blood serum. First value -- inorganic P; second value -- organic P	Guy and Taven, 1972

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FLUORIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given	1.6 μ V	5	NMR	Blood plasma. 5 cities	Guy et al., 1975
	0.019-0.112 ppm	0.47 ppm	41	ISE	In-patients, ages 17-82. Blood plasma	Perkins et al., 1976
	Not given	0.32 μ g/ml	Not given	Not given	None	Montoul and Smith, 1973
	Not given	0.88 $\pm$ 0.12 and 0.68 $\pm$ 0.10 μ V	16 pairs	ISE and Chem.	First value -- maternal serum; second value -- cord blood	Chen and Taves, 1974
	0.06-0.64 ppm ash	Not given	6	ISE and Colorimetry	None	Singer and Armstrong, 1969
	0.14-0.26 ppm	Not given	118	Not given	Five area with varied F content of water	Singer and Armstrong, 1960
	Not given	0.0006 g F	Not given	Not given	Whole blood F content	Smith, 1966
	Not given	0.01 ⁺ ppm or 0.7 $\pm$ 4 μ V	16	Fluorometry	Blood serum	Taves, 1966
	Not given	1.35 $\pm$ 0.85 and 0.38 $\pm$ 0.21 to 4.3 $\pm$ 1.8 μ V	106	Not given	Blood serum. First value -- organic F; second value -- inorganic F, low F water; and third value -- inorganic F, high F water	Taves et al., 1976
	Not given	0.013 ppm	Not given	Chem.	Blood serum	Taves, 1966
	0.38 $\pm$ 0.21-4.3 $\pm$ 1.8 and 1.35 $\pm$ 0.85 μ V	Not given	106	Not given	First values -- inorganic F; second values -- organic F	Taves et al., 1976

FLUORIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bone	Not given	800 ppm dry, defatted basis	Not given	Not given	Chicago area autopsies	Hefferen et al., 1972
	100-4000 ppm dry, fat-free tissue	Not given	Not given	Not given	High and low F areas. Iliac crest	Hodge and Smith, 1970
	0.052-0.134, 0.031-0.142, and 0.057-0.191 % ash	0.093, 0.084, and 0.125 % ash	11	Not given	First values -- mandible; second values -- femur, and third values -- iliac crest	Singer and Armstrong, 1962
	Not given	2.547 g F	Not given	Not given	Total F in bones and teeth	Smith, 1966
	1165-1490 ppm ash	Not given	11	Chem.	Root bone	Youn et al., 1960
	0.08-0.69, 0.08-0.70, and 0.10-0.80 % ash	Not given	Not given	Not given	Values, respectively, for iliac crest, rib, and vertebra	Zipkin, 1970
	0.072-0.802 ppm ash	Not given	69	Colorimetry	None	Zipkin, 1960
Brain	Not given	2.0 µg/g dry wt.	Not given	Not given	None	Mentoul and Smith, 1971
Extracellular fluid	Not given	0.002 g F	Not given	Not given	None	Smith, 1966
Heart	0.32-2.14 ppm wet wt.	0.55-1.29 ppm wet wt.	23	Not given	Autopsy of normals; first mean value -- zero F in water; second mean value -- 4.0 ppm F in water	Hodge and Smith, 1965
	Not given	2.0 µg/g dry wt.	Not given	Not given	None	Mentoul and Smith, 1971
	1.19-23.3 ppm dry wt.	2.42 ppm dry wt. (median)	16-23	Not given	None	Smith et al., 1960

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FLUORIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	0.30-5.45 ppm wet wt.	0.63-2.55 ppm wet wt.	23	Not given	Autopsy of normal; first mean value - zero F in water; second mean value - 4.0 ppm F in water	Hodge and Smith, 1965
	Not given	3.2 ug/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	1.35-25.6 ppm dry wt.	4.01 ppm dry wt. (median)	16-23	Not given	None	Smith et al., 1960
Liver	0.27-1.47 ppm wet wt.	0.52-0.92 ppm wet wt.	23	Not given	Autopsy of normal; first mean value - zero F in water; second mean value - 4.0 ppm F in water	Hodge and Smith, 1965
	Not given	4.0 ug/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	0.92-5.41 ppm dry wt.	2.14 ppm dry wt. (median)	16-23	Not given	None	Smith et al., 1960
Lung	0.54-2.91 ppm wet wt.	0.71-1.98 ppm wet wt.	23	Not given	Autopsy of normal; first mean value - zero F in water; second mean value - 4.0 ppm F in water	Hodge and Smith, 1965
	1.79-12.4 ppm dry wt.	4.34 ppm dry wt. (median)	16-23	Not given	None	Smith et al., 1960
Milk	0.0-0.6 ppm	Not given	Not given	Chem.	Higher values for mothers living near super phosphate plant	Smith, 1966
Muscle	Not given	0.016 g F	Not given	Not given	Total F in muscle and skin	Smith, 1966
Placenta	Not given	0.121 $\pm$ 0.06 and 0.228 $\pm$ 0.09 ppm	Not given	Not given	First value - low F intake; second value - high F intake	Gedalia, 1970

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FLUORIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Placenta (continued)	1.9-8.1 and 6.6-103.6 μ M	4.42 and 46.4 μ M	16 pairs	ISE and Chem.	First value -- organic F; second value -- inorganic F	Shen and Taves, 1974
Skin	Not given	0.016 g F	Not given	Not given	Total F in skin and muscles	Smith, 1966
Spleen	0.31-1.0 ppm wet wt.	0.51-0.82 ppm wet wt.	23	Not given	Autopsy of normals; first mean value -- zero F in water; second mean value -- 4.0 ppm F in water	Hodge and Smith, 1965
	1.34-16.7 ppm dry wt.	3.43 ppm dry wt. (median)	16-23	Not given	None	Smith et al., 1960
Teeth	Not given	56 ppm and 98 ppm	18	Not given	First value -- enamel; second value -- dentin	Anonymous, 1959
	970-3120 ppm	2160 $\pm$ 550 ppm	15	AAS	School children. Left maxillary incisor.	Brudevold et al.,
	Not given	73.9 $\pm$ 5.95 126.7 $\pm$ 8.63 ppm	208	MS	<20 year-olds; first value -- high caries area (New England); second value -- low caries area (South Carolina)	Curzon and Loe, 1977
	27.1-748.8 ppm	Not given	12	X-ray spectrometry	Normals, 17-24 yr. Enamel	Hoerman et al., 1966
	478-832, 302-529, 170-310, and 41-177 ppm	Not given	87	ISE	Children 12-14 yr. Premolar tooth enamel; values respectively are tooth surface, subsurface, inner, and bulk.	Little and Barrett, 1976
	70-730 μ g/g	248 $\pm$ 20 μ g/g	56	MS	<20 year-olds, wide geographic area	Loe et al., 1973

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FLUORIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Teeth (continued)	0.0067-0.0245, 0.0170-0.0990, and 0.104-0.212 % ash	0.0107, 0.062%, and 0.1580 % ash	11	Not given	First values - enamel; second values - dentin; and third values - cementum	Singer and Armstrong, 1962
	Not given	2.547 g F	Not given	Not given	Total F in bones and teeth	Smith, 1961
	0.234-0.774 ppm	Not given	18 groups	ISE	Cementum	Stepnick et al., 1975
	62-2711 ppm ash	Not given	11	Chem.	None	Youn et al.,
Urine	0.39-0.43 mg/liter	0.41 mg/liter	Not given	NAA	None	Gills et al., 1974
	0.2-4.8 ppm	Not given	1998	Chem.	Males, 15-20 yrs.	McClure and Kinser, 1944
	Not given	54 ± 6.8 ppm	16 pairs	ISE and Chem.	Maternal	Shen and Taves, 1974

GADOLINIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.26 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 33.3 yrs. Serum	Gofman et al., 1964

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GALLIUM

Tissue	Range	Mean Level	Nr. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.09 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3. Blood serum	Gofman et al., 1964
Lung	Not given	3.5 and 6.0 ug/g ash	2	ES	Sudden accident victims (normal)	Koch et al., 1956

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GERMANIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.10 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum	Gofman et al., 1964
	Not given	0.29 $\mu\text{g/ml}$	4	Colorimetry	Serum	Schroeder et al., 1967
	Not given	0.65 $\mu\text{g/ml}$	4	Colorimetry	Red blood cells	Schroeder et al., 1967
Urine	0.62-2.16 $\mu\text{g/ml}$	1.26 $\mu\text{g/ml}$	4	Colorimetry		Schroeder et al., 1967

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GOLD

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	<10-60 ug/g ash	<10 ug/g ash (median)	6 of 15	ES	Adults	Tipton and Cook, 1963
Aorta	<10-40 ug/g ash	<10 ug/g ash (median)	27 of 105	ES	Adults	Tipton and Cook, 1963
Bladder	<10-30 ug/g ash	<10 ug/g ash (median)	22 of 122	ES	Adults	Tipton and Cook, 1963
Blood	0.0-0.23 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3. Blood serum	Gelfan et al., 1964
	Not given	0.00004 ug/ml	Not given	Not given	None	Rentoul and Smith, 1973
Brain	Not given	0.5 ug/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	<10-40 ug/g ash	<10 ug/g ash (median)	1 of 129	ES	Adults	Tipton and Cook, 1963
Diaphragm	<10-40 ug/g ash	<10 ug/g ash (median)	9 of 91	ES	Adults	Tipton and Cook, 1963
Esophagus	<10-22 ug/g ash	<10 ug/g ash (median)	18 of 68	ES	Adults	Tipton and Cook, 1963
Hair	0.08×10^{-2} to 27.0×10^{-2} ppm	4.3×10^{-2} ppm	33	NAA	Children and adults, Oak Ridge, Tenn.	Bates and Dyer, 1965
	Not given	0.67 ug/g	33	NAA	None	Mahler et al., 1970
	Not given	0.0267 ± 0.0046 ppm	10	NAA	None	Obrusnik et al., 1972

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GOLD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair (continued)	Not given	0.05 ug/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
Heart	Not given	0.00013 ug/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	<10-40 ug/g ash	<10 ug/g ash (median)	6 of 140	ES	Adults	Tipton and Cook, 1963
Intestine	<10-20 ug/g ash	<10 ug/g ash (median)	13 of 68	ES	Adults. Duodenum.	Tipton and Cook, 1963
	<10-25 ug/g ash	<10 ug/g ash (median)	19 of 104	ES	Adults. Jejunum.	Tipton and Cook, 1963
	<10-33 ug/g ash	<10 ug/g ash (median)	21 of 84	ES	Adults. Ileum.	Tipton and Cook, 1963
	<10-20 ug/g ash	<10 ug/g ash (median)	6 of 31	ES	Adults. Cecum.	Tipton and Cook, 1963
	<10-25 ug/g ash	<10 ug/g ash (median)	6 of 31	ES	Adults. Sigmoid Colon.	Tipton and Cook, 1963
	<10-<10 ug/g ash	<10 ug/g ash (median)	3 of 42	ES	Adults. Rectum.	Tipton and Cook, 1963
Kidney	Not given	0.5 ug/g dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	<10-10 ug/g ash	<10 ug/g ash (median)	15 of 145	ES	Adults	Tipton and Cook, 1963
Larynx	<10-<10 ug/g ash	<10 ug/g ash (median)	3 of 50	ES	Adults	Tipton and Cook, 1963

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GOLD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	Not given	0.0001 $\mu\text{g/g}$ dry wt.	Not given	Not given	None	Rentoul and Smith, 1973
	<10-<10 $\mu\text{g/g}$ ash	<10 $\mu\text{g/g}$ ash (median)	4 of 150	ES	Adults	Tipton and Cook, 1963
Lung	<10-22 $\mu\text{g/g}$ ash	<10 $\mu\text{g/g}$ ash (median)	3 of 141	ES	Autopsies	Tipton and Cook, 1963
	<10-<10 $\mu\text{g/g}$ ash	<10 $\mu\text{g/g}$ ash (median)	3 of 141	ES	Adults	Tipton and Cook, 1963
Muscle	<10-<10 $\mu\text{g/g}$ ash	<10 $\mu\text{g/g}$ ash (median)	4 of 137	ES	Adults	Tipton and Cook, 1963
Ovary	<10-23 $\mu\text{g/g}$ ash	<10 $\mu\text{g/g}$ ash (median)	5 of 16	ES	Adults	Tipton and Cook, 1963
Omentum	7-220 $\mu\text{g/g}$ ash	30 $\mu\text{g/g}$ ash (median)	Not given	ES	Adults	Tipton and Cook, 1963
Nail	0.0-1.52 and 0.0-2.05 $\mu\text{g/g}$	0.44 $\pm$ 0.60 and 0.52 $\pm$ 0.58 $\mu\text{g/g}$	6 children; 13 adults	NAA	Low values -- children; high values -- adults	Kanabrocki et al., 1968
	Not given	0.171 $\mu\text{g/g}$	13	NAA	Fingernail	Mahler et al., 1970
Pancreas	18-130 $\mu\text{g/g}$ ash	49 $\mu\text{g/g}$ ash (median)	138	ES	Adults	Tipton and Cook, 1963
Prostate	<5-81 $\mu\text{g/g}$ ash	10 $\mu\text{g/g}$ ash (median)	44 of 50	ES	Adults	Tipton and Cook, 1963
Saliva	0.01-0.64 $\mu\text{g/100 ml}$	0.06 $\pm$ 0.02 $\mu\text{g/100 ml}$	15	NAA	None	Kanabrocki et al., 1965

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GOLD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen	7-90 ug/g ash	27 ug/g ash (median)	138 of 143	ES	Adults	Tipton and Cook, 1963
Skin	16-120 ug/g ash	46 ug/g ash (median)	21 of 22	ES	Adults	Tipton and Cook, 1963
Stomach	5-35 ug/g ash	12 ug/g ash (median)	123 of 131	ES	Adults	Tipton and Cook, 1963
Testis	5-27 ug/g ash	12 ug/g ash (median)	123 of 131	ES	Adults	Tipton and Cook, 1963
Thyroid	5-54 ug/g ash	12 ug/g ash (median)	20 of 21	ES	Adults	Tipton and Cook, 1963
Trachea	15-120 ug/g ash	44 ug/g ash (median)	60	ES	Adults	Tipton and Cook, 1963
Uterus	<10-110 ug/g ash	<10 ug/g ash (median)	1 of 32	ES	Adults	Tipton and Cook, 1963

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HAFNIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.41 ppm	Not given	19	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum	Gulman et al., 1964

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HEPTACHLOR

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.1-0.2 ppb	0.13 ppb	106	GC-EC	53 Mother-infant pairs	Selby et al., 1969
	0.1-0.8 ppb	0.21 ppb	106	GC-EC	53 Mother-infant pairs	Selby et al., 1969
Milk	Not given	Not given	1436	GC-EC	Found in <2%	Savage, 1976
Placenta	2.0-52.0 ppb	6.23 ppb	106	GC-EC	53 Mother-infant pairs	Selby et al., 1969
	0.1-54.9 ppb	2.12 ppb	106	GC-EC	53 Mother-infant pairs	Selby et al., 1969

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HEPTACHLOREPOXIDE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	0.11 ± 0.11 ppm	221	GC-EC	From surgeries	Burns, 1974
	Not given	0.04 ppm	30	GC-EC	Fat basis. Perirenal fat	Casaret et al., 1968
	Not given	0.05 ppm	29	GC-EC	Fat basis. Mesenteric fat	Casaret et al., 1968
	Not given	0.05 ppm	30	GC-EC	Fat basis. Panniculus fat.	Casaret et al., 1968
	0.01-0.14 and 0.02-0.09 ppm	0.05 and 0.05 ppm	25	GC-EC	Phenytoin (14 cases) and control (11) groups, respectively	Davis et al., 1971
	0.03-1.45 ppm	0.24 ± 0.05 ppm	25	GC		Hayes et al., 1965
	0.10-0.29 ppm	0.16 ppm	505	GC	Autopsies. Abdominal wall.	Hoffman et al., 1967
	0.04-0.46 mg/kg	0.25 mg/kg	53	GLC	Nursing mothers in Philadelphia area. Milk fat.	Kroger, 1972
	0.0-10.62 ppm	0.17 ppm	1412	GC-EC		Kutz et al., 1974
	Not given	0.09 and 0.08 ppm	3964	GC-EC, TLC, and MS	1973 (2177 cases) and 1974 (1787) years, respectively	Kutz et al., 1977
	Not given	0.09, 0.09, 0.08, 0.09, and 0.08 ppm	6933	GC-EC	Fat basis; 1970-1974 years, respectively	Kutz et al., 1977
	Not given	0.16-1.12 ppm	332	GC-EC	Autopsies. Diseased organs	Radomski et al., 1968
	0-1.3 ppb	0.1 ppb	202	GC-EC	White males and females. Adominal fat.	Wyllie et al., 1972

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HEPTACHLOREPOXIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	Not given	0.01 ppm	18	GC-EC	Fat basis	Casaret et al., 1968
Brain	Not given	<0.01	32	GC-EC	Fat basis	Casaret et al., 1968
	Not given	0.0-0.01 $\pm$ 0.01 ppm	312	GC-EC	Autopsies. Brain disease.	Radomski et al., 1968
Blood	Not given	0.0008 ppm	10	GC-EC	Women. Serum.	Dale et al., 1966
	0.0002-0.0031 ppm	0.0011 ppm	10	GC-EC	Plasma	Dale et al., 1966
	0.0004-0.0019 ppm	0.0008 ppm	10	GC-EC		Dale et al., 1966
	0.0004-0.0010 ppm	0.0007 ppm	10	GC-EC	Red blood cells	Dale et al., 1966
	0.0006-0.0028 ppm	0.0012 ppm	10	GC-EC	Serum	Dale et al., 1966
	<0.0006-0.0036 and <0.0003-0.0026 ppm	0.0012 $\pm$ 0.0004 and 0.0008 $\pm$ 0.0003 ppm	20	GC-EC	Males (10) and females (10) respectively. Red blood cells	Dale et al., 1967
	<0.0003-0.0120 and 0.0003-0.0031 ppm	0.0023 and 0.0022 ppm	20	GC-EC	Males (10) and females (10) respectively	Dale et al., 1967
	0.01-0.1 ppb	Not given	67M	GC	209 black and 130 white mother- infant pairs. Serum.	D'Ercole et al., 1976
	0.1-0.6 ppb	0.21 ppb	53	GC-EC	Mother-infant pairs. Maternal blood.	Nelby et al., 1969

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HEPTACHLOREPOXIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	0-3 ppb	<0.07 ppb	1000	GC-EC	Southern Idaho. Serum.	Watson et al., 1970
	0-2 ppb	0.1 ppb	202	GC-EC	White males and females. Serum.	Wyllie et al., 1972
Bone	Not given	0.02 ppm	30	GC-EC	Fat basis. Marrow.	Canaret et al., 1968
Gonad	Not given	0.01 ppt.	16	GC-EC	Fat basis	Canaret et al., 1968
Kidney	Not given	0.01 ppm	38	GC-EC	Fat basis	Canaret et al., 1968
Liver	Not given	0.08 ppm	42	GC-EC	Fat basis	Canaret et al., 1968
	Not given	Trace - 0.05 ± 0.09 ppm	332	GC-EC	Autopsies. Liver disease.	Radomski et al., 1968
Lung	Not given	0.02 ppm	25	GC-EC	Fat basis	Canaret et al., 1968
Lymph	Not given	<0.01 ppm	11	GC-EC	Fat basis. Tracheobronchial nodes.	Canaret et al., 1968
Milk	Trace - 5 ppb	0.4 ppb	40	GC	Women, fat basis; rural Colorado	Savage et al., 1973
	15.24-2050 ppb	91.36 ppb	1436	GC-EC	National study. Fat basis.	Savage, 1976
	Trace - 0.03 ppm	0.004 ppm	57	GC-EC and GC-MS	Mississippi and Arkansas	Strauman and Kutz, 1977
Placenta	0.1-6.5 ppb	1.21 ppb	53	GC-EC	Mother-infant pairs	Selby et al., 1969

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HEPTACHLOREPOXIDE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen	Not given	<0.01 ppm	27	GC-EC	Fat basis	Cassaret et al., 1968

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HEXACHLOROPHENE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0-80 ppb	20.0 ppb	20	GC-EC		Shafik, 1973
Milk	Trace-9.0 ppb (1971) 0-8.3 ppb (1973)	Not given Not given	12	GC-EC	White, urban, middle-class mothers	West et al., 1975

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HOLMIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.41 ppm	Not given	39	X-ray spectrometry	Healthy men, mean age 35.3 yrs. Serum	Gofman et al., 1964

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INDIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.21 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum	Gofman et al., 1964

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IODINE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.57 ppm	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964
Hair	0.03-0.14 µg/g dry wt.	Not Given	2	MS; AAS		Yurachek et al., 1969
Milk	0.03-28%	25% (median)	5	Radiometry	2 of administered dose sequent- ered after 48 hrs.	Weaver et al., 1960
Teeth	0.01-0.07 µg/g dry wt.	0.036 µg/g dry wt.	56	MS	<20-year-old	Loose et al., 1973
Thyroid	20-39%	25% (median)	5	Radiometry	2 of administered dose sequent- ered after 48 hrs.	Weaver et al., 1960
Urine	50-74%	53% (median)	5	Radiometry	2 of administered dose sequent- ered after 48 hrs.	Weaver et al., 1960

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IRIDIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.13 ppm	Not Given	19	X-ray spectrometry	Healthy males, mean age 15.1 yrs. Serum.	Gofman et al., 1964

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KEPONE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Tissues	<1-1.32 ppm	0.38 ppm	186	Not given	Samples taken from sites treated with Mirex during the past 10 yrs.	Anon., 1976

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LANTHANUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.21 ppm	Not given	39	X-ray spectrometry	Healthy males; mean age 35.3 yrs. Serum.	Gofman et al., 1964
Teeth	0.02-0.12 mg/g dry wt.	0.004 mg/g dry wt.	56	MS	<20 years old. Enamel.	Loose et al., 1973

LEAD

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	0.04 ± 0.01 ppm wet wt.	43	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	0.1-1.5 mg (total tissue)	0.60 mg	258	ES		Schroeder and Tipton, 1968
Adrenal	Not given	0.25 ± 0.12 ppm wet wt.	41	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	11-140 $\mu\text{g/g}$ ash	27 $\mu\text{g/g}$ ash	15	ES		Tipton and Cook, 1963
Aorta	Not given	$1.65 \pm$ ppm wet wt.	45	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	0.6-7.6 ppm wet wt.	3.5 ppm wet wt.	18	AAS	Sudden deaths, Baltimore, Md.	Poklis, 1975
	0.15-1.0 mg (total aorta)	0.22 mg	258	ES		Schroeder and Tipton, 1968
	34-280 $\mu\text{g/g}$ ash	140 $\mu\text{g/g}$ ash	104	ES		Tipton and Cook, 1963
Bladder	Not given	6 ppm wet wt.	2	ES	Sudden accident victims	Koch et al., 1956
	<5-41 $\mu\text{g/g}$ ash	13 $\mu\text{g/g}$ ash	99 of 112	ES		Tipton and Cook, 1963
Blood	Not given	+ 40 $\mu\text{g}/100$ ml	2269	ASV	Urban area children	Anderson and Clark, 1974
	13.1-27.4 $\mu\text{g}/\text{L}$ (range of means)	20 $\mu\text{g}/\text{L}$	70	AAS	Omaha, Nebraska area children; half caucasian and half negro	Angle et al., 1974
	5.6-27.4 $\mu\text{g}/100$ ml;	Not given	104	AAS	Blood; Plasma; Red blood cells. Children, 10-18 years old.	Angle and McIntire, 1974
	4.5-7.2 $\mu\text{g}/100$ ml;					
	14.5-41.8 $\mu\text{g}/100$ ml					

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given	29.1 $\mu\text{g}/100\text{ ml}$; 28.1 $\mu\text{g}/100\text{ ml}$; 20.0 $\mu\text{g}/100\text{ ml}$; <20.0 $\mu\text{g}/100\text{ ml}$	1559	Electrophoresis	Philadelphia, Pennsylvania 1-3 olds; 6 year olds; 10 year olds; 11-18 year olds	Adebonojo, 1974
	<80 $\mu\text{g}/100\text{ ml}$	27-33 $\mu\text{g}/100\text{ ml}$	34	AAS	Pistol range instructors from Georgia	Landrigan et al., 1975
	14-210 μg	40.8 μg	450	AAS	Children	Rosen, 1972
	11-78 μg	33.8 μg	26	AAS	Children	Rosen, 1972
	2-81 $\mu\text{g}/100\text{ ml}$	26.2 $\mu\text{g}/100\text{ ml}$	119	AAS	Illinois children	Thomas et al., 1976
	9-102 $\mu\text{g}/100\text{ ml}$	40 $\mu\text{g}/100\text{ ml}$	379	AAS	Newark, New Jersey children, 1-8 year olds	Bagdon et al., 1974
	Not given	0.91 $\pm$ 0.77 $\mu\text{g/g}$	84	AAS	Maternal blood from Nashville, Tennessee hospitals	Baglan et al., 1974
	Not given	0.58 $\pm$ 0.93 $\mu\text{g/g}$	130	AAS	Fetal blood from Nashville, Tennessee hospitals	Baglan et al., 1974
	Not given	0.0039 $\pm$ 0.0002 $\mu\text{g}/100\text{ ml}$	122	ES	Los Angeles area blood donors, Serum.	Butt et al., 1964
	Not given	0.0027 $\pm$ 0.0005 $\mu\text{g}/100\text{ ml}$	96	ES	Los Angeles area surgical patients. Serum.	Butt et al., 1964
	Not given	0.0028 $\pm$ 0.0008 $\mu\text{g}/100\text{ ml}$	48	ES	Los Angeles area residents, Serum.	Butt et al., 1964
	Not given	0.0177 $\pm$ 0.0008 $\mu\text{g}/100\text{ ml}$	47	ES	Los Angeles area residents	Butt et al., 1964

LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	40-60 $\mu\text{g}/100\text{ ml}$	50 $\mu\text{g}/100\text{ ml}$	5226	AAS	Newark, New Jersey children, 1-15 years old	Caprio et al., 1974
	19-81 $\mu\text{g}/100\text{ ml}$	40.7 $\mu\text{g}/100\text{ ml}$	75	AAS	Charleston, South Carolina pre-school children; 36-42% hematocrit levels	Chisolm et al., 1974
	19-71 $\mu\text{g}/100\text{ ml}$	36.9 $\mu\text{g}/100\text{ ml}$	40	AAS	Charleston, South Carolina pre-school children; 30-35% hematocrit levels	Chisolm et al., 1974
	33-68 $\mu\text{g}/100\text{ ml}$	Not given	18	AAS	Children 13-67 months of age	Chisolm et al., 1975
	3-70 $\mu\text{g}/100\text{ ml}$	21 $\mu\text{g}/100\text{ ml}$	210	AAS	Rural children	Cohen et al., 1973
	6-136 $\mu\text{g}/100\text{ ml}$	30 $\mu\text{g}/100\text{ ml}$	272	AAS	Urban children	Cohen et al., 1973
	7-80 $\mu\text{g}/100\text{ ml}$	25.4 $\pm$ 17 $\mu\text{g}/100\text{ ml}$	34	AAS	Autistic and atypical children	Cohen et al., 1976
	9-22 $\mu\text{g}/100\text{ ml}$	15.2 $\pm$ 4.2 $\mu\text{g}/100\text{ ml}$	10	AAS	Normal children	Cohen et al., 1976
	Not given	41.1 $\pm$ 12.2 $\mu\text{g}/100\text{ ml}$; 22.2 $\pm$ 10 $\mu\text{g}/100\text{ ml}$	N; 37	AAS	Hyperactive children with history of lead poisoning; nonhyperactive children	David, 1974
	5-64.5 $\mu\text{g}/100\text{ ml}$; 5-56.5 $\mu\text{g}/100\text{ ml}$; 25-64.5 $\mu\text{g}/100\text{ ml}$; 5-44.5 $\mu\text{g}/100\text{ ml}$	Not given; 26 $\mu\text{g}/100\text{ ml}$; 41 $\mu\text{g}/100\text{ ml}$; 22 $\mu\text{g}/100\text{ ml}$	119; 54; N; 37	AAS	Hyperactive and nonhyperactive children; hyperactive; hyperactive with history of lead poisoning; nonhyperactive	David, 1972
	1-53 $\mu\text{g}/100\text{ ml}$	30 $\mu\text{g}/100\text{ ml}$	68	Not given	Exposed urban children, mostly negro, 60% female	de la Burde and Shapiro, 1975

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given; Not given; Not given	156 $\mu\text{g}/100\text{ml}$; 88 $\mu\text{g}/100\text{ ml}$; 14 $\mu\text{g}/100\text{ ml}$	1; 1; 3	Not given	Caucasian female; male; children	Dickinson et al., 1972
	4.3-12.0 $\mu\text{g}/100\text{ ml}$; 4.6-17.5 $\mu\text{g}/100\text{ ml}$	Not given; Not given	249; 253	Not given	Fetal blood from controls; fetal blood from patients living in lead mining region	Fahim et al., 1975
	13.1-30.1 $\mu\text{g}/100\text{ ml}$; 14.3-29.1 $\mu\text{g}/100\text{ ml}$	Not given; Not given	249; 253	Not given	Maternal blood from controls; maternal blood from patients living in lead mining region	Fahim et al., 1975
	12-60 $\mu\text{g}/100\text{ ml}$	Not given	12	AAS	9 children, 3 adults	Fung et al., 1975
	10.0-12.6 $\mu\text{g}/100\text{ ml}$ (mean range)	10.5 $\mu\text{g}/100\text{ ml}$	381	AAS	Maternal blood. Louisiana patients 11-35 years old	Gershanik et al., 1974
	7.0-11.1 $\mu\text{g}/100\text{ ml}$ (mean range)	9.4 $\mu\text{g}/100\text{ ml}$	218	AAS	Cord blood. Louisiana patients 11-35 years old	Gershanik et al., 1974
	0.07-0.33 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 years	Gofman et al., 1964
	0-100 $\mu\text{g}/\text{ml}$; 10-27 $\mu\text{g}/\text{ml}$; 10-53 $\mu\text{g}/\text{ml}$	21 $\mu\text{g}/\text{ml}$; 21 $\mu\text{g}/\text{ml}$; 16 $\mu\text{g}/\text{ml}$	105; 33; 40	Colorimetry	New York City residents; California residents; Ohio residents	Goldwater and Hoover, 1967
	<10-100 $\mu\text{g X}$	Not given	385	AAS	Kansas City children 1-3 years old	Green et al., old
	Not given	0.21 $\pm$ 0.09 ppm wet wt.	43	Colorimetry	Cincinnati area, white males, 20-84 years old	Gross et al., 1975
	<10-110 $\mu\text{g}/100\text{ ml}$	Not given	>84,000	AAS	New York City children of lower socioeconomic status	Guinee, 1972

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	9.4-20.9 $\mu\text{g}/100\text{ ml}$	Not given	116	AAS	School-aged males	Hammer et al., 1971
	Not given	0.011-0.038 $\text{mg}/100\text{ g}$	1877	Not given	Males from U.S. major cities	Hammond, 1969
	Not given	0.011-0.026 $\text{mg}/100\text{ g}$	700	Not given	Philadelphia residents	Hammond, 1969
	10-20 $\mu\text{g}/100\text{ g}$; 10-20 $\mu\text{g}/100\text{ g}$; 10-20 $\mu\text{g}/100\text{ g}$	14.0 $\mu\text{g}/100\text{ g}$; 12.5 $\mu\text{g}/100\text{ g}$; 13.2 $\mu\text{g}/100\text{ g}$	11; 13; 24	Colorimetry	New Haven, Connecticut patients, maternal venous blood; suburban; urban ghetto; total sample	Harris et al., 1972
	10-20 $\mu\text{g}/100\text{ g}$; 10-20 $\mu\text{g}/100\text{ g}$; 10-20 $\mu\text{g}/100\text{ g}$	12.7 $\mu\text{g}/100\text{ g}$; 11.9 $\mu\text{g}/100\text{ g}$; 12.3 $\mu\text{g}/100\text{ g}$	11; 13; 24	Colorimetry	New Haven, Connecticut patients, cord blood; suburban; urban ghetto; total sample	Harris et al., 1972
	<1-81 $\mu\text{g}/100\text{ ml}$	14.6 $\mu\text{g}/100\text{ ml}$	100	ASV	Ann Arbor, Michigan residents, 18-58 years old	Hecker et al., 1974
	.001-.060 $\text{mg}/100\text{ g}$	Not given	897	Colorimetry	Urban and rural area residents	Hofreiter et al., 1961
	111-295 $\mu\text{g}/\text{liter}$; 76-142 $\mu\text{g}/\text{liter}$; 78-159 $\mu\text{g}/\text{liter}$	160 $\mu\text{g}/\text{liter}$; 96 $\mu\text{g}/\text{liter}$; 114 $\mu\text{g}/\text{liter}$	59	AAS	Men; women; 11 women using oral contraceptives	Hohnadel et al., 1973
	Not given	16.4 0.7 $\mu\text{g}/100\text{ml}$; 10.5 0.4 $\mu\text{g}/100\text{ml}$	252	AAS	Los Angeles; Lancaster	Johnson et al., 1975
	Not given	0.025 $\text{mg}/100\text{ g wet wt.}$	Not given	ES		Kehoe et al., 1940
	0.7-7.7 $\mu\text{g}/100\text{ ml}$	3.9 $\mu\text{g}/100\text{ ml}$	Not given	ES	Sudden accident victims. Plasma.	Koch et al., 1956
	<1.109.27 $\mu\text{g}/100\text{ ml}$	13.17 $\mu\text{g}/100\text{ ml}$	243	AAS	19 cities	Kubota et al., 1977

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	0.024-0.072 $\mu\text{g}/10^9$ RBC 0.021-0.076 $\mu\text{g}/10^9$ RBC	0.044 $\mu\text{g}/10^9$ RBC 0.037 $\mu\text{g}/10^9$ RBC	47	AAS	Maternal; fetal blood. 47 matched pairs.	Kuhnert et al., 1977
	40-68 $\mu\text{g}/100$ ml	48 $\mu\text{g}/100$ ml	46	Not given	Children	Landrigan et al., 1975
	>40 $\mu\text{g}/100$ ml	Not given	1369	Not given	Found in 53% of cases living within 1.6 km of smelter	Landrigan et al., 1975
	12-28 $\mu\text{g}/100$ g	18.37 $\mu\text{g}/100$ g	1	Colorimetry	35 samples	Lerner, 1975
	Not given	7.2-21.7 $\mu\text{g}/100$ g	10	MS	Age 25-37 years	Manton, 1977
	Not given	17.3 $\pm$ 6.4 - 19.9 $\pm$ 8.1 $\mu\text{g}/100$ ml	4000+	Colorimetry	DuPont employees from 23 locations	McLaughlin et al., 1973
	15.5-21.6 $\mu\text{g}/100$ g (geometric means)	23.3 $\mu\text{g}/100$ g	5750	Colorimetry	DuPont employees at 23 cities	McLaughlin et al., 1973
	10-25 $\mu\text{g}/100$ ml 50-80 $\mu\text{g}/100$ ml	20.4 $\mu\text{g}/100$ ml 56.9 $\mu\text{g}/100$ ml	46	Colorimetry	125 controls; 21 subjects (chosen from low income)	Moore et al., 1975
	Not given	0.37 $\pm$ 0.15 $\mu\text{g}/\text{g}$	341	AAS	Children	Fueschel et al., 1972
	0.17-0.25 $\mu\text{g}/\text{g}$	0.194 $\mu\text{g}/\text{g}$	5	MS	Healthy adult males	Rabinovitz et al., 1975
	14-30 $\mu\text{g}/100$ ml 41-51 $\mu\text{g}/100$ ml	22.6 $\mu\text{g}/100$ ml 45.3 $\mu\text{g}/100$ ml	19	AAS	Black children, age 4-6	Reigart and Graber, 1976
	Not given	0.29 $\mu\text{g}/\text{ml}$	Not given	Not given	Normal level	Rentoul and Smith, 1973
	Not given	0.03 mg/100 ml; 0.027 mg/100 ml	100	Not given	50 poisoned children; 50 controls; New York City	Russo et al., 1973

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	10-200 $\mu\text{g}/100\text{ ml}$	20.8-43.9 $\mu\text{g}/100\text{ ml}$	1812	Not given	3 neighborhoods in Chicago, summer	Sachs, 1974
	Not given	(a) 24.2 $\mu\text{g}/100\text{ ml}$; (b) 22.0 $\mu\text{g}/100\text{ ml}$; (c) 21.5 $\mu\text{g}/100\text{ ml}$; (d) 15.2 $\mu\text{g}/100\text{ ml}$	28	Colorimetry	(a) Urban smokers; (b) Urban nonsmokers; (c) Suburban smokers; (d) Suburban nonsmokers;	Scanlon, 1971
	0.22-2.7 mg (total blood)	1.4 mg	258	ES		Schroeder and Tipton, 1968
	12-77 $\mu\text{g}/100\text{ ml}$	Not given	24	AAS		Searle et al., 1973
	59-68 $\mu\text{g}/100\text{ ml}$	Not given	Not given	ASV		Silbergeld and Chinolm, 1976
	4-86 $\mu\text{g}/100\text{ ml}$	36 $\mu\text{g}/100\text{ ml}$	320	AAS	Children, ages 1-5 years	Singh et al., 1975
	>40 $\mu\text{g}/100\text{ ml}$	Not given	(a) 1 of 79; (b) 3 of 190	AAS	(a) 1972; (b) 1974; children	Smith et al., 1976
	0.87-30.5 $\mu\text{g}/100\text{ g}$	15.7 $\mu\text{g}/100\text{ g}$	60	AAS	White middle and upper class, Salt Lake City	Smith, 1976
	Not given	23 $\pm$ 1.0 - 84 $\pm$ 5.0 $\mu\text{g}/100\text{ ml}$	124	AAS	Black and Puerto Rican, Bronx, age 1-6 years	Sorrell and Rowan, 1977
Bone	13.5-34.6 $\mu\text{g}/100\text{ g}$; 3.8-43.0 $\mu\text{g}/100\text{ g}$	Not given	100	Colorimetry	Live near freeway; do not live near freeway	Thomas et al., 1967
	Not given;	14.09 $\pm$ 11.22 ppm wet wt.	45; 44;	Colorimetry	Cincinnati area white males, 20-84 years old; tibia; skull; rib; vertebrae	Gross et al., 1975
	Not given;	13.81 $\pm$ 9.09 ppm wet wt.	45; 44			
	Not given	7.14 $\pm$ 4.19 ppm wet wt.				
	Not given	4.42 $\pm$ 2.52 ppm wet wt.				

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bone (continued)	11-214 ppm ash wt.	59 ppm ash wt.	120	AAS	North and South Carolina adult and pediatric autopsies	Hammer et al., 1973
	0.2-32 ppm ash wt.	Not given	14	AAS	North and South Carolina pediatric autopsies	Hammer et al., 1973
	0.21-1.11 mg/100 g	0.65 mg/100 mg	15	ES; Chem.	Autopsies. Flat bone.	Kehoe, 1961
	0.67-3.59 mg/100 g	1.78 mg/100 mg	15	ES; Chem.	Autopsies. Long bone.	Kehoe, 1961
	Not given	1.88 mg/100 g wet wt.	Not given	ES	Long bone	Kehoe et al., 1940
	Not given	0.470 mg/100 g	Not given	ES	Rib bone	Kehoe et al., 1940
	Not given	19 ppm	2	ES		Koch et al., 1956
	7.5-195 mg (total tissue)	110.0 mg	258	ES		Schroeder and Tipton, 1968
	77-237 ug/g ash	Not given	40	AAS	1 skeleton	Strehlow, 1969
Brain	Not given;	0.11 + 0.05 ppm wet wt.;	39; 41	Colorimetry	Cincinnati area white males, 20-84 years old; grey; white	Gross et al., 1975
	Not given	0.11 + 0.04 ppm wet wt.				
	0.01-0.09 mg/100 g wet wt.	0.04 mg/100 g wet wt.	15	ES	Autopsies	Kehoe, 1961
	Not given	0.013 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.2 ppm wet wt.	3	ES		Kehoe et al., 1956

LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain (continued)	Not given	0.08 ± 0.01 mg/100 g dry wt.	Not given	ES	Above 1 year old	Musbaum et al., 1958
	Not given	0.20 μ g/g dry wt.	Not given	Not given	Normal levels	Rentoul and Smith, 1973
	0-8.8 mg (total brain)	0.14 mg	258	ES		Schroeder and Tipton, 1968
	<5-39 μ g/g ash	5 μ g/g ash	89 of 129	ES		Tipton and Cook, 1963
Connective	0-4.8 mg (total tissue)	1.08 mg	258	ES		Schroeder and Tipton, 1968
Diaphragm	<5-29 μ g/g ash	10 μ g/g ash	75 of 91	ES		Tipton and Cook, 1963
Esophagus	<5-70 μ g/g ash	10 μ g/g ash	55 of 68	ES		Tipton and Cook, 1963
Fascia	Not given	0.10 ± 0.05 ppm wet wt.	43	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
Feces	Not given	0.90 ± 0.09 μ g/g; 1.22 ± 0.08 μ g/g	248	AAS	Los Angeles; Lancaster	Johnson et al., 1975
	Not given	0.336 mg/24 hr.	117	ES	Urban	Kehov et al., 1940
Fetal membranes	9-40 μ g/100 g; 11-12 μ g/100 g	Not given; Not given	249; 253	Not given	Control patients; patients living in a lead mining region	Fahim et al., 1976
Gastrointestinal tract	0-3.1 mg (total organ)	0.15 mg	258	ES		Schroeder and Tipton, 1968

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	Not given	31.5 ug/g	50	AAS	Maternal scalp hair. Cincinnati hospital patients, mean age 22.5 years	Baumslag et al., 1974
	Not given	16.6 ug/g	51	AAS	Maternal pubic hair. Cincinnati hospital patients, mean age 22.5 years	Baumslag et al., 1974
	Not given	13.9 ug/g	34	AAS	Neonatal scalp hair. Cincinnati hospital patients	Baumslag et al., 1974
	2.12-100.00 ug/g	13.47 ug/g; 11.74 ug/g; 14.07 ug/g; 17.13 ug/g	284; 126; 90; 71	AAS	New York City children; Riverhead; Queens; Bronx	Creason, 1975
	1.96-155.00 ug/g	12.21 ug/g; 10.39 ug/g; 14.50 ug/g; 12.88 ug/g	207; 85; 77; 49	AAS	New York City adults; Riverhead; Queens; Bronx	Creason, 1975
	7.6-61 ppm; 10.6-50 ppm	24.1 ppm; 26.7 ppm	25; 25	AAS	Females 13-72 years old; males 9-60 years old	Kada and Lamhdin, 1973
	0.0041-0.01 % dry tissue	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	5.5-45.9 ppm	Not given	116	AAS	Scalp hair from school-aged males	Hammer et al., 1971
	0-595 ppm; 0-195 ppm; 0-85 ppm; 0-85 ppm; 0-25 ppm	107.1 ppm; 44.3 ppm; 14.3 ppm; 12.1 ppm; 7.6 ppm	45; 25; 37; 21; 38	AAS	Fourth grade males: lead and zinc mining and smelting area; lead and zinc smelting area; copper smelting area; government and commercial area; education and farm trading area	Hammer et al., 1971
	2-141 ug/g	34 ug/g	12	AAS	Scalp hair	Hinnerich et al., 1974

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair (continued)	Not given	(a) 44.9 ± 4.3 $\mu\text{g/g}$ (b) 19.3 ± 3.1 $\mu\text{g/g}$ (c) 56.2 ± 7.0 $\mu\text{g/g}$ (d) 15.7 ± 1.3 $\mu\text{g/g}$	230 (a) (b), 188 (c) (d)	AAS	(a) Long hair, Los Angeles (b) Long hair, Lancaster (c) Short hair, Los Angeles (d) Short hair, Lancaster	Johnson et al., 1975
	Not given	118 ± 100 $\mu\text{g/g}$; 27 $\mu\text{g/g}$	705	AAS	Study area; controls. Age 6 mo.-6 yrs., impoverished section of Boston	Pueschel et al., 1972
	Not given	35 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Kentoul and Smith, 1971
	Not given	17.8 ± 2.2 $\mu\text{g/g}$; 19 ± 3 $\mu\text{g/g}$	180	AAS	117 women; 47 men	Schroeder and Naxon, 1964
	0.05-1.5 mg (total tissue)	0.75 mg	258	ES		Schroeder and Tipton, 1968
	Not given	44.7 ± 0.3 $\mu\text{g/g}$	1	AAS		Sorenson et al., 1971
	1-2080 $\mu\text{g/g}$	Not given	260	Not given	Traffic and desk officers, Boston, Irish and Italian	Speizer and Ferris, 1973
	Not given	14.5 and 21.8 $\mu\text{g/g}$ dry wt.	2	MN; AAS		Yurachek et al., 1969
Heart	Not given	0.08 ± 0.04 ppm wet wt.	43	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	Not given	0.04 mg/100 g wet wt.	15	ES; Chem.	Autopsies	Kelso, 1961
	Not given	0.038 mg/100 g wet wt.	Not given	ES		Kelso et al., 1940
	Not given	0.20 ± 0.01 mg/100 g dry wt.	Not given	ES	Above 1 year old	Murbaum et al., 1958

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart (continued)	0-0.4 mg (total organ)	0.02 mg	258	ES		Schroeder and Tipton, 1968
	<5-18 ug/g ash	5 ug/g ash	79 of 140	ES		Tipton and Cook, 1963
Intestine	Not given	0.12 ± 0.05 ppm wet wt.	45	Colorimetry	Cincinnati area white males, 20-84 years old. Jejunum.	Gross et al., 1975
	Not given	0.07 ± 0.03 ppm wet wt.	45	Colorimetry	Cincinnati area white males, 20-84 years old. Cecum.	Gross et al., 1975
	Not given	0.023 mg/100 g wet wt.	Not given	ES		Kelso et al., 1940
	Not given	0.3 ppm wet wt.; 0.8 ppm wet wt.	1; 7	ES	Large intestine; small intestine	Koch et al., 1958
	5-82 ug/g ash; 5-53 ug/g ash; 5-62 ug/g ash; 5-90 ug/g ash; <5-50 ug/g ash; 5-77 ug/g ash	25 ug/g ash (median); 13 ug/g ash (median); 20 ug/g ash (median); 27 ug/g ash (median); 13 ug/g ash (median); 20 ug/g ash (median)	67 of 68; 97 of 104; 82 of 84; 31; 94 of 109; 41 of 42	ES	Duodenum; Jejunum; Ileum; Cecum; Sigmoid colon; Rectum	Tipton and Cook, 1963
	Not given; Not given	0.79 ± 0.42 ppm wet wt. 0.48 ± 0.22 ppm wet wt.	45; 44	Colorimetry	Cincinnati area white males, 20-84 years old; cortex; medulla	Gross et al., 1975
Kidney	15-246 ppm ash wt.	30 ppm ash wt.	120	AAS	North and South Carolina adult and pediatric autopsies	Hammer et al., 1973
	1.4-74 ppm ash wt.	Not given	14	AAS	North and South Carolina pediatric autopsies	Hammer et al., 1973
	Not given; Not given	120 ug/g ash; 120 ug/g ash	12; 12	AAS	St. Louis area veteran autopsies; control; emphysema patients	Hirst et al., 1973

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney (continued)	0.015-0.16 mg/100 g wet wt.	0.05 mg/100 g wet wt.	15	ES; Chem.	Autopsies	Kehoe, 1961
	Not given	0.027 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1946
	522.1-2335.5 ug/g dry wt.	1404 ug/g dry wt.	5	ES	Normals	Koch et al., 1957
	Not given	(a) 49 ug/g ash (b) 60 ug/g ash (c) 47 ug/g ash (d) 50 ug/g ash	80	AAS	(a) controls (b) hypertensives (c) heart disease (d) malignant diseases	Morgan, 1969
	16-1728 ug/g ash	69 ug/g ash	100	AAS	Autopsies, VA hospital, Birmingham, Alabama	Morgan, 1972
	34-68 ug/g ash	54 ug/g ash	46	AAS	Necropsies, VA hospital, Birmingham, Alabama	Morgan, 1972
	Not given	0.36 ± 0.02 mg/100 g dry wt.	Not given	ES	Above 1 year old	Nusbaum et al., 1958
	Not given	0.166 mg/g ash; 123 mg/g ash	24	AAS	12 emphysematous; 12 controls	Perry et al., 1972
	0.21-1.1 micromoles/g ash	Not given	150	ES	Adults	Perry et al., 1962
	0.40-3.8 ppm wet wt.	1.8 ppm wet wt.	22	AAS	Sudden deaths, Baltimore, Maryland	Poklis and Freimuth, 1976
	Not given	0.27 ug/g dry wt.	Not given	Not given	Normal level	Rentoul and Smith, 1973

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney (continued)	0.003-2.0 mg (total organs)	0.34 mg	258	ES		Schroeder and Tipton, 1963
	0-1.5+ mg/100 dry wt.	Not given	Not given	Not given	Cancer patients and autopsy specimens	Tietz et al., 1957
	42-220 μ g/g ash	98 μ g/g ash (median)	145	ES		Tipton and Cook, 1963
Larynx	11-140 μ g/g ash	64 μ g/g ash (median)	50	ES		Tipton and Cook, 1963
Liver	Not given	0.98 $\pm$ 0.53 ppm wet wt.	45	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	15-785 ppm ash wt.	45 ppm ash wt.	120	AAS	North and South Carolina adult and pediatric autopsies	Hammer et al., 1973
	0.7-167 ppm ash wt.	Not given	14	AAS	North and South Carolina pediatric autopsies	Hammer et al., 1973
	Not given; Not given	120 μ g/g ash; 140 μ g/g ash	12; 12	AAS	St. Louis area veteran autopsies; control; emphysema patients	Hirst et al., 1973
	0.04-0.28 mg/100 g wet wt.	0.12 mg/100 g wet wt.	15	ES; Chem.	Autopsies	Kehee, 1961
	Not given	0.130 mg/100 g wet wt.	Not given	ES		Kehee et al., 1940
	610-2046 μ g/g dry wt.	1332 μ g/g dry wt.	3	ES	Normals	Koch et al., 1957
	Not given	3.8 ppm wet wt.	5	ES	Sudden accident victims	Koch et al., 1957
	Not given	0.52 $\pm$ 0.02 mg/100 g dry wt.	Not given	ES	Above 1 year old	Munbaum et al., 1958

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver (continued)	Not given	0.141 mg/g ash; 0.111 mg/g ash	24	AAS	12 emphysematous; 12 controls	Perry et al., 1972
	0.29-1.2 micromole/g ash	Not given	150	ES	Adults	Perry et al., 1962
	Not given	276 ± 176 µg/g ash	10	ES	Accident victims, St. Louis area	Perry et al., 1973
	1.0-6.3 ppm wet wt.	2.5 ppm wet wt.	22	AAS	Sudden deaths, Baltimore, Maryland	Foklis and Freimuth, 1976
	Not given	1.7 µg/g dry wt.	Not given	Not given	Normal level	Kentoul and Smith, 1973
	0.72-13.5 mg (total organ)	3.1 mg	258	ES		Schroeder and Tipton, 1968
	0-1.34 mg/100 g dry wt.	Not given	Not given	Not given	Cancer patients and autopsy specimens	Tietz et al., 1957
	60-250 µg/g ash	130 µg/g ash (median)	150	ES		Tipton and Cook, 1963
Lung	Not given	0.36 ± 0.12 ppm wet wt.	42	Colorimetry	Cincinnati area white males, 20-84 years old	Cross et al., 1975
	Not given; Not given	130 µg/g ash; 240 µg/g ash	12; 12	AAS	St. Louis area veteran autopsies; control; emphysema patients	Hirst et al., 1973
	Not given	0.02 mg/100 g wet wt.	15	ES; Chem.	Autopsies	Kehoe, 1961
	Not given	0.028 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	1123.2-1338.5 µg/g dry wt.	1205 µg/g dry wt.	3	ES	Normals	Koch et al., 1957

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung (continued)	Not given	1.6 ppm wet wt.	4	ES	Sudden accident victims	Koch et al., 1957
	Not given	0.23 ± 0.02 mg/100 g dry wt.	Not given	ES	Above 1 year old	Munbaum et al., 1958
	Not given	0.210 mg/g ash; 0.145 mg/g ash	24	AAS	12 emphysematous; 12 controls	Perry et al., 1972
	0.062-0.68 micromole/g ash	Not given	150	ES	Adults	Perry et al., 1962
	0.21-1.8 ppm wet wt.	0.85 ppm wet wt.	22	AAS	Sudden deaths, Baltimore, Maryland	Poklis and Freimuth, 1976
	Not given	Max. 5500; Min. 50; Retained 1 yr. 0 µg/yr.	168	Not given	58 cities and 29 nonurban areas	Schroeder, 1970
	0.05-6.1 mg (total organ)	0.39 mg	258	ES		Schroeder and Tipton, 1963
	Not given	0.57-1.67 µg/g	66	AAS;	0.57 µg/g female; 1.04 µg/g, males	Stringer et al., 1974
	0-1.0 mg/100 g dry wt.	Not given	Not given	Not given	Cancer patients and autopsy specimens	Tiets et al., 1957
	5-550 µg/g ash	67 µg/g ash (median)	141	ES	Autopsies, 9 cities	Tipton et al., 1964
	15-140 µg/g ash	47 µg/g ash (median)	141	ES		Tipton and Cook, 1963
Lymph nodes	Not given	0.86 ± 0.93 ppm wet wt.	41	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Milk	0.006-0.058 $\mu\text{g}/\text{ml}$	0.026 $\pm$ 0.011 $\mu\text{g}/\text{ml}$	29	AAS	United States residents, 23-28 year	Dillen et al., 1974
	0-0.07 $\mu\text{g}/\text{ml}$	0.02 $\mu\text{g}/\text{ml}$	14	AAS		Lamm et al., 1973
	0.0060-0.0202 ppm	0.0109 ppm	14	AAS	Age 21-37 years	Pinkerton et al., 1972
Muscle	Not given	0.07 $\pm$ 0.03 ppm wet wt.	44	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	0.010-0.17 mg/100 g wet wt.	0.03 mg/100 g wet wt.	15	ES; Chem.	Autopsies	Kehoe, 1961
	Not given	0.010 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.4 ppm wet wt.	8	ES	Sudden accident victims	Koch et al., 1957
	0-179.2 mg (total tissue)	1.7 mg	258	ES		Schroeder and Tipton, 1968
	<5-16 $\mu\text{g}/\text{g}$ ash	<5 $\mu\text{g}/\text{g}$ ash (median)	65 of 136	ES		Tipton and Cook, 1963
Nails	0.0037-0.024 % dry tissue	Not given	18	ES	Healthy males, 15-70 years old	Goldblum et al., 1953
Omentum	7-220 $\mu\text{g}/\text{g}$ ash	30 $\mu\text{g}/\text{g}$ ash (median)	72 of 74	ES		Tipton and Cook, 1963
Ovary	<5-27 $\mu\text{g}/\text{g}$ ash	11 $\mu\text{g}/\text{g}$ ash (median)	12 of 16	ES		Tipton and Cook, 1963

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Pancreas	Not given	0.46 ± 0.23 ppm wet wt.	45	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	Not given	2.0 ppm wet wt.	2	ES	Sudden accident victims	Koch et al., 1957
	0.49-1.8 ppm wet wt.	0.92 ppm wet wt.	22	AAS	Sudden deaths, Baltimore, Maryland	Foklis and Fretmuth, 1976
	0-1.1 mg (total organ)	0.06 mg	258	ES		Schroeder and Tipton, 1968
	18-130 $\mu\text{g/g}$ ash	49 $\mu\text{g/g}$ ash (median)	138	ES		Tipton and Cook, 1963
Placenta	Not given	1.83 ± 2.56 $\mu\text{g/g}$ dry wt.	234	AAS	Nashville, Tennessee hospital patients	Baglan et al., 1974
	Not given	0.86 ± 0.28 - 3.12 ± 0.92 micromoles/g	554	AAS		Dawson et al., 1960
	Not given	1.95 ± 1.42 micromoles/g dry wt.	554	AAS	Houston, Texas hospital patients	Dawson, 1969
	6-8 $\mu\text{g}/100$ g; 7-9 $\mu\text{g}/100$ g	Not given; Not given	249; 253	Not given	Control patients; patients living in lead mining district	Fahim et al., 1976
	Not given	0.293 ± 0.025 $\mu\text{g/g}$ wet wt.	58	Not given	City hospitals in South and Southeast	Karp and Robertson, 1977
Prostate	Not given	0.20 ± 0.22 ppm wet wt.	41	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	Not given	0.2 ppm wet wt.	4	ES	Sudden accident victims	Koch et al., 1957

LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Prostate (continued)	<5-81 $\mu\text{g/g}$ ash	10 $\mu\text{g/g}$ ash (median)	44 of 50	ES		Tipton and Cook, 1963
Saliva	3-23 $\mu\text{g}/100$ ml	Not given	12	AAS	9 children, 3 adults	Pung et al., 1975
Skin	0.0252-0.134 % dry tissue	Not given	18	ES	Healthy males, 15-70 years old	Goldblum et al., 1953
	Not given	0.08 ± 0.03 ppm wet wt.	43	Colorimetry	White males, 20-84 years old	Gross et al., 1975
	0-11.8 mg (total tissue)	1.5 mg	258	ES		Schroeder and Tipton, 1968
	16-120 $\mu\text{g/g}$ ash	46 $\mu\text{g/g}$ ash (median)	21 of 22	ES		Tipton and Cook, 1963
Spleen	Not given	0.33 ± 0.15 ppm wet wt.	43	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	0.01-0.07 mg/100 g wet wt.	0.03 mg/100 g wet wt.	15	ES; Chem.	Autopsies	Kehoe, 1961
	Not given	0.030 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	595-1208 $\mu\text{g/g}$ dry wt.	985 $\mu\text{g/g}$ dry wt.	3	ES	Normals	Koch et al., 1957
	Not given	1.4 ppm wet wt.	3	ES	Sudden accident victims	Koch et al., 1957
	Not given	0.28 ± 0.04 mg/100 g dry wt.	Not given	ES	Above 1 year old	Nunbaum et al., 1958
	0-2.2 mg (total organ)	0.06 mg	258	ES		Schroeder and Tipton, 1968

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen (continued)	7-90 $\mu\text{g/g}$ ash	27 $\mu\text{g/g}$ ash (median)	138 of 143	ES		Tipton and Cook, 1963
Stomach	Not given	0.10 $\pm$ 0.05 ppm wet wt.	45	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	Not given	0.022 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	1.0 ppm wet wt.	3	ES	Sudden accident victims	Koch et al., 1957
	5-35 $\mu\text{g/g}$ ash	12 $\mu\text{g/g}$ ash (median)	123 of 131	ES		Tipton and Cook, 1963
Sweat	8-184 $\mu\text{g/liter}$; 49-283 $\mu\text{g/liter}$; 28-171 $\mu\text{g/liter}$	51 $\pm$ 42 $\mu\text{g/liter}$; 118 $\pm$ 72 $\mu\text{g/liter}$; 101 $\pm$ 49 $\mu\text{g/liter}$	33; 15; 11	AAS	Males; females; females (oral contraceptives)	Mohnadel et al., 1973
Teeth	0.25-5.75 mg/100 g	1.51 mg/100 g	82	ES	Cincinnati residents	Althuller et al., 1962
	200-3550 ppm	1790 $\pm$ 960 ppm	35	AAS	Left maxillary central incisor, Cambridge, Massachusetts, 9-15 year olds. Enamel.	Brudevold et al., 1975
	350-2600 ppm	1410 $\pm$ 660 ppm	15	AAS	Left maxillary central incisor, Cambridge, Massachusetts, 9-15 year olds. Enamel.	Brudevold et al., 1975
	Not given	5.0 $\pm$ 5.9 ppm	153	AAS	115 donors from ages 3.5 to 12 years	Chatman and Wilson, 1975
	50-150 $\mu\text{g/100 ml}$; 120-220 $\mu\text{g/100 ml}$	140 $\mu\text{g/100 ml}$; 218 $\mu\text{g/100 ml}$	36; 32	Not given	Control children; exposed urban children; mostly black, 60% female	de la Burde and Shapiro, 1975

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Teeth (continued)	Not given	5.1-19.9 ppm (geometric mean)	324	AAS	Children in lead paint area	Lockeretz, 1973
	1.0-6.5 $\mu\text{g/g}$	$3.1 \pm 0.16 \mu\text{g/g}$	56	MS	<20 years old, wide geographic area	Looney et al., 1973
	2-700 ppm; 0-80 ppm	$15.1 \pm 109.0 \text{ ppm}$; $11.1 \pm 14.8 \text{ ppm}$	109	AAS	69 urban; 40 suburban	Needleman et al., 1972
	Not given	198 $\mu\text{g/g}$; 41.7 $\mu\text{g/g}$	761	Not given	Old housing; new housing	Needleman et al., 1974
	30-400 $\mu\text{g/g}$	Not given	760	EC	Philadelphia school children	Needleman and Shapiro, 1974
	254-336 $\mu\text{g/g}$ ash	Not given	40	AAS	1 skeleton	Strehlow, 1969
Testis	Not given	$0.15 \pm 0.09 \text{ ppm wet wt.}$	43	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	Not given	0.3 ppm wet wt.	1	ES	Sudden accident victims	Koch et al., 1957
	5-27 $\mu\text{g/g}$ ash	12 $\mu\text{g/g}$ ash (median)	68 of 72	ES		Tipton and Cook, 1963
Thyroid	Not given	$0.17 \pm 0.11 \text{ ppm wet wt.}$	40	Colorimetry	Cincinnati area white males, 20-84 years old	Gross et al., 1975
	Not given	1.0 ppm wet wt.	2	ES	Sudden accident victims	Koch et al., 1957
	5-54 $\mu\text{g/g}$ ash	10 $\mu\text{g/g}$ ash	20 of 21	ES		Tipton and Cook, 1963

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Trachea	0.6-8.8 ppm wet wt.	3.0 ppm wet wt.	17	AAS	Sudden deaths, age 17-74 years, Baltimore, Maryland	Foklin and Freimuch, 1975
	15-120 ug/g ash	44 ug/g ash (median)	60	ES		Tipton and Cook, 1963
Umbilical cord	9-11 ug/100 g; 11-12 ug/100 g	Not given; not given	249; 253	Not given	Control patients; patients living in a lead mining region	Fahim et al., 1976
Urine	22-129 ug/24 hr.	Not given	11	ASV; AAS	Children 13-67 months of age	Chisolm et al., 1975
	Not given	325 $\pm$ 167 ug/liter; 77 $\pm$ 92 ug/liter	4; 24	Not given	Hyperactive children with history of lead poisoning; nonhyperactive children	David, 1974
	0->241 ug/liter; 0->241 ug/liter; 161->241 ug/liter; 0->241 ug/liter	Not given; 146 ug/100 liter; 325 ug/100 liter; 77 ug/liter	92; 50; 4; 24	Not given	Hyperactive and nonhyperactive children; hyperactive; hyperactive with history of lead poisoning; nonhyperactive	David, 1972
	Not given	86 ug/24 hr.	1	Not given	Caucasian female	Dickinson et al., 1972
	0-118 ug/liter; 15-75 ug/liter; 10-50 ug/liter	38 ug/liter; 38 ug/liter; 31 ug/liter	110; 27; 40	Colorimetry	New York City residents; California residents; Ohio residents	Goldwater and Hoover, 1967
	Not given	0.06 $\pm$ 0.11 ppm wet wt.	8	Colorimetry	Cincinnati area white males, 20-84 years old	Cross et al., 1975
	Not given	0.009-0.034 mg/100 g	418	Not given	Philadelphia residents	Hammond, 1969
	0.002-0.081 mg/liter	Not given	897	Colorimetry	Urban and rural area residents	Hofreiter et al., 1961

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LEAD (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	Not given	14.3 ± 0.7 ug/liter; 10.5 ± 1.0 ug/liter	402	AAS	Los Angeles; Lancaster	Johnson et al., 1975
	Not given	0.027 mg/liter	Not given	ES		Kehoe et al., 1940
	Not given	0.023 ug/ml	Not given	Not given	Normal level	Rentoul and Smith, 1973
	Not given	27.1 ± 16.2 - 29.0 ± 13.3 ug/liter	4000+	Colorimetry	DuPont employees from 23 locations	McLaughlin et al., 1973
	20.1-25.3 ug/liter (geometric means)	23.3 ug/liter (geometric means)	5750	Colorimetry	DuPont employees from 23 locations	McLaughlin et al., 1973
	Not given	(a) 120 ug/liter (b) 110 ug/liter (c) 126 ug/liter (d) 149 ug/liter (e) 97.2 ug/lit r	32	ES	(a) normals (b) females (c) males (d) blacks (e) non-blacks	Perry and Perry, 1959
	0.4-4.7 ug/100 ml	Not given	10	AAS		Searle et al., 1973
	122.1-233.4 ug/g; 2.8-313.6 ug/g	188.3 ± 17.9 ug/g; 92.3 ± 64.8 ug/g	41	Not given	Reamed teeth; sectioned teeth, Philadelphia	Shapiro et al., 1975
Uterus	<5-29 ug/g ash	5 ug/g ash (median)	20 of 32	ES		Tipton and Cook, 1963

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LITHIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	Not given	0.78 ± 0.01 meq./liter	260	AAS	Adult Kansas City, Kansas residents. Serum.	Bierenbaum et al. 1975
	Not given	48 ± 0.01 meq./liter	260	AAS	Adult Kansas City, Missouri residents. Serum.	Bierenbaum et al. 1975
Hair	0.009-0.300 μ g/g	0.044 μ g/g	277	Flame photometry	New York City children ages 0-15	Creason, 1975
	0.009-0.228 μ g/g	0.056 μ g/g	206	Flame photometry	New York City adults ages ≥ 16	Creason, 1975
Placenta	Not given	0.010 ± 0.002 μ g/g wet wt.	58	Not given	Southern and Southeastern city hospital patients	Karp and Robertson, 1977
Teeth	<0.1-4.2 μ g/g	1.6 ± 0.12 μ g/g	56	MS	<20 years old. Enamel.	Loose et al., 1973
	Not given	0.35 ± 0.02 ppm; 0.07 ± 0.02 ppm	208	MS	New England residents <20 years old with high caries; South Carolina residents <20 years old with low caries. Enamel.	Curzon and Loose, 1977

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LUTETIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.13 ppm	Not given	39	X-ray spectrometry	Healthy males; mean age 35.3 yrs. Serum.	Gofman et al., 1964

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MAGNESIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.0060-0.0063% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	$24 \pm 0.2 \mu\text{g/g wet wt.}$	150	ES	Accidental deaths	Schroeder et al., 1969
Adrenal	Not given	60 ppm wet wt.	1	Colorimetry	Sudden accident victims	Koch et al., 1956
	0.46-1.5 g/100 g ash	0.84 g/100 g ash (median)	10	ES	Adults	Tipton and Cook, 1963
Alimentary tract	0.013-0.0213 % wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
Aorta	Not given	140 ppm wet wt.	1	Colorimetry	Sudden accident victims	Koch et al., 1956
	130-1740 $\mu\text{g/g dry wt.}$	279-919 $\mu\text{g/g dry wt.}$	46	AAS	Autopsies. 5 mo - 91 yrs old. Various diseases. Chicago.	Marks et al., 1972
	230-600 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	0.94-2.0 g/100 g ash	1.4 g/100 g ash (median)	94	ES	Adults	Tipton and Cook, 1963
Bladder	Not given	150 ppm wet wt.	2	Colorimetry	Sudden accident victims	Koch et al., 1956
	0.36-2.3 g/100 g ash	1.4 g/100 g ash (median)	98	ES	Adults	Tipton and Cook, 1963
Blood	Not given	$2.03 \pm 0.01 \text{ mg/liter;}$ $1.91 \pm 0.01 \text{ mg/liter}$	520	AAS	Kansas; Missouri; half in hard-water and half in soft-water area	Bierenbaum et al., 1975
	Not given	$38 \pm 0.4 \mu\text{g/g wet wt.}$	150	ES	Accidental deaths	Schroeder et al., 1969

MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bone	0.168-0.191% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male. Skeletal bone.	Forbes et al., 1956
	2.4-3.2 $\mu\text{g/g}$ dry wt.	$2.8 \pm 0.33 \mu\text{g/g}$ dry wt.	40; 81	AAS	Normals. Osteogenic sarcoma.	Jones et al., 1972
	Not given	140 ppm wet wt.	2	Colorimetry	Sudden accident victims	Koch et al., 1956
	Not given	$1100 \pm 25.2 \mu\text{g/g}$ wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
Brain	Not given	140 ppm wet wt.	2	Colorimetry	Sudden accident victims	Koch et al., 1956
	260-490 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	$150 \pm 3.4 \mu\text{g/g}$ wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	0.58-1.2 g/100 g ash	0.90 g/100 g ash (median)	108	ES	Adults	Tipton and Cook, 1963
Diaphragm	1.2-2.5 g/100 g ash	1.7 g/100 g ash (median)	91	ES	Adults	Tipton and Cook, 1963
Esophagus	Not given	80 ppm wet wt.	2	Colorimetry	Sudden accident victims	Koch et al., 1956
	1.0-2.0 g/100 g ash	1.4 g/100 g ash (median)	57	ES	Adults	Tipton and Cook, 1963
Feces	Not given	170 ± 19 and 200 ± 13 mg/day	2	Flame photometry	Healthy males; age 24 and 25 yrs. University of Cincinnati	Tipton et al., 1969

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Gastro-intestinal tract	Not given	125 $\pm$ 9.6 μ g/g wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
Hair	0.001-0.010 % dry wt.	Not given	18	ES	Age 15-70 yrs. White.	Goldblum et al., 1953
	15-166 μ g/g	67.66 μ g/g	12	AAS	Males and females. Various ages. Diverse geographic areas.	Hinners et al., 1974
	Not given	49.7 $\pm$ 8.0 μ g/g; 85.7 $\pm$ 13.8 μ g/g	180	AAS	117 women; 47 men	Schroeder and Nason, 1969
	Not given	16.4 and 14.5 μ g/g dry wt.	2	MS; AAS		Yurachek et al., 1969
	0.0120-0.0168% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
Heart	430-860 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	180 $\pm$ 5.5 μ g/g wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	1.1-2.3 g/100 g ash	1.6 g/100 g ash (median)	122	ES	Adults	Tipton and Cook, 1963
	Not given	150 ppm wet wt.	9	Colorimetry	Sudden accident victims	Koch et al., 1956
Intestines	0.85-1.7 g/100 g ash	1.3 g/100 g ash (median)	60	ES	Adults. Duodenum.	Tipton and Cook, 1963
	0.92-2.1 g/100 g ash	1.2 g/100 g ash (median)	83	ES	Adults. Jejunum.	Tipton and Cook, 1963

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestines	1.1-3.8 g/100 g ash	1.8 g/100 g ash (median)	77	ES	Adults. Ileum.	Tipton and Cook, 1963
	1.6-5.0 g/100 g ash	2.7 g/100 g ash (median)	31	ES	Adults. Cecum.	Tipton and Cook, 1963
	1.3-4.5 g/100 g ash	2.0 g/100 g ash (median)	88	ES	Adults. Sigmoid colon.	Tipton and Cook, 1963
	1.4-3.7 g/100 g ash	2.3 g/100 g ash (median)	41	ES	Adults. Rectum.	Tipton and Cook, 1963
Kidney	0.0169-0.02362 wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	542.1-2335.2 μ g/g dry wt.	1404 μ g/g dry wt.	5	Not given	Normal levels	Koch et al., 1957
	Not given	160 ppm	6	Colorimetry	Sudden accident victims	Koch et al., 1956
	450-720 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	360-680 micromole/g ash	Not given	150	ES	Adults	Perry et al., 1972
	Not given	129 $\pm$ 3.3 μ g/g wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	0.88-1.7 g/100 g ash	1.2 g/100 g ash (median)	121	ES	Adults	Tipton and Cook, 1963
Larynx	0.71-1.8 g/100 g ash	1.1 g/100 g ash (median)	49	ES	Adults	Tipton and Cook, 1963

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	0.0050-0.0081% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	610-2046 $\mu\text{g/g}$ dry wt.	1332 $\mu\text{g/g}$ dry wt.	3	Not given	Normal levels	Koch et al., 1957
	Not given	140 ppm wet wt.	7	Colorimetry	Sudden accident victims	Koch et al., 1956
	390-820 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	340-750 micromole/g ash	Not given	150	ES	Adults	Perry et al., 1962
	Not given	172 ± 5.2 $\mu\text{g/g}$ wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	0.83-1.8 g/100 g ash	1.3 g/100 g ash (median)	126	ES	Adults	Tipton and Cook, 1963
	Not given	128 ± 44.0 ppm wet wt. 103 ± 28.0 ppm wet wt.	12	Chem; ES	7 noncirrhotic; 5 cirrhotic patients	Vallee et al., 1957
Lungs	0.0047-0.0069% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	1123.2-1338.5 $\mu\text{g/g}$ dry wt.	1205 $\mu\text{g/g}$ dry wt.	3	Not given	Normal levels	Koch et al., 1957
	Not given	80 ppm wet wt.	4	Colorimetry	Sudden accident victims	Koch et al., 1956
	244-820 $\mu\text{g/g}$ dry wt.	517-518 $\mu\text{g/g}$ dry wt.	26	AAS	Autopsies. 5 mo - 91 yrs. old. Various diseases. Chicago area	Marks et al., 1972
	300-600 micromole/g ash	Not given	100	ES	Adults	Perry, 1968
	260-550 micromole/g ash	Not given	150	ES	Adults	Perry et al., 1962

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lungs	Not given	71 ± 2.2 $\mu\text{g/g}$ wet wt.	150	ES	Accidental deaths	Schroeder et al., 1964
	3,800-16,000 $\mu\text{g/g}$ ash	9100 $\mu\text{g/g}$ ash	119	ES	Autopsies, 9 cities.	Tipton et al., 1964
	0.62-1.3 g/100 g ash	0.86 g/100 g ash (median)	119	ES	Adults	Tipton and Cook, 1963
Muscle	0.017-0.0198% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	320 ppm wet wt.	12	Colorimetry	Sudden accident victims	Koch et al., 1956
	Not given	189 ± 7.2 $\mu\text{g/g}$ wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	0.98-2.4 g/100 g ash	1.5 g/100 g ash (median)	119	ES	Adults	Tipton and Cook, 1963
Myocardium	613-1590 $\mu\text{g/g}$ dry wt.	724-1290 $\mu\text{g/g}$ dry wt.	26	AAS	Autopsies, 5 mo - 91 yrs. old. Various diseases, Chicago area.	Marks et al., 1972
Nails	0.0023-0.011% dry wt.	Not given	18	ES	Age 15-70 yrs. White.	Goldblum et al., 1953
Nerve	0.0097-0.0107% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
Omentum	0.65-1.9 g/100 g ash	1.2 g/100 g ash (median)	72	ES	Adults	Tipton and Cook, 1963
Ovary	0.70-1.2 g/100 g ash	0.87 g/100 g ash (median)	16	ES	Adults	Tipton and Cook, 1963

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Pancreas	Not given	260 ppm wet wt.	3	Colorimetry	Sudden accident victims	Koch et al., 1956
	Not given	160 ± 4.4 μ g/g wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	15-24 g/100 g ash	20 g/100 g ash (median)	114	ES	Adults	Tipton and Cook, 1963
Placenta	Not given	0.98 ± 0.34 micromole/g dry wt.	554	AAS	Normal deliveries, Houston, Texas	Dawson, 1969
	Not given	$0.71 \pm 0.17 - 1.48 \pm 0.25$ micromole/g dry wt.	554	AAS		Dawson et al., 1968
Prostate	Not given	300 ppm wet wt.	2	Colorimetry	Sudden accident victims	Koch et al., 1956
	1.1-2.2 g/100 g ash	1.5 g/100 g ash (median)	40	ES	Adults	Tipton and Cook, 1963
Skin	0.0048-0.0102% wet wt.	Not given	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	0.001-0.015% dry wt.	Not given	18	ES	Age 15-70 yrs. White.	Goldblum et al., 1953
	Not given	59 ± 4.0 μ g/g wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	75-112 mg/kg dry wt.	Not given	27	AAS		Subryan et al., 1975
	0.60-1.1 g/100 g ash	0.36 g/100 g ash (median)	19	ES	Adults	Tipton and Cook, 1963

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen	Not given	0.0124% wet wt.	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
	Not given	85 ppm wet wt.	5	Colorimetry	Sudden accident victims	Koch et al., 1956
	595-1208 $\mu\text{g/g}$ dry wt.	985 $\mu\text{g/g}$ dry wt.	3	Not given	Normal levels	Koch et al., 1957
	445-1080 $\mu\text{g/g}$ dry wt.	567-716 $\mu\text{g/g}$ dry wt.	26	AAS	Autopsies, 5 mo - 91 yrs. old. Various diseases, Chicago area.	Marks et al., 1972
	270-590	Not given	100	ES	Adults	Perry, 1968
	Not given	128 $\pm$ 4.2 $\mu\text{g/g}$ wet wt.	150	ES	Accidental deaths	Schroeder et al., 1969
	0.70-1.5 g/100 g ash	0.92 g/100 g ash (median)	123	ES	Adults	Tipton and Cook, 1963
Stomach	Not given	320 ppm wet wt.	3	Colorimetry	Sudden accident victims	Koch et al., 1956
	0.90-2.0 g/100 g ash	1.4 g/100 g ash (median)	110	ES	Adults	Tipton and Cook, 1963
Teeth	88-5720 ppm	1650 $\pm$ 890 ppm	35	AAS	School children in Cambridge, Mass.	Brudevold et al., 1975
	Not given	0.618% wet wt.	2	Colorimetry	1 white (age 60) and 1 black (age 48) male	Forbes et al., 1956
Testis	Not given	150 ppm	2	Colorimetry	Sudden accident victims	Koch et al., 1956
	0.78-1.5 g/100 g ash	1.0 g/100 g ash (median)	68	ES	Adults	Tipton and Cook, 1963
Thyroid	Not given	160 ppm wet wt.	2	Colorimetry	Sudden accident victims	Koch et al., 1956

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MAGNESIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Thyroid (continued)	0.23-1.5 g/100 g ash	0.90 g/100 g ash (median)	14	ES	Adults	Tipton and Cook, 1963
Trachea	0.71-1.8 g/100 g ash	1.2 g/100 g ash (median)	57	ES	Adults	Tipton and Cook, 1963
Urine	Not given	98 $\pm$ 5 and 92 $\pm$ 4 mg/day	2	Flame photometry	Healthy males, age 23 and 25 yrs. University of Cincinnati	Tipton et al., 1969
Uterus	0.80-1.7 g/100 g ash	1.1 g/100 g ash (median)	30	ES	Adults	Tipton and Cook, 1963

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MANGANESE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	Not given	36 ± 3.1 ppm ash	13	ES	Adults from 15 cities	Schroeder et al., 1966
	24-49 $\mu\text{g/g}$ ash	32 $\mu\text{g/g}$ ash	13	ES	Adults	Tipton and Cook, 1963
Aorta	0.11-0.69 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	11 ± 1.2 ppm ash	95	ES	Adults from 15 cities	Schroeder et al., 1966
	4-17 $\mu\text{g/g}$ ash	8 $\mu\text{g/g}$ ash	95	ES	Adults	Tipton and Cook, 1963
Bladder	Not given	18 ± 1.7 ppm ash	109	ES	Adults from 15 cities	Schroeder et al., 1966
	6-40 $\mu\text{g/g}$ ash	13 $\mu\text{g/g}$ ash	109	ES	Adults	Tipton and Cook, 1963
Blood	Not given	0.0025 ± 0.0002 ; 0.0028 ± 0.0002 ; 0.0013 ± 0.0001 ; 0.0040 ± 0.0001 $\text{mg}/100\text{ml}$	266	ES	122 blood donors; 96 surgical and degenerative disease patients (Serum); 48 normals (Serum); 48 normals (Whole blood)	Butt et al., 1964
	Not given	0.587 ± 0.183 ; 8.44 ± 2.73 $\mu\text{g}/\text{liter}$	14	NAA	Plasma; whole blood. Normals.	Cotzias et al., 1967
	0.36-0.90 $\mu\text{g}/\text{ml}$	Not given	12	Colorimetry	Los Angeles, California lab workers. Serum	Fernandez et al., 1963
	Not given	0.00-0.06 ppm	39	X-ray spectrometry	Healthy males; mean age 35.3 yrs. Serum	Gofman et al., 1964
	Not given	0.015 $\mu\text{g}/100\text{g}$	Not given	ES		Kehoe et al., 1940

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MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	Not given	0.15 μ g/ml	Not given	Not given		Rentoul and Smith, 1973
Body, total content	Not given	1 ² μ g	168	Not given	Autopsies from 58 cities and 29 rural areas	Schroeder, 1970
Bone	3.5-5.2; 2.7-10.3 μ g/g dry wt.	4.6 $\pm$ 1.62; 6.6 $\pm$ 4.37 μ g/g dry wt.	40; 81	AAS	Normals; osteogenic sarcomas	Janes et al., 1972
	Not given	0.300 μ g/100g; 0.170 μ g/100g wet wt.	Not given	ES	Long bone; rib bone	Keloe et al., 1940
	Not given	2 ppm ash	91	ES	Adults from 15 cities	Schroeder et al., 1966
Brain	Not given	0.13 $\pm$ 0.01 μ g/g dry wt.	99	ES	Above 1 yr. old	Nunbaum et al., 1958
	0.26-0.62 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	1.00 μ g/g dry wt.	Not given	Not given		Rentoul and Smith, 1973
	Not given	20 $\pm$ 0.7 ppm ash	127	ES	Adults from 15 cities	Schroeder et al., 1966
Diaphragm	10-32 μ g/g ash	18 μ g/g ash	127	ES	Adults	Tipton and Cook, 1967
	Not given	17 $\pm$ 1.2 ppm ash	91	ES	Adults from 15 cities	Schroeder et al., 1966
	6-32 μ g/g ash	15 μ g/g ash	91	ES	Adults	Tipton and Cook, 1967

MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Esophagus	Not given	17 ± 1.5 ppm ash	66	ES	Adults from 15 cities	Schroeder et al., 1966
	6-40 µg/g ash	13 µg/g ash	66	ES	Adults	Tipton and Cook, 1963
Feces	Not given	2.5 ± 0.6 mg/day; 3.0 ± 0.4 mg/day	2	Flame photometry	Healthy males from University of Cincinnati, 23 and 25 years old	Tipton et al., 1969
Hair	0.08-20 ppm	2.1 ppm	33	NAA	Adults and children, Oak Ridge, Tenn.	Bate and Dyer, 1965
	0.05-12.0; 0.07-11.0 µg/g	0.56; 0.95 µg/g	498	ES	Children; adults. 3 New York City communities	Cresson, 1975
	0.8-3.2; <1-2.2 ppm	Not given	50	AAS	25 males, age 9-60 yrs.; 25 women, age 13-72 yrs.	Eade and Lambdin, 1973
	1.0 x 10 ⁻⁹ - 5.5 x 10 ⁻¹² dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	0.2-4.0 µg/g	1.4 µg/g	12	AAS	Males and females of various ages and diverse geographic areas. Scalp hair.	Hinnera et al., 1974
	Not given	1.466; 1.062; 0.549 µg/g	13; 18; 12	NAA	Controls; dialysis patients; uremics	Mahler et al., 1970
	Not given	2.51 µg/g dry wt.	Not given	Not given		Kentoul and Smith, 1973
	Not given	1.7; 1.8 µg/g dry wt.	2	AAS; MS		Yurachek et al., 1969

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MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart	Not given	0.032 $\mu\text{g}/100\text{g}$ wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.15 $\pm$ 0.01 mg/100g dry wt.	186	ES	Above 1 year old	Nusbaum et al., 1958
	0.27-0.086 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	0.88 $\mu\text{g}/\text{g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
	Not given	23 $\pm$ 0.9 ppm ash	139	ES	Adults from 15 cities	Schroeder et al., 1966
	12-40 $\mu\text{g}/\text{g}$ ash	20 $\mu\text{g}/\text{g}$ ash	139	ES	Adults	Tipton and Cook, 1963
Intestines	Not given	0.035 $\mu\text{g}/100\text{g}$ wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	70 $\pm$ 10.0; 68 $\pm$ 3.9; 110 $\pm$ 11.0; 180 $\pm$ 31.0; 76 $\pm$ 9.7; 82 $\pm$ 19.0 ppm ash	67; 101; 84; 31; 107; 42	ES	Adults from 15 cities; duodenum; jejunum; ileum; cecum; sigmoid colon; rectum.	Schroeder et al., 1966
	25-100; 32-120; 33-200; 24-400; 16-150; 11-180 $\mu\text{g}/\text{g}$ ash	57; 58; 74; 110; 46; 39 $\mu\text{g}/\text{g}$ ash	67; 101; 84; 31; 107; 42	ES	Adults. Duodenum; jejunum; ileum; cecum; sigmoid colon; rectum.	Tipton and Cook, 1963
Kidney	Not given	0.060 $\mu\text{g}/100\text{g}$ wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.30 $\pm$ 0.01 mg/100g dry wt.	316	ES	Above 1 year old	Nusbaum et al., 1958
	0.82-2.7 micromoles/g ash	Not given	150	ES	St. Louis adults, died unexpectedly	Perry et al., 1962

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Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney (continued)	0.73-2.0 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968
	Not given	3.34 $\mu\text{g/g}$ dry wt.	Not given	Not given	Adults from 15 cities	Rentoul and Smith, 1973
	Not given	91 $\pm$ 4.0 ppm ash	143	ES	Adults from 15 cities	Schroeder et al., 1966
	0-1.5 mg/100g dry wt.	Not given	Not given	ES	Chicago area cancer patients	Fitz et al., 1957
	45-150 $\mu\text{g/g}$ ash	82 $\mu\text{g/g}$ ash	143	ES	Adults	Tipton and Cook, 1961
Larynx	Not given	8 $\pm$ 1.1 ppm ash	35	ES	Adults from 15 cities	Schroeder et al., 1966
	2-18 $\mu\text{g/g}$ ash	6 $\mu\text{g/g}$ ash	35	ES	Adults	Tipton and Cook, 1961
Liver	Not given	0.205 $\mu\text{g}/100\text{g}$ wet wt.	Not given	ES		Kelley et al., 1970
	Not given	138; 142; 184; 153 $\mu\text{g/g}$ ash	104	AAS	Male autopsies at Birmingham Veterans Hospital; controls; emphysema; cancer	Morgan, 1972
	Not given	0.53 $\pm$ 0.02 mg/100g dry wt.	315	ES	Above 1 year old	Nubbaum et al., 1958
	1.0-3.0 micromoles/g ash	Not given	150	ES	St. Louis adults who died unexpectedly	Perry et al., 1962
	1.5-4.2 micromoles/g ash	Not given	100	ES	Adults	Perry, 1968

MANGANESE (continued)

MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	Not Given	28.5±114 µg/g ash	10	ES	St. Louis area male residents killed in accidents	Perry et al., 1973
	Not Given	4.65 µg/g dry wt.	Not Given	Not Given		Rentoul and Smith, 1973
	Not Given	130±7.0 ppm ash	148	ES	Adults from 15 cities	Schroeder et al., 1966
	0-1.5 mg/100g dry wt.	Not Given	Not Given	ES	Chicago area cancer patients	Tietz et al., 1957
	Not Given	1.3±0.3 ppm wet wt. 17±0.56 ppm wet wt.	7; 5	Chemical and/or ES	Noncirrhotic patients, cirrhotic patients	Vallee et al., 1957
	55-220 µg/g ash	100 µg/g ash	148	ES	Adults	Tipton and Cook, 1963
	Not Given	0.022 µg/100g wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	0.18±0.01 mg/100g dry wt.	97	ES	Above 1 year of age	Musbaum et al., 1958
	0.15-0.81 micromole/g ash	Not Given	150	ES	St. Louis adults who died unexpectedly	Perry et al., 1962
	0.25-1.3 micromole/g ash	Not Given	100	ES	Adults 10th and 90th percentiles	Perry, 1968
	50-1700 µg/g	Not Given	168	Not Given	Autopsies from 58 cities and 29 rural areas	Schroeder, 1970
	Not Given	24±2.0 ppm ash	141	ES	Adults from 15 cities	Schroeder et al., 1966
	0-1 mg/100g dry wt.	Not Given	Not Given	ES	Chicago area cancer patients	Tietz et al., 1957

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MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	5-170 $\mu\text{g/g}$ ash	24 $\mu\text{g/g}$ ash	141	ES	Autopsies from 9 cities	Tipton et al., 1964
	8-43 $\mu\text{g/g}$ ash	17 $\mu\text{g/g}$ ash	141	ES	Adults	Tipton and Cook, 1963
Muscle	Not Given	0.050 $\mu\text{g}/100\text{g}$ wet wt.	Not Given	ES		Kohor et al., 1940
	Not Given	6-0.4 ppm ash	133	ES	Adults from 15 cities	Schroeder et al., 1966
	2-14 $\mu\text{g/g}$ ash	5 $\mu\text{g/g}$ ash	133	ES	Adults	Tipton and Cook, 1963
Nails	6.3×10^{-8} - 3.3×10^{-7} % dry wt.	Not Given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	0.43-3.81 $\mu\text{g/gm}$	1.91-1.38 $\mu\text{g/g}$	6	NAA	Thumbnails, children, adults	Kanabrocki et al., 1968
	0.42-1.38 $\mu\text{g/gm}$	0.87-0.31 $\mu\text{g/g}$	12			
	Not Given	0.66 $\mu\text{g/g}$, 1.199 $\mu\text{g/g}$, 0.61 $\mu\text{g/g}$	13, 18, 12	NAA	Controls, dialysis patients, uremics	Mahler et al., 1970
Omentum	Not Given	48-9.8 ppm ash	75	ES	Adults from 15 cities	Schroeder et al., 1966
	13-78 $\mu\text{g/g}$ ash	29 $\mu\text{g/g}$ ash	75	ES	Adults	Tipton and Cook, 1963
Ovary	Not Given	18-2.2 ppm ash	16	ES	Adults from 15 cities	Schroeder et al., 1966
	9-32 $\mu\text{g/g}$ ash	16 $\mu\text{g/g}$ ash	16	ES	Adults	Tipton and Cook, 1963
Pancreas	Not Given	110-4.9 ppm ash	138	ES	Adults from 15 cities	Schroeder et al., 1966

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MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Pancreas	54-200 $\mu\text{g/g}$ ash	98 $\mu\text{g/g}$ ash	138	ES	Adults	Tipton and Cook, 1963
Placenta	Not Given	0.115 $\pm$ 0.011 $\mu\text{g/g}$ wet wt.	58	Not Given	Southern and Southeastern hospital patients	Karp and Robertson, 1977
Prostate	Not Given	19 $\pm$ 2.9 ppm ash	50	ES	Adults from 15 cities	Schroeder et al., 1966
	7-28 $\mu\text{g/g}$ ash	14 $\mu\text{g/g}$ ash	50	ES	Adults	Tipton and Cook, 1963
Saliva	0.05-0.79 $\mu\text{g}/100\text{ml}$	0.28 $\pm$ 0.06 $\mu\text{g}/100\text{ml}$	21	NAA	Normal adults	Kanabrocki et al., 1965
Skin	2.4 $\times 10^{-9}$ -6.1 $\times 10^{-7}$ $\times$ dry wt.	Not Given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	Not Given	22 $\pm$ 10.0 ppm ash	22	ES	Adults from 15 cities	Schroeder et al., 1966
	6-17 $\mu\text{g/g}$ ash	13 $\mu\text{g/g}$ ash	22	ES	Adults from 15 cities	Tipton and Cook, 1963
Spleen	Not Given	0.022 $\mu\text{g}/100\text{g}$ wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	0.14 $\pm$ 0.01 $\mu\text{g/g}$ dry wt.	98	ES	Above 1 year of age	Numbaum et al., 1958
	0.19-0.74 micromole/g ash	Not Given	100	ES	Adults 10th and 90th percentiles	Perry, 1968
	Not Given	11 $\pm$ 0.8 ppm ash	143	ES	Adults from 15 cities	Schroeder et al., 1966
	5-19 $\mu\text{g/g}$ ash	9 $\mu\text{g/g}$ ash	143	ES	Adults	Tipton and Cook, 1963

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MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Stomach	Not Given	0.030 $\mu\text{g}/100\text{g}$ wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	47-2.5 ppm ash	129	ES	Adults from 15 cities	Schroeder et al., 1966
	22-74 $\mu\text{g}/\text{g}$ ash	42 $\mu\text{g}/\text{g}$ ash	129	ES	Adults	Tipton and Cook, 1963
Teeth	0.08-1.10 $\mu\text{g}/\text{g}$	0.32-0.00 $\mu\text{g}/\text{g}$	56	MS	20 years old. Enamel	Loose et al., 1971
Testes	Not Given	14-0.6 ppm ash	72	ES	Adults from 15 cities	Schroeder et al., 1966
	8-21 $\mu\text{g}/\text{g}$ ash	12 $\mu\text{g}/\text{g}$ ash	72	ES	Adults	Tipton and Cook, 1963
Thyroid	Not Given	19-2.3 ppm ash	21	ES	Adults from 15 cities	Schroeder et al., 1966
	9-35 $\mu\text{g}/\text{g}$ ash	17 $\mu\text{g}/\text{g}$ ash	21	ES	Adults	Tipton and Cook, 1963
Trachea	Not Given	14-1.0 ppm ash	54	ES	Adults from 15 cities	Schroeder et al., 1966
	7-24 $\mu\text{g}/\text{g}$ ash	12 $\mu\text{g}/\text{g}$ ash	54	ES	Adults	Tipton and Cook, 1963
Urine	Not Given	0.82-0.34 $\mu\text{g}/\text{g}$ day	16	NAA	Dialyzed urine	Kanabrocki et al., 1965
	Not Given	0.01 $\mu\text{g}/\text{liter}$	Not Given	ES		Kehoe et al., 1940

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MANGANESE (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	< 12-66 ug/liter	< 26.7 ug/liter	24	ES	Normal Americans ages 4-69 years, females, males, negroes, caucasians	Perry and Perry, 1959
		< 23.4 ug/liter	10			
		< 29.1 ug/liter	14			
		< 30.3 ug/liter	10			
		< 25.1 ug/liter	14			
Uterus	Not Given	< 15.3 ug/liter 28.4 ug/liter 23.5 ug/liter	8	ES	American hypercholesterolemic patients ages 21-63 years: before Na ₂ Ca EDTA administration, during Na ₂ Ca EDTA administration, after Na ₂ Ca EDTA administration.	Perry and Perry, 1959
	Not Given	35 ppb, 65 ppb	15; 15	Not Given	Normotensive, hypertensive	Perry, 1968
	Not Given	0.043-0.08 mg/day, 0.053-0.016 mg/day	2	Flame photometry		Tipton et al., 1969
	Not Given	12-1.3 ppm ash	31	ES	Adults from 15 cities	Schroeder et al., 1966
Uterus	7-20 ug/g ash	10 ug/g ash	31	ES	Adults	Tipton and Cook, 1967

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Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	0.008 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1964
Adrenal	2.0-15.8 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
Blood	Not given	0.048 $\pm$ 0.044 μ g/g dry wt.	929	AAS	4 hospitals, Nashville, Tenn. Mother's blood.	Saglan et al., 1974
	Not given	0.054 $\pm$ 0.048 μ g/g dry wt.	872	AAS	4 hospitals, Nashville, Tenn. Fetal blood.	Saglan et al., 1974
	0.5-6.0 μ g/10g	Not given	54	Colorimetry	Females, age 17-49 yrs., rural Ohio	Benning, 1968
	Not given	52 ppb; 96 ppb	Not given	Not given	Michigan residents. Whole blood; red blood cells.	Evli, 1971
	Not given	5.8 $\pm$ 0.7; 5.0 $\pm$ 0.8; 2.6 $\pm$ 0.3 ng/ml	18	AAS	Coastal; interior; urban mothers. Plasma.	Galster, 1976
	Not given	14.5 $\pm$ 5.1; 22.6 $\pm$ 3.0; 8.9 $\pm$ 0.9 ng/ml	18	AAS	Coastal; interior; urban mothers. Red blood cells.	Galster, 1976
	Not given	4.1 $\pm$ 0.4; 3.0 $\pm$ 0.8; 3.3 $\pm$ 0.5 ng/ml	18	AAS	Coastal; interior; urban infants. Plasma.	Galster, 1976
	Not given	60.2 $\pm$ 10.0; 12.1 $\pm$ 6.0; 10.8 $\pm$ 1.0 ng/ml	18	AAS	Coastal; interior; urban infants. Red blood cells.	Galster, 1976
	0.00-0.11 ppm	Not given	59	X-ray spectrometry	Healthy males, mean age 33.3 yrs. Serum.	German et al., 1964

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MERCURY (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (continued)	0.0-22.5 $\mu\text{g}/100\text{ ml}$	7.6 $\mu\text{g}/100\text{ ml}$	22	Colorimetry		Soldwater and Stelman, 1966
	0-30 ppb	8 ppb	210	AAS	Upper middle class, Washington, D.C.	Goody, 1977
	<1.0-2.5 $\mu\text{g}/100\text{ ml}$	1.0 $\mu\text{g}/100\text{ ml}$	16	Not given	Mother, Buffalo, N.Y.	Hartung and Dinman, 1972
	<3300 ng/ml; 0.001 - 0.017 $\mu\text{g/g}$	Not given	Not given	Not given	Exposed; normal. Mother's blood.	Kook and Longo, 1976
	<3000 ng/ml; 0.001 - 0.020 $\mu\text{g/g}$	Not given	Not given	Not given	Exposed; normal. Fetal blood.	Kook and Longo, 1976
	Not given	1.6 $\pm$ 0.3 ng/ml; 2.4 $\pm$ 0.4 ng/ml; 1.0 $\pm$ 0.2 ng/ml	10; 10	AAS	Rocheater; Alaska, Alaska (plasma)	Lagoo and Clarkon, 1972
	0.003-0.017 ppm wet wt.	0.008 ppm wet wt.	50	NAA	sed blood cells	Messaro et al., 1975
	0.002-0.011 ppm wet wt.	0.007 ppm wet wt.	50	NAA	Plasma	Messaro et al., 1975
	0-8 ppb; 0-6 ppb	Not given	170	AAS	Maternal; umbilical cord. Iowa City and Chicago areas	Fitzke et al., 1976
	Not given	0.02 $\mu\text{g}/\text{ml}$	Not given	Not given	Normal level	Xentoul and Smith, 1973
Brain	Not given	0.05 ppm	6	Not given	Fetus, Buffalo, N.Y.	Hartung and Dinman, 1972
	Not given	0.093 ppm	28	GC; GC-EC	Autopsies, age 4-74 yrs., 1911-1972	Keverskian et al., 1973

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MERCURY (Continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	1.3-34.0 ppm	Not given	59	AAS; colorimetric	Autopsies	Revolution et al., 1972
	0.02-2.39 ppm wet wt.	Not given	Not given	NAA		Masamoto et al., 1974
	0.006-0.965 μ g/g wet wt. 0.008-0.470 μ g/g wet wt.	0.132 μ g/g wet wt. 0.091 μ g/g wet wt.	123	AAS	Cerebellum, cerebrum, Autopsies, 20-year fetus, placenta, blood, urine, and total	Patel and Kohn, 1974
Diaphragm	Not given	2.74 μ g/g dry wt.	Not given	Not given	Normal level	Reid et al., 1971
	Not given	11.0 ppm	59	AAS; colorimetric	Autopsies	Revolution et al., 1972
Gastro-intestinal tract	Not given	0.008 ppm	1	Colorimetric	30-year-old cadaver	Patel et al., 1974
Hair	Not given	1.00 μ g/g dry wt. (median)	130	AAS	Postnatal, Nephrotoxic form, Mother's hair	Patel et al., 1974
	Not given	2.3 μ g/g dry wt. (median)	6	AAS	Postnatal, Autopsies, placenta, fetal hair, pig	Patel et al., 1974
	0.1-33 ppm	2.6 ppm	10	NAA	Adults and children, cat, sheep, pig	Reid et al., 1971
	0.12-135.0 ppm	4.18 ppm (250 males, 500 females)	1000	N	Human	Reid et al., 1971

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MERCURY (continued)

Tissue	Range	Mean level	No. of Cases	Analytical Method	Comments	Reference
Hair (Continued)	0.043-11.10 $\mu\text{g/g}$; 0.05-14 $\mu\text{g/g}$	0.672 $\mu\text{g/g}$; 0.774 $\mu\text{g/g}$	78; 200	AA	Children, adults - New York city communities	Trueman, 1977
	0.2-12.4 ppm; 0.1-10 ppm	5.4 ppm; 3.8 ppm	23; 25	AA	Men, age 20-60 yrs, women, age 20-70 yrs.	Davis and Lamb, 1976
	Not given	4.757 $\pm$ 0.621; 3.87 $\pm$ 0.740; 4.043 $\pm$ 0.796 $\mu\text{g/g}$	18	AA	Coastal, interior, urban mothers	Alister, 1977
	5.3-125 $\mu\text{g/g}$	Not given	Not given	AAS; GC		Shaw and et al., 1976
	5-90 ppm; 5-100 ppm	20.4 ppm; 29.6 ppm	127; 99	AAS	Los Angeles, 80 men and 141 women, Pasadena, women	Ward et al., 1975
	Not given	1.243 $\pm$ 0.029 ppm	10	NAA	Homogenized hair	Chiriac et al., 1972
	Not given	5.57 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Kent, J. and Smith, 1973
	492-12,000 ppb; 190-6143 ppb	1708 ppb	153	Not given	Women; men	Ell et al., 1975
Heart	Not given	0.052 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1974
	0.047 ppm	Not given	28	CCP, GC-EI	Autopsies, age 20-60 yrs., 1970	Kevorkian et al., 1973
	1.1-10.4 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1973
	0.012-0.704 $\mu\text{g/g}$ wet wt.	0.102 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26-week fetuses, Puget Sound, urban and rural	Miller and Noddy, 1974

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MERCURY (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart (continued)	Not given	1.76 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Rentoul and Smith, 1973
Kidney	0-0.40 ppm	Not given	28	GC; GC-EC	Autopsies, age 4-74 yrs., 1913-1972	Kevorkian et al., 1973
	1.6-27.2 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
	0.14-2.3 $\mu\text{g/g}$ dry wt. 0.35-5.3 $\mu\text{g/g}$ dry wt.	0.99 $\pm$ 0.84 $\mu\text{g/g}$ dry wt. 9.4 $\pm$ 14 $\mu\text{g/g}$ dry wt.	6; 32	NAA	Infants; adults. Autopsies.	Livingstone, 1971
	0.35-53 $\mu\text{g/g}$; 0.14-23 $\mu\text{g/g}$	9.4 $\mu\text{g/g}$; 0.99 $\mu\text{g/g}$	32; 6	NAA	Adults; infants. Renal cortex.	Livingstone, 1972
	0.006-6.40 $\mu\text{g/g}$ wet wt.	0.759 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, urban and rural	Mottet and Body, 1974
	Not given	9.03 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Rentoul and Smith, 1971
	0.075-3.36 ppm	0.762 ppm wet wt.	45	AAS	20 males, 15 females	Stein et al., 1974
	Not given	0.005 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
Liver	0.02-0.10 ppm	0.06 ppm	10	Not given	Stillbirths, Buffalo, N.Y.	Hartung and Dinman, 1972
	<0.01-0.39 ppm	0.06 ppm	43	Not given	Fetus, Buffalo, N.Y.	Hartung and Dinman, 1972

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MERCURY (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver (continued)	3.0-19.9 ppm	Not given	59	AAS; colorimetry	Autopsies	Kavorkian et al., 1972
	0.008-1.43 µg/g wet wt.	0.250 µg/g wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, urban and rural	Mottet and Body, 1974
	Not given	3.66 µg/g dry wt.	Not given	Not given	Normal level	Kentoul and Smith, 1973
	0.026-0.545 ppm	0.172 ppm wet wt.	20	AAS	30 males, 15 females	Stein et al., 1974
Lung	Not given	0.017 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
	2.0-34.4 ppm	Not given	59	AAS; colorimetry	Autopsies	Kavorkian et al., 1972
	0.0-2.763 µg/g wet wt.	0.251 µg/g wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, rural and urban	Mottet and Body, 1974
	0.007-1.5 ppm wet. wt.	0.03 ppm wet wt.	47	AAS	30 males, 15 females	Stein et al., 1974
	0.004-1.5 µg/g wet wt.	0.04 µg/g wet wt.	Not given	Not given	Autopsies, Los Alamos, New Mexico	Stein et al., 1972
Milk	Not given	7.6 ± 2.7; 3.2 ± 0.8; 3.3 ± 0.5 ng/ml	38	AAS	Coastal; interior; urban. Mothers	Galster, 1976
	<200 ng/ml	Not given	Not given	Not given	Exposed	Koss and Largo, 1976
	Not given	0.93 ppb	170	AAS	Iowa City and Chicago areas	Pickin et al., 1976

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MERCURY (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle	Not given	0.020 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
	3.0-11.1 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
	0.0-0.954 $\mu\text{g/g}$ wet wt.	0.126 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, urban and rural	Mottet and Body, 1974
Nerve	Not given	0.047 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
Offal	Not given	0.024 ppm	1	Colorimetry	46-year-old cadaver	Forbes et al., 1954
Ovary	Not given	0.2 ppm	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
Pancreas	0.9-29.6 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
	0.007-0.511 $\mu\text{g/g}$ wet wt.	0.065 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26 wk fetuses, Puget Sound, urban and rural	Mottet and Body, 1974
Placenta	Not given	0.129 $\pm$ 0.161 $\mu\text{g/g}$ dry wt.	10	AAS	4 hospitals, Nashville, Tenn.	Bugian et al., 1974
	Not given	1.53 $\mu\text{g/10g}$	54	Colorimetry	Females, age 17-49 yrs., rural Ohio	Benning, 1958
	Not given	38.9 $\pm$ 5.1; 30.7 $\pm$ 11.8; 11.6 $\pm$ 1.3 ng/g	38	AAS	Coastal; interior; urban. Mothers.	Galster, 1976
	Not given	0.014 $\pm$ 0.001 $\mu\text{g/g}$ wet wt.	58	Not given	City hospitals in South and Southeast	Karp and Robertson, 1977

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MERCURY (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Placenta (continued)	0.010-0.803 $\mu\text{g/g}$ wet wt.	0.087 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, urban and rural. Cord.	Mottet and Body, 1974
	Not given	2.28 ppb	170	AAS	Iowa City and Chicago areas	Pickin et al., 1976
Skin	Not given	0.003 ppm	1	Colorimetry	46-year-old cadaver	Yorbas et al., 1954
	0.004-1.275 $\mu\text{g/g}$ wet wt.	0.193 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, urban and rural	Mottet and Body, 1974
Spleen	1.8-18.8 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
	0.012-1.205 $\mu\text{g/g}$ wet wt.	0.122 $\mu\text{g/g}$ wet wt.	113	AAS	Autopsies, 26-wk fetuses, Puget Sound, urban and rural	Mottet and Body, 1974
Teeth	Not given	5.3 ± 5.4 $\mu\text{g/g}$	38	Colorimetry	California	Kuhnlein and Calloway, 1977
Testis	1.9-7.8 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
Thyroid	Not given	0.1 ppm	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972
Urine	Not given	10-3740 $\mu\text{g/liter}$	14	Colorimetry	Females, age 17-48 yrs., rural Ohio	Benning, 1958
	4.5-118.5 $\mu\text{g/liter}$; 0-22.5 $\mu\text{g/liter}$	34.0 $\mu\text{g/liter}$; 4.5 $\mu\text{g/liter}$	22	Colorimetry	10 exposed; 12 control	Goldwater and Nicolari, 1966

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MERCURY (continued)

Tissue	Range	Mean Level	Nr. of Cases	Analytical Method	Comments	Reference
Urine (continued)	0-221.0 µg/liter	Not given	68 of 308	Not given	New York City, California, Ohio	Jacobs et al., 1964
	<2.91 µg/ml	Not given	Not given	Not given	Exposed mothers	Koon and Longo, 1976
	0.003-0.017 ppm wet wt.	0.008 ppm wet wt.	Not given	Not given		Mussaro et al., 1974
	Not given	0.023 µg/g dry wt.	Not given	Not given	Normal level	Mentoul and Smith, 1973
Uterus	11.7-20.5 ppm	Not given	59	AAS; colorimetry	Autopsies	Kevorkian et al., 1972

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MIREX

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	5.2 p.p.m (highest value)	50:	Not given	8 southern states; 20% of the samples positive	Anonymous, 1978
	0.16-5.94 ppm	2.50 ppm	6	GC-EC	Rural adults	Kutz et al., 1974
Human tissues	<1.0-1.32 ppm	0.38 ppm (0.08 ppm if negatives included)	186	Not given	Samples taken in treatment areas	Anonymous, 1976
Milk	Not given	Not detected	1436	GC-EC	Limit of detectability 30 ppb	Savage, 1976

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MOLYBDENUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	5.1 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
Adrenal	Not given	15.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0-22.0 $\mu\text{g/g}$ ash	15 $\mu\text{g/g}$ ash (median)	10 of 13	ES	Autopsies. 9 U.S. cities	Tipton and Cook, 1963
Aorta	Not given	<2.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash (median)	1 of 104	ES	Autopsies. 9 U.S. cities	Tipton and Cook, 1963
Bladder	Not given	0.02 ppm	2	ES	Sudden accident victims	Koch et al., 1956
	Not given	<2.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash (median)	6 of 110	ES	Autopsies. 9 U.S. cities	Tipton and Cook, 1963
Blood	0.50-15.73 $\mu\text{g}/100$ ml	0.50-41.0 $\mu\text{g}/100$ ml	229	Colorimetry	Whole blood; 48 of 229 samples had undetectable amounts (<0.5 $\mu\text{g}/100$ ml)	Allaway et al., 1968
	Not given	(a) 0.0021 and (b) 0.0072 $\text{mg}/100$ ml	266	ES	Patients, blood donors, and normal individuals. Los Angeles area. (a) Serum, and (b) Whole Blood.	Butt et al., 1964
	0.10-0.30 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.1. Blood serum.	Gofman et al., 1964
Bone	Not given	<4.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970

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MOLYBDENUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	Not given	<0.02 ppm	3	ES	Sudden accident victims	Koch et al., 1956
	Not given	2.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash (median)	3 of 129	ES	Autopsies. 9 U.S. cities.	Tipton and Cook, 1963
Diaphragm	Not given	3.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash (median)	3 of 91	ES	Autopsies. 9 U.S. cities.	Tipton and Cook, 1963
Esophagus	Not given	<2.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash (median)	1 of 66	ES	Autopsies. 9 U.S. cities.	Tipton and Cook, 1963
Feces	Not given	0.088 $\pm$ 0.017 and 0.099 $\pm$ 0.015 mg/day	2	ES	Healthy males, Cincinnati, Ohio	Tipton et al., 1969
Hair	Not given	0.13 and 0.28 $\mu\text{g/g}$ dry wt.	2	AAS; MS	None	Yurachek et al., 1969
Heart	Not given	3.8 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash (median)	8 of 140	ES	Autopsies. 9 U.S. cities.	Tipton and Cook, 1963
Intestine	Not given	<0.02 and 0.04 ppm	1 and 7	ES	Sudden accident victims. low value-large intestine and high value-small intestine	Koch et al., 1956

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MOLYBDENUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestine	Not given	4.0 µg/g ash	177	ES	Adult. Duodenum.	Schroeder et al., 1970
	Not given	4.0-5.5 µg/g ash	177	ES	Adult. Jejunum.	Schroeder et al., 1970
	Not given	<4.0 µg/g ash	177	ES	Adult. Ileum.	Schroeder et al., 1970
	Not given	<4.0 µg/g ash	177	ES	Adult. Cecum.	Schroeder et al., 1970
	Not given	2.5 µg/g ash	177	ES	Adult. Sigmoid colon.	Schroeder et al., 1970
	Not given	2.0 µg/g ash	177	ES	Adult. Rectum.	Schroeder et al., 1970
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	6 of 67	ES	Adult. Duodenum.	Tipton and Cook, 1963
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	7 of 102	ES	Adult. Jejunum.	Tipton and Cook, 1963
	<4.0-9.0 µg/g ash	<4.0 µg/g ash	18 of 83	ES	Adult. Ileum.	Tipton and Cook, 1963
	<4.0-5.0 µg/g ash	<4.0 µg/g ash	6 of 31	ES	Adult. Cecum.	Tipton and Cook, 1963
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	4 of 108	ES	Adult. Sigmoid colon.	Tipton and Cook, 1963
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	2 of 42	ES	Adult. Rectum.	Tipton and Cook, 1963

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MOLYBDENUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	Not given	0.24 ppm	6	ES	Sudden accident victims	Koch et al., 1956
	0.8-2.5 µg/g dry wt.	1.86 µg/g dry wt.	6	Colorimetry	None	Koch et al., 1957
	15.0-31.0 µg/g ash	Not given	177	ES	Accident victims	Schroeder et al., 1970
	0.0-0.5* mg/100 g dry wt.	Not given	Not given	ES	None	Tietz et al., 1957
	20.0-48.0 µg/g ash	31.0 µg/g ash	140 of 144	ES	None	Tipton and Cook, 1963
Larynx	Not given	<4.0 µg/g ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash (median)	1 of 50	ES	None	Tipton and Cook, 1963
Liver	Not given	0.7 ppm	5	ES	Sudden accident victims	Koch et al., 1956
	2.8-9.6 µg/g dry wt.	5.2 µg/g dry wt.	5	Colorimetry	None	Koch et al., 1957
	Not given	228 ± 178 µg/g ash	10	ES	Males, 5 black and 5 white; accident victims	Perry et al., 1973
	53.0-77.0 µg/g ash	Not given	177	ES	Accident victims	Schroeder et al., 1970
	0.0-2.0 mg/100 g dry wt.	Not given	Not given	ES	None	Tietz et al., 1957
	32.0-140.0 µg/g ash	75.0 µg/g ash	147	ES	None	Tipton and Cook, 1963

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MOLYBDENUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	Not given	0.24 ppm	4	ES	Sudden accident victims	Koch et al., 1956
	0.2-6.1 ug/g dry wt.	2.2 ug/g dry wt.	4	Colorimetry	None	Koch et al., 1957
	Not given	Min. - 20 ug Max. - 200 ug Retained per yr-0.0	168	Not given	Autopsy samples from 58 cities and 29 nonurban areas	Schroeder, 1970
	Not given	2.7 ug/g ash	177	ES	Accident victims	Schroeder et al., 1970
	0.0-0.31+	Not given	Not given	ES	None	Tietz et al., 1957
	<4.0-20.0 ug/g ash	<4.0 ug/g ash	5 of 141	ES	Autopsies. 9 U.S. cities.	Tipton et al., 1964
	<4.0 - <4.0 ug/g ash	<4.0 ug/g ash	5 of 141	ES	None	Tipton and Cook, 1963
Muscle	Not given	0.03 ppm	8	ES	Sudden accident victims	Koch et al., 1956
	Not given	<4.0 ug/g ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 ug/g ash	<4.0 ug/g ash	2 of 136	ES	None	Tipton and Cook, 1963
Omentum	<4.0-12.0 ug/g ash	Not given	177	ES	Accident victims	Schroeder et al., 1970
Ovary	<4.0 - <4.0 ug/g ash	<4.0 ug/g ash	0 of 16	ES	None	Tipton and Cook, 1963
Pancreas	Not given	0.03 ppm	1	ES	Sudden accident victims	Koch et al., 1956

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MOLYBDENUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Pancreas	Not given	3.2 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash	12 of 139	ES	None	Tipton and Cook, 1963
Prostate	Not given	3.9 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash	2 of 50	ES	None	Tipton and Cook, 1963
Skin	Not given	<2.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash	2 of 22	ES	None	Tipton and Cook, 1963
Spleen	Not given	0.1 ppm	3	ES	Sudden accident victims	Koch et al., 1956
	0.0-1.2 $\mu\text{g/g}$ dry wt.	0.5 $\mu\text{g/g}$ dry wt.	3	Colorimetry	None	Koch et al., 1956
	Not given	4.2 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash	4 of 143	ES	None	Tipton and Cook, 1963
Stomach	Not given	6.08 ppm	3	ES	Sudden accident victims	Koch et al., 1956
	Not given	3.0 $\mu\text{g/g}$ ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 $\mu\text{g/g}$ ash	<4.0 $\mu\text{g/g}$ ash	11 of 130	ES	None	Tipton and Cook, 1963

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MOLYBDENUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Testis	Not given	0.03 ppm	1	ES	Sudden accident victims	Koch et al., 1956
	Not given	3.1 µg/g ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	2 of 72	ES	None	Tipton and Cook, 1963
Teeth	0.7-39.0 µg/g	5.5 ± 0.71 µg/g	56	MS	<20-year olds, wide geographic area	Lossie et al., 1973
Thyroid	Not given	3.4 µg/g ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	1 of 21	ES	None	Tipton and Cook, 1963
Trachea	Not given	<2.0 µg/g ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	1 of 60	ES	None	Tipton and Cook, 1963
Urine	12-150 µg/liter	29.0-46.9 µg/liter	32	ES	Mixed population ages 4-69 yr.	Perry and Perry, 1959
	Not given	4.5-15.0 ppb	23	Not given	None	Perry, 1968
	Not given	0.11 ± 0.01 and 0.13 ± 0.01 ng/day	2	ES	Healthy males, Cincinnati, Ohio	Tipton et al., 1969
Uterus	Not given	<2.0 µg/g ash	177	ES	Accident victims	Schroeder et al., 1970
	<4.0 - <4.0 µg/g ash	<4.0 µg/g ash	1 of 32	ES	None	Tipton and Cook, 1963

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NEODYMIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.08 ppr	Not given	11	X-ray spectrometry	Healthy males, mean age 35.3 yr. Serum.	Goffman et al., 1964
Teeth	0.02-0.09 ug/g dry wt.	0.045 ug/g dry wt.	56	MS	<20 year-olds, wide geographic area	Lorge et al., 1973

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NICKEL

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	< 5.0-60.0 $\mu\text{g/g}$ ash	10.0	10 of 13	ES		Tipton and Cook, 1963
Aorta	0.09-0.34 $\mu\text{M/g}$ ash	Not Given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	< 5.0-20.0 $\mu\text{g/g}$ ash	< 5.0	47 of 104	ES		Tipton and Cook, 1963
Bladder	Not Given	0.7 ppm wet wt.	2	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	< 5.0-20.0 $\mu\text{g/g}$ ash	< 5.0	46 of 110	ES		Tipton and Cook, 1963
Blood	Not Given	(a) 0.0053-0.0062 Mg/100ml (b) 0.0327 0.0010 Mg/100ml	30 of 48	ES	Normal individuals, Los Angeles area, (a) Serum and (b) Whole blood	Butt et al., 1964
	0.0-0.18 ppm	Not Given	39	X-ray spectrometry	Healthy males mean age 35.3. Serum	Gofman et al., 1964
	(a) 1.1-4.5 $\mu\text{g/liter}$ (b) 0.4-4.6 $\mu\text{g/liter}$	(a) 3.1 (b) 2.7	48 (males) 11 (females)	AAS	(a) males (b) females	Hohnadel et al., 1973
	0.0-45 $\mu\text{g}/100\text{g}$	3.0	150	ES	Adult males U.S. citizen	Imbus et al., 1961
	1.0-8.5 $\mu\text{g}/100\text{ml}$	3.0	8	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	0.8-5.2 Mg/liter	2.6	26	AAS	Hartford, CT	McNeeley et al., 1972
	Not Given	2.6 0.8 $\mu\text{g/liter}$	47	AAS	Elevated in some diseased patients	McNeeley et al., 1972

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	3.0-8.0 µg/liter	Not Given	Not Given	Not Given		Mertz, 1974
	Not Given	0.03 µg/g dry wt.	Not Given	Not Given		Rentoul and Smith, 1973
Bone	23.4-81.0 µg/g dry wt.	51.0	40	AAS		Jones et al., 1972
	Not Given	0.16 ppm wet wt.	2	ES	Sudden accident victims age 23-37	Koch et al., 1956
Brain	Not Given	0.08 ppm wet wt.	3	ES	Sudden accident victims age 21-37	Koch et al., 1956
	Not Given	0.3 µg/g dry wt.	Not Given	Not Given		Rentoul and Smith, 1973
	< 5.0-5.0 µg/g ash	< 5.0	9 of 129	ES		Tipton and Cook, 1963
Diaphragm	< 5.0-19.0 µg/g ash	< .50	28 of 81	ES		Tipton and Cook, 1963
Esophagus	< 5.0-27.0 µg/g ash	< .50	27 of 66	ES		Tipton and Cook, 1963
Feces	Not Given	0.22±0.03 and 0.33±0.05 mg/day	2	ES	Healthy males, Cincinnati OH	Tipton et al., 1969
Hair	(a) 0.036 to 11.0 µg/g (b) 0.045 to 11.0 µg/g	(a) 0.51 (b) 0.74	498	Not Given	NY metropolitan area, (a) children and (b) adults	Cresson, 1975
	(a) 0.9-7.2 ppm (b) 0.7-7.5 ppm	(a) 1.9 (b) 3.4	50	AAS	Males - 9-60 years old and females - 13-72 years old	Eade and Lambkin, 1973
	0.8-15.6 µg/g	3.7	12	AAS	General population mixed sample	Hinners et al., 1974

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	Not Given	6.0 $\mu\text{g/g}$ dry wt.	Not Given	Not Given		Rentoul and Smith, 1973
	Not Given	(a) 0.97 ± 0.15 $\mu\text{g/g}$ (b) 3.96 ± 1.10 $\mu\text{g/g}$	180	AAS	No dyed or bleached hair, (a) males and (b) females	Schroeder and Mason, 1969
		0.45 and 3.4 $\mu\text{g/g}$ dry wt.	2	AAS; MS		Yurachek et al., 1969
Heart	0.09-0.46 $\mu\text{M/g}$ ash	Not Given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1967
	Not Given	0.2 $\mu\text{g/g}$ dry wt.	Not Given	Not Given		Rentoul and Smith, 1971
	(a) 0.43-0.83 $\mu\text{g}/100\text{g}$ (b) 1.6-3.0 $\mu\text{g}/100\text{g}$	(a) 0.61 (b) 2.3	4	AAS	(a) wet wt. (b) dry wt.	Sunderman et al., 1970
	< 5.0-140.0 $\mu\text{g/g}$ ash	< 5.0	48 of 140	ES		Tipton and Cook, 1963
Intestine	Not Given	(a) 0.98 ppm wet wt. (b) 1.06 ppm wet wt.	1 of 7	ES	Sudden accident victims ages 21-37, (a) large intestine and (b) small intestine	Koch et al., 1956
	Not Given	30 ppm ash	2652	ES	7 cities	Schroeder et al., 1962
	< 5.0-16.0 $\mu\text{g/g}$ ash	5.0	35 of 67	ES	Duodenum	Tipton and Cook, 1963
	< 5.0-11.0 $\mu\text{g/g}$ ash	< 5.0	21 of 102	ES	Jejunum	Tipton and Cook, 1963
	< 5.0-44.0 $\mu\text{g/g}$ ash	9.0	52 of 84	ES	Ileum	Tipton and Cook, 1963

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestine	3.0-100.0 $\mu\text{g/g}$ ash	21.0	29 of 31	ES	Cecum	Tipton and Cook, 1963
	< 5.0-55.0 $\mu\text{g/g}$ ash	12.0	81 of 106	ES	Sigmoid colon	Tipton and Cook, 1963
	3.0-38.0 $\mu\text{g/g}$ ash	16.0	2 of 24	ES	Rectum	Tipton and Cook, 1963
Kidney	0.0-1.4 $\mu\text{g/g}$ dry wt.	0.6 $\mu\text{g/g}$ dry wt.	6	ES		Koch et al., 1957
	Not Given	0.04 ppm wet wt.	6	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	0.09-0.19 $\mu\text{M/g}$ ash	Not Given	150	ES	Adults who died unexpectedly, St. Louis, MO	Perry et al., 1972
	Not Given	0.2 $\mu\text{g/g}$ dry wt.	Not Given	Not Given		Rentoul and Smith, 1973
	0-0.2+ mg/100g dry wt.	Not Given	Not Given	ES		Tietz et al., 1957
	3.0-11.0 $\mu\text{g/g}$ ash	< 5.0	30 of 144	ES		Tipton and Cook, 1963
	3.0-17.0 $\mu\text{g/g}$ ash	< .50	18 of 50	ES		Tipton and Cook, 1963
Larynx						
Liver	0.3-0.8 $\mu\text{g/g}$ dry wt.	0.17 $\mu\text{g/g}$ dry wt.	5	ES		Koch et al., 1957
	Not Given	0.16 ppm wet wt.	5	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	0.09-0.19 $\mu\text{M/g}$ ash	Not Given	150	ES	Adults who died suddenly, St. Louis, MO	Perry et al., 1962

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	Not Given	2.6- $\mu\text{g/g}$ ash	10	ES	Healthy adult males, 5 white, 5 black, long-term St. Louis residents	Ferry et al., 1973
	(a) 0.52-1.32 $\mu\text{g}/100\text{g}$ (b) 2.1-4.8 $\mu\text{g}/100\text{g}$	(a) 0.87 (b) 3.20	4	AAS	(a) wet wt. (b) dry wt.	Sunderman et al., 1970
	< 5.0-11.0 $\mu\text{g/g}$ ash	< 5.0	27 of 148	ES		Tipton and Cook, 1963
Lung	0.0-4.6 $\mu\text{g/g}$ dry wt.	1.4 $\mu\text{g/g}$ dry wt.	4	ES		Koch et al., 1957
	Not Given	0.24 ppm wet wt.	4	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	0.09-0.48 $\mu\text{M/g}$ ash	Not Given	150	ES	Adults who died unexpectedly, St. Louis, MO	Ferry et al., 1962
	Not Given	(min) 50 $\mu\text{g}/\text{year}$ (max) 8000 $\mu\text{g}/\text{year}$ retained per year - 10 μg	168	Not Given	Autopsies 58 U.S. cities and urban areas	Schroeder, 1970
	7-60 ppm	Not Given	137	ES	7 cities	Schroeder et al., 1962
	(a) 0.81-2.4 $\mu\text{g}/100\text{g}$ (b) 3.3-14.6 $\mu\text{g}/100\text{g}$	(a) 1.59 (b) 8.60	4	AAS	(a) wet wt. (b) dry wt.	Sunderman et al., 1970
	0-0.6+ $\text{mg}/100\text{g}$ dry wt.	Not Given	Not Given	ES		Tietz et al., 1957
	< 5.0-28.0 $\mu\text{g/g}$ ash	< 5.0	70 of 141	ES		Tipton and Cook, 1963
Muscle	Not Given	0.14 ppm wet wt.	7	ES	Sudden accident victims ages 21-37	Koch et al., 1956

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle (continued)	<5.0-12.0 $\mu\text{g/g}$ ash	<5.0 $\mu\text{g/g}$ ash	30 of 136	ES	None	Tipton and Cook, 1963
Omentum	<5.0-76.0 $\mu\text{g/g}$ ash	22.0 $\mu\text{g/g}$ ash	63 of 75	ES	None	Tipton and Cook, 1963
Ovary	<5.0-17.0 $\mu\text{g/g}$ ash	<5.0 $\mu\text{g/g}$ ash	4 of 16	ES	None	Tipton and Cook, 1963
Pancreas	Not given	0.16 ppm wet wt.	4	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	<5.0-11.0 $\mu\text{g/g}$ ash	<5.0 $\mu\text{g/g}$ ash	26 of 129	ES	None	Tipton and Cook, 1963
Placenta	Not given	0.006 ± 0.006 $\mu\text{g/g}$ wet wt.	58	Not given	South and southeast U.S. areas	Karp and Robertson, 1977
Prostate	Not given	0.04 ppm wet wt.	4	ES	Sudden accident victims ages 21-37.	Koch et al., 1956
	<5.0-5.0 $\mu\text{g/g}$ ash	<5.0 $\mu\text{g/g}$ ash	8 of 50	ES	None	Tipton and Cook, 1963
Skin	15.0-180.0 $\mu\text{g/g}$ ash	47.0 $\mu\text{g/g}$ ash	21 of 22	ES	None	Tipton and Cook, 1963
Spleen	0.3-1.0 $\mu\text{g/g}$ dry wt.	0.8 $\mu\text{g/g}$ dry wt.	3	ES	None	Koch et al., 1957
	Not given	0.10 ppm wet wt.	3	ES	Sudden accident victims ages 21-37.	Koch et al., 1956
	0.09-0.09 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis, Mo.	Ferry et al., 1962

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen (continued)	<5.0-5.0 ug/g ash	<5.0 ug/g ash	17 of 143	ES	None	Tipton and Cook, 1963
Stomach	Not given	0.36 ppm wet wt.	3	ES	Sudden accident victims ages 21-37	Koch et al., 1956
	<5.0-18.0 ug/g ash	<5.0 ug/g ash	44 of 130	ES	None	Tipton and Cook, 1963
Sweat	(a) 7-180 ug/liter (b) 39-270 ug/liter	(a) 5? ug/liter (b) 131 ug/liter	48 males 11 (females)	AAS	(a) Males (b) Females	Mohndel et al., 1973
Teeth	0.11-3.0 ug/g	0.64 ug/g	56	MS	20 year-olds; wide geographic area	Loose et al., 1971
Testis	<5.0-16.0 ug/g ash	<5.0 ug/g ash	17 of 72	ES	None	Tipton and Cook, 1963
Thyroid	Not given	0.16 ppm wet wt.	2	ES	Sudden accident victims ages 21-37.	Koch et al., 1956
	<3.0-10.0 ug/g ash	<5.0 ug/g ash	7 of 21	ES	None	Tipton and Cook, 1963
Trachea	<5.0-15.0 ug/g ash	5.0 ug/g ash	31 of 60	ES	None	Tipton and Cook, 1963
Urine	Not given	<0.10 mg/liter	Not given	NAA	None	Gills et al., 1974
	0.0-82 ug/liter	7.6 ug/liter	150	ES	Adult males U.S. cities	Imbus et al., 1963
	0.7-4.0 ug/liter	2.0 ug/liter	20	AAS	Hartford, CT	McNeeley et al., 1972
	10-100 ug/liter	Not given	Not given	Not given	None	Mertz, 1974

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NICKEL (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	10-70 $\mu\text{g/liter}$	(a) 20.1 $\mu\text{g/liter}$ (b) 16.6 $\mu\text{g/liter}$ (c) 22.6 $\mu\text{g/liter}$	24	ES	Normals. St. Louis, Mo. (a) overall, (b) females, and (c) males	Perry and Perry, 1957
	Not given	1.5 ppb	15	Not given	Hypertensives-little difference	Perry, 1968
	Not given	0.11 ± 0.03 mg/day	2	ES	Healthy males, Cincinnati, Ohio	Tipton et al., 1969
Uterus	<5.0-6.0 $\mu\text{g/g ash}$	<5.0 $\mu\text{g/g ash}$	6 of 32	ES	None	Tipton and Cook, 1963

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NIOSH

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	1.71 ug/g wet wt.	1 of 5	Colorimetry	Healthy males mean age 35.3. Serum	Schroeder and Balassa, 1965
Aorta	Not Given	6.21 ug/g wet wt.	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Blood	0.0-0.16 ppm	Not Given	39	X-ray spectrometry		Gofman et al., 1964
	0.53-0.74 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Brain	0.31-1.05 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Hair	1.72-2.39 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Heart	0.35-0.93 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Kidney	0.66-8.81 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Liver	1.84-5.76 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Lung	0.55-2.67 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Pancreas	0.93-1.18 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Spleen	0.74-1.98 ug/g wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Teeth	<0.10-0.76 ug/g dry wt.	0.31	56	MS	< 20 year olds, wide geographic area	Loosev et al., 1973

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NIOBIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Testis	0.41-0.80 $\mu\text{g/g}$ wet wt.	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965
Urine	0.24-0.39 $\mu\text{g/ml}$	Not Given	1 of 5	Colorimetry		Schroeder and Balassa, 1965

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TRANS-NONACHLOR

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	0.04 and 0.06 ppm	10	GC-EC	9 U.S. regions, values for New England and SW central states, respectively, confirmed in most other areas	Kutz et al., 1976
Milk	Trace-0.01 ppm	0.001 ppm	57	GC-EC and GC/MS	Arkansas and Mississippi mothers, mean age 27; 17 black, 40 white, 1973-74	Strawman and Kutz, 1977

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OSMIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.57 ppm	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.1 yrs. Serum.	Gofman et al., 1964

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OXYCHLORDANE

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.03-0.40 ppm	0.41 ppm	27	GC-EC, IR, and MS	None	Biros et al., 1973
	1.73 ppm (max.)	0.12 ppm (median)	1092 (1973); 898 (1974)	GC-EC, IR, and MS GC-EC, IR, and MS	75 U.S. sites; 98+ % positive; blacks had 2+ level of whites	Kutz et al., 1977
	1.87 ppm (max.)	0.11-0.12 ppm (median)	1913 (1972); 898 (1974)	GC-EC	75 U.S. sites	Kutz et al., 1977
Milk	1.0-116.0 ppb	95.8 ± 195.1 ppb	1061 of 1436	GC-EC	National study. Fat basis.	Savage, 1976
	Trace-0.02 ppm	0.005 ppm	57	GC-EC and GC/MS	Mississippi and Arkansas females	Strassman and Kutz, 1977

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PALLADIUM

Tissue	Range	Mean level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.1 ppm	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964
	Not Given	<0.9 µg/100ml	300	AAS	Several locations in California	Johnson et al., 1975
Feces	Not Given	<0.001 µg/g	300	AAS	Several locations in California	Johnson et al., 1975
Hair	Not Given	<0.02 µg/g	300	AAS	Several locations in California	Johnson et al., 1975
Urine	Not Given	<0.30 µg/g	300	AAS	Several locations in California	Johnson et al., 1975

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PBB's

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.104-174 ppm	0.53 ppm	15	GC	Missouri dairy farm residents	Humphrey and Hayner, 1975
	0.0-273.016 ppb	1965 $\pm$ 356, 516 $\pm$ 92, 226 $\pm$ 73, and 0.0 ppb	111 exposed; 116 non-exposed	Not given	Values respectively for quarantined farmers, nonquarantined farmers, city residents, and out-of-state visitors	Meester and McCoy, 1976
Blood			110 exposed; 104 non-exposed	GC	Missouri dairy farm residents	Humphrey and Hayner, 1975
	(a) 0.0-2.26 ppm (b) 0.002-2.26 ppm (c) 0.0-0.09 ppm (d) 0.002-0.09 ppm	(a) 0.014 ppm (median) (b) 0.035 ppm (median) (c) 0.003 ppm (median) (d) 0.006 ppm (median)			(a) exposed adults (b) exposed children (c) nonexposed adults (d) nonexposed children	
	0.0-2.26 ppm	<0.1 ppm (est.)	165 exposed; 133 non-exposed	Not given	Farm families	Kay, 1977
	0.1-28.6 ppb	Not given	35 of 116	Not given	Higher values for quarantined farmers	Meester and McCoy, 1976
Milk	0.21-92.66 ppm	10.8 ppm	6	GC	Missouri dairy farm residents	Humphrey and Hayner, 1975

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PCB's and PCT's

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	0.0->2.0 ppm	Not given	688-1247 (1972-1974)	GC-EC and MS	2 positives increased from 1972 to 1974; increased % at <1.0 and 1-2 ppm levels	Kutz and Strassman, 1976
	0.0->2.0 ppm	Not given	186	GC-EC	Michigan general population; 98% contained trace to >2.0 ppm	Price and Welch, 1972
Blood	Not given	3.7 ppb	54	GC-EC	Blood plasma. 11% positive.	Hammer et al., 1972
	10-100 ppb	48 ppb	Not given	GC-EC	Whole blood. Data on debilitated patients; none found in normals	Heusselberg and Scherr, 1974
Feces	Not given	87.0 ug/day/person	32	GLC	Preadolescent females	Price et al., 1972
Hair	0.34-0.76 ppm	Not given	4	GC	None	Matthews et al., 1976
Milk	0.04-1.00 ppm	0.05 ppm, fat basis	39	GC-EC and TLC	8 positives of 39	Savage et al., 1973
	0.04-0.10 ppm	0.04 ppm, fat basis	39	GC-EC	Females ages 19-33	Savage et al., 1972
	40-100 ppb	9.75 ppb, fat basis	40	GC	Rural county	Savage et al., 1973
Urine	Not given	5.8 ug/day/person	32	GLC	Preadolescent females	Price et al., 1972

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PCP-PENTACHLOROPHENOL

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	5.0-52.0 ppb	23.3 ppb	20	GC-EC	General population in Florida	Shafik, 1973
Blood	Not Given	0.5-1.7 ppb	3,568	Not Given	General Population in Hawaii	Rashad et al., 1976
Urine	0.0-1840 ppb	42.0 ppb	290	GC	Values for occupationally exposed workers much higher	Bevenue et al., 1967
	2.2-11.2 ppb	2.2-10.8 ppb	Not Given	GC		Cranmer and Freal, 1970

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PLATINUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.46 ppm	Not given	39	X-ray spectrometry	39 healthy men, mean age 35.3 years. Serum.	Gofman et al., 1964
	<3.1 ug/100 ml	Not given	300	AAS	Levels of Pt, Pd, and Pb before auto catalysts, 150 subjects living near urban freeway; 150 in high desert area	Johnson et al., 1974
Feces	<0.002 ug/g	Not given	100	AAS	Levels of Pt, Pd, and Pb before auto catalysts, 150 subjects living near urban freeway; 150 in high desert area	Johnson et al., 1974
Hair	<0.05 ug/g	Not given	300	AAS	Levels of Pt, Pd, and Pb before auto catalysts, 150 subjects living near urban freeway; 150 in high desert area	Johnson et al., 1974
Urine	<0.6 ug/liter	Not given	300	AAS	Levels of Pt, Pd, and Pb before auto catalysts, 150 subjects living near urban freeway; 150 in high desert area	Johnson et al., 1974
21 tissues	0.003-1.46 ug/g wet wt.	0.16 ug/g wet wt.	1313 samples; 97 sets, 62/1313	ES	Before auto catalysts; 1313 samples from 97 autopsy sets; of 1313 samples, 62 contained Pt; fat highest, none in lung, bones, hair; California	Duffield et al., 1976

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PRASEODYMIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.13 ppm	Not Given	19	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964
Teeth	0.01-0.07 ug/g dry wt.	0.027 ug/g dry wt.	56	MS	< 20-year-olds, wide geographic area	Loose et al., 1973

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RHENIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.26 ppm	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964

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RHODIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0-0-0.16 ppm	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964

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MUTATION

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	Not given	(a) 15.4 ± 3.2 $\mu\text{g/g}$ dry wt. (b) 17.8 ± 4.0 $\mu\text{g/g}$ dry wt.	(a) 712 (b) 684	NAA	10% higher for whites, Nashville, Tennessee. (a) maternal blood; (b) infant blood	Baglan et al., 1974
	0.02-0.28 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964
	Not given	(a) 4.18 ± 0.62 $\mu\text{g/ml}$ (b) 0.16 ± 0.03 $\mu\text{g/ml}$	23	AAS	Normal Utah males. (a) rbc; (b) plasma	Wood, 1969
	Not given	(a) 4.28 ± 0.75 $\mu\text{g/ml}$ (b) 0.18 ± 0.02 $\mu\text{g/ml}$ (c) 4.10 ± 0.54 $\mu\text{g/ml}$ (d) 0.15 ± 0.02 $\mu\text{g/ml}$	12 females 9 males	AAS	(a) male rbc (b) male plasma (c) female rbc (d) female plasma	Wood, 1970
Hair	Not given	0.20 and 0.23 $\mu\text{g/g}$ dry wt.	2	AAS; MS		Yurachek et al., 1969
Placenta	Not given	25.0 ± 5.8 $\mu\text{g/g}$ dry wt.	826	NAA	10% higher for whites, Nashville, Tennessee	Baglan et al., 1974
Teeth	0.14-0.87 $\mu\text{g/g}$	0.41 $\mu\text{g/g}$	56	MS	<20-year-olds, wide geographic area	Lesee et al., 1973

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RUTHENIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.23 ppr.	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964

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SAMARIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.18 ppm	Not given	39	X-ray spectrometry	Healthy males; mean age 35.3 yrs. Serum.	Gofman et al., 1964

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SCANDIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.0-0.3 ppm	Not Given	39	X-ray spectrometry	Healthy males, mean age 35.3 yrs. Serum.	Gofman et al., 1964
Hair	Not Given	0.0022±0.00012 ppm	10	NAA	Hair cycle discussed	Obrusnik et al., 1972

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SELENIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	0.04 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Blood	10-34 μ g/100 ml	20.6 μ g/100 ml	210	Fluorometry	Blood bank donors	Allaway et al., 1968
	Not given	0.093 $\pm$ 0.115 μ g/g dry wt.	83	NAA	4 large hospitals in Nashville, Tenn. Maternal blood.	Baglan et al., 1974
	Not given	0.076 $\pm$ 0.109 μ g/g dry wt.	123	NAA	4 large hospitals in Nashville, Tenn. Fetal blood.	Baglan et al., 1974
	0.05-0.15 ppm	Not given	39	X-ray Spectrometry	Healthy males, mean age 35.3 yrs. Serum	Gofman et al., 1964
	Not given	1.49 $\pm$ 0.06	18	NAA	VA hospital patients in Louisville Ky.	McConnell et al., 1975
	17.0-27.3 μ g/100 ml	21.71 $\pm$ 1.05 μ g/100 ml	10	Fluorometry	Normal persons, age 50-71 yrs.	Shamberger et al., 1971
	13.7-21.1 μ g/100 ml	16.2 $\pm$ 0.75 μ g/100 ml	12	Fluorometry	Cancer patients, age 50-71 yrs.	Shamberger et al., 1971
	18-32 μ g/100 ml	23.6 μ g/100 ml; 22.3 μ g/100 ml	48	Fluorometry	21 normal women, 27 normal males; Cleveland area	Shamberger et al., 1973
Bone	Not given	0.42 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Brain	0.04-0.21 ppm wet wt.	0.13 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Breast	Not given	0.11 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970

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SELENIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	1-11 ppm	6.4 ppm	33	NAA	Adults & children from Oak Ridge, Tenn.	Bate and Dyer, 1965
	0.025-1.65 $\mu\text{g/g}$	0.320 $\mu\text{g/g}$	260	AAS	Children from Queens, Riverhead, and Bronx	Creason, 1975
	0.025-1.58 $\mu\text{g/g}$	0.303 $\mu\text{g/g}$	188	AAS	Adults from Queens, Riverhead, and Bronx	Creason, 1975
	Not given	0.720 $\pm$ 0.132 ppm	10	NAA		Obrowsnik et al., 1972
Heart	0.25-0.37 ppm wet wt.	0.28 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Intestine	0.12-0.32 ppm wet wt.	0.21 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years. Small intestine	Schroeder et al., 1970
Kidney	0.61-1.84 ppm wet wt.	1.09 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Liver	Not given	1.73 $\pm$ 0.24 $\mu\text{g/g}$ dry wt.	7	NAA	VA hospital patients in Louisville, Ky.	McConnell et al., 1975
	0.28-0.81 ppm wet wt.	0.54 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Lung	0.05-0.26 ppm wet wt.	0.15 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Milk	0.007-0.060 ppm	0.018 ppm	241	Fluorometry	Nursing mothers in or near cities; 27.4 $\pm$ 0.3 yrs; 183 $\pm$ 9 days post-partum.	Shearer et al., 1975
	Not given	0.24 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970

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SELENIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle	0.11-0.38 ppm wet wt.	0.24 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Pancreas	Not given	0.63 ± 0.07 µg/g dry wt.	12	NAA	VA hospital patients in Louisville, Ky.	McConnell et al., 1975
	0.27-0.34 ppm wet wt.	0.30 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Placenta	Not given	0.102 ± 0.077 µg/g dry wt.	135	NAA	4 large hospitals in Nashville, Tenn.	Baglan et al., 1974
	Not given	0.114 ± 0.005 µg/g wet wt.	58	Not given	City hospitals in south and southeast	Karp and Robertson, 1977
Saliva	1.1-5.2 ppb	3.1 ppb	26	Fluorometry	Children, ages 11-12, Oregon.	Hadjimarkos, 1972
Spleen	0.28-0.47 ppm wet wt.	0.34 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Synovial membrane	Not given	0.63 ± 0.12 µg/g dry wt.	28	NAA	VA hospital patients in Louisville, Ky.	McConnell et al., 1975
Teeth	0.12-0.90 µg/g	0.43 ± 0.03 µg/g	56	MS	Wide geographic area	Loose et al., 1971
Testis	0.15-0.38 ppm wet wt.	0.30 ppm wet wt.	6	Fluorometry	Age 9 months to 69 years	Schroeder et al., 1970
Urine	Not given	0.010 mg/liter	Not given	NAA		Gill et al., 1974
	0-15.9 µg/100 cc	5.0 ± 2.9 µg/100 cc; 4.2 ± 1.8 µg/100 cc	11	Chem.	1st morning specimens; consecutive specimens for 24-hr period. Malen, Rochester, N.Y.	Sterner et al., 1961

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SILICON

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	1000-5000 µg/liter	Not given	Not given	Not given		Mertz, 1974
Hair	0.03-0.36 % dry wt.	Not given	18	ES	Age 15-70 yrs., white	Goldblum et al., 1953
	10.9-27.9 µg/g dry wt.	Not given	2	MS; AAS		Yurachek et al., 1969
Nails	0.17-0.54 % dry wt.	Not given	18	ES	Age 15-70 yrs., white	Goldblum et al., 1953
Skin	0.64-2.14 % dry wt.	Not given	18	ES	Age 15-70 yrs., white	Goldblum et al., 1953
Teeth	100-450 µg/g	243 ± 18 µg/g	56	MS	Wide geographic area	Lowe et al., 1973
Urine	10,000-50,000 µg/liter	Not given	Not given	Not given		Mert., 1974

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SILVER

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	<0.1-3.2 $\mu\text{g/g}$ ash	0.8 $\mu\text{g/g}$ ash (median)	10 of 13	ES		Tipton and Cook, 1963
Aorta	<0.1-1.0 $\mu\text{g/g}$ ash	0.1 $\mu\text{g/g}$ ash (median)	63 of 105	ES		Tipton and Cook, 1963
Bladder	<0.1-0.7 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	46 of 112	ES		Tipton and Cook, 1963
Blood	Not given	0.0004 $\pm$ 0.00003 mg/100 ml	122	ES	Blood donors, Los Angeles area. Serum.	Butt et al., 1964
	Not given	0.0030 $\pm$ 0.0003 mg/100 ml	96	ES	Surgical and degenerative disease patients, Los Angeles area. Serum.	Butt et al., 1964
	Not given	0.0013-0.0014 mg/100 ml	41	ES	Normal persons, Los Angeles area. Serum.	Butt et al., 1964
	Not given	0.0024 $\pm$ 0.0003 mg/100 ml	7	ES	Normal persons, Los Angeles area. Whole blood.	Butt et al., 1964
	0.02-0.38 ppm	Not given	39	X-ray spectrometry	Healthy males. Age 35.3 yrs. Serum.	Gofman et al., 1964
	Not given	0.00+ mg/100 g	Not given	ES		Kehoe et al., 1940
	Not given	0.03 $\mu\text{g/ml}$	Not given	Not given	Normal level	Rentoul and Smith, 1973
Bone	Not given	0.00 mg/100 g wet wt.	Not given	ES	Long bone	Kehoe et al., 1940
	Not given	0.01 mg/100 g wet wt.	Not given	ES	Rib bone	Kehoe et al., 1940
Brain	Not given	0.003 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.033 mg/100 g dry wt.	1	ES		Nusbaum et al., 1958

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SILVER (cont. nued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain (continued)	Not given	0.03 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Rentoul and Smith, 1973
	<0.1-1.6 $\mu\text{g/g}$ ash	0.6 $\mu\text{g/g}$ ash (median)	113 of 128	ES		Tipton and Cook, 1963
Diaphragm	<0.1-0.5 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	17 of 91	ES		Tipton and Cook, 1963
Esophagus	0.1-1.0 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	32 of 68	ES		Tipton and Cook, 1963
Hair	0-12 ppm	3.8 ppm	33	NAA	Oak Ridge, Tenn.	Bate et al., 1965
	0.007-6.20 $\mu\text{g/g}$; 0.007-4.30 $\mu\text{g/g}$	0.205 $\mu\text{g/g}$; 0.165 $\mu\text{g/g}$	266; 198	ES	Children; adults. 3 New York communities.	Creason, 1975
	4.3×10^{-7} - 4.5×10^{-6} % of dry wt.	Not given	18	ES	Age 15-70 yrs. White.	Goldblum et al., 1953
	Not given	0.275 ± 0.038 ppm	10	NAA		Ohrnink et al., 1972
	Not given	0.9 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Rentoul and Smith, 1973
	0.4-2.0 $\mu\text{g/g}$ dry wt.	Not given	2	MS; AAS		Yurachek et al., 1969
Heart	Not given	0.00 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.026 mg/100 g dry wt.	3	ES		Nusbaum et al., 1958
	Not given	0.01 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Rentoul and Smith, 1973

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SILVER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart (continued)	<0.1-0.3 µg/g ash	<0.1 µg/g ash (median)	11 of 119	ES		Tipton and Cook, 1963
Intestines	Not given	0.002 mg/100g wet wt.	Not given	ES		Keloe et al., 1940
	<0.1-1.1 µg/g ash	0.1 µg/g ash (median)	35 of 68	ES	Duodenum,	Tipton and Cook, 1963
	<0.1-1.8 µg/g ash	0.1 µg/g ash (median)	31 of 102	ES	Jejunum	Tipton and Cook, 1963
	<0.1-1.1 µg/g ash	0.1 µg/g ash (median)	49 of 84	ES	Ileum	Tipton and Cook, 1963
	<0.1-1.4 µg/g ash	0.1 µg/g ash (median)	16 of 31	ES	Cecum	Tipton and Cook, 1963
	<0.1-2.0 µg/g ash	0.1 µg/g ash (median)	64 of 109	ES	Sigmoid colon	Tipton and Cook, 1963
	<0.1-1.4 µg/g ash	<0.1 µg/g ash (median)	14 of 42	ES	Rectum	Tipton and Cook, 1963
Kidney	Not given	0.00	Not given	ES		Keloe et al., 1940
	Not given	0.026 mg/100 g dry wt.	3	ES		Nusbaum et al., 1958
	<0.0009-0.0093 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	0.005 µg/g dry wt.	Not given	Not given	Normal level	Kentoul and Smith, 1973
	<0.1-1.0 µg/g ash	<0.1 µg/g ash (median)	67 of 143	ES		Tipton and Cook, 1963

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SILVER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Larynx	<0.1-0.5 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	20 of 50	ES		Tipton and Cook, 1963
Liver	Not given	0.005 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.034 mg/100 g dry wt.	3	ES		Nusbaum et al., 1958
	Not given	0.96 $\pm$ 0.88 $\mu\text{g/g}$ ash	10	ES	5 white, 5 black healthy males	Perry et al., 1973
	0.0091-0.030 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1962
	Not given	0.04 $\mu\text{g/g}$ dry wt.	Not given	Not given	Normal level	Kantoul and Smith, 1973
Lung	0.1-.2 $\mu\text{g/g}$ ash	0.8 $\mu\text{g/g}$ ash (median)	139 of 148	ES		Tipton and Cook, 1963
	Not given	0.004 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.030 mg/100 g dry wt.	Not given	ES		Nusbaum et al., 1958
	<0.0009-0.0046 micromole/g ash	Not given	150	ES	Adults who died unexpectedly, St. Louis	Perry et al., 1973
	<0.1-12 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	54 of 139	ES	Autopsy cases from 9 cities	Tipton et al., 1964
	<0.1-0.5 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	54 of 139	ES		Tipton and Cook, 1963
	Not given	0.00 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
Muscle	<0.1-0.5 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	27 of 135	ES		Tipton and Cook, 1963

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SILVER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Nails	4.8×10^{-6} - 6.5×10^{-7} % dry wt.	Not given	18	ES	Age 15-70 yrs. White.	Goldblum, et al., 1953
Omentum	<0.1-1.5 $\mu\text{g/g}$ ash	0.5 $\mu\text{g/g}$ ash (median)	61 of 74	ES		Tipton and Cook, 1963
Ovary	<0.1-1.1 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	7 of 16	ES		Tipton and Cook, 1963
Pancreas	<0.1-1.0 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	61 of 137	ES		Tipton and Cook, 1963
Placenta	Not given	Not given	58	Not given	City hospitals in South and Southeast	Karp and Robertson, 1977
Prostate	<0.1-1.3 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	24 of 48	ES		Tipton and Cook, 1963
Skin	1.7×10^{-6} - 4.5×10^{-6} % dry wt.	Not given	18	ES	Age 15-70 yrs. White.	Goldblum et al., 1953.
	0.1-4.0 $\mu\text{g/g}$ ash	1.3 $\mu\text{g/g}$ ash (median)	21 of 22	ES		Tipton and Cook, 1963
Spleen	Not given	0.00 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	Not given	0.025 mg/100 g dry wt.	3	ES		Muebaum, et al., 1958
	<0.1-0.5 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	44 of 141	ES		Tipton and Cook, 1963
Stomach	Not given	0.00 mg/100 g wet wt.	Not given	ES		Kehoe et al., 1940
	<0.1-1.0 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	52 of 130	ES		Tipton and Cook, 1963

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SILVER (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Teeth	Not given	1.0 ppm	Not given	Not given	Pueblo Indians, 800-year-old enamel	Anon, 1959
	Not given	1.11 ± 1.04 ppm; 7.43 ± 2.70 ppm	208	MS	High caries, New England; low caries, South Carolina. <20-year-old.	Curzon et al., 1977
	0.01-0.77 $\mu\text{g/g}$ dry wt.	0.140 $\mu\text{g/g}$ dry wt.	56	MS	Wide geographic area	Lowee et al., 1973
Testis	<0.1-0.5 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	24 of 71	ES		Tipton and Cook, 1963
Thyroid	<0.1-9.8 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	10 of 20	ES		Tipton and Cook, 1963
Trachea	<0.1-1.3 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	32 of 60	ES		Tipton and Cook, 1963
Urine	Not given	0.00 mg/liter	Not given	ES		Kehoe et al., 1940
	0.42-3.8 $\mu\text{g/liter}$	1.50-1.67 $\mu\text{g/liter}$	24	EE	10 black and 14 white persons age 4-69 yrs., St. Louis, Mo.	Perry and Perry, 1959
Uterus	<0.1-0.6 $\mu\text{g/g}$ ash	<0.1 $\mu\text{g/g}$ ash (median)	10 of 32	ES		Tipton and Cook, 1963

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STRONTIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	0.3-9.5 ug/g ash	3.5 ug/g ash	13	ES		Tipton and Cook, 1963
Aorta	0.12-0.87 micromole/g ash	Not given	100	ES		Perry, 1968
	0.17-0.89 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis.	Perry et al., 1962
	15-78 ug/g ash	33 ug/g ash	103	ES		Tipton and Cook, 1963
Blood	Not given	0.0153 ± 0.0008 mg/100 ml	122	ES	Blood donors in Los Angeles area. Serum.	Butt et al., 1964
	Not given	0.0040 ± 0.0005 mg/100 ml	96	ES	Hospital patients in Los Angeles area. Serum.	Butt et al., 1964
	Not given	0.0046 ± 0.0003 mg/100 ml	48	ES	Normal persons in Los Angeles area. Serum.	Butt et al., 1964
	Not given	0.0039 ± 0.0002 mg/100 ml	47	ES	Normal persons in Los Angeles area. Whole blood.	Butt et al., 1964
	0.00-0.05 ppm	Not given	39	X-ray spectrometry	39 healthy men. Mean age 35.3. Serum.	Gofman et al., 1964
Bone	30-80 ppm	Not given	2	ES	Skeleton. White male, age 60. Black male, age 48.	Forbes et al., 1956
	Not given	0.011 % of ash; 0.019 % of ash	38	ES	Fetal. Other samples.	Musbaum et al., 1958
	Not given	0.57 mg/g calcium	5	AAS	Fetal	Rosenthal et al., 1972
	38.91 ± 0.76 mg/g calcium	Not given	3	AAS	Adult	Rosenthal et al., 1972

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STRONTIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bone (continued)	<0.1-3.4 pCi/g calcium	Not given	35	Not given	Alaska, ages 4 months to 67 years.	Schubert, 1962
	41.6-157 ppm	79.1 ± 20 ppm (0-3 months); 73.8 ± 26 ppm (1-13 years); 107 ± 23 ppm (19-33 years); 114 ± 28 ppm (33-74 years)	35	NAA	Males and Females, birth to 74 years.	Sowden and Stitch, 1957
Brain	0.0064-0.096 micromole/g ash	Not given	100	ES		Perry, 1968
	0.0037-0.049 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	0.5-4.3 µg/g ash	3.3 µg/g ash	127	ES		Tipton and Cook, 1963
Diaphragm	1.4-7.8 µg/g ash	3.3 µg/g ash	91	ES		Tipton and Cook, 1963
Esophagus	4.1-17 µg/g ash	8.2 µg/g ash	65	ES		Tipton and Cook, 1963
Feces	Not given	1.7 ± 0.2 mg/day; 2.1 ± 0.2 mg/day	2	ES	Healthy, 21- and 25-year-old men at University of Cincinnati.	Tipton et al., 1969
Hair	2.2 x 10 ⁻⁶ to 9.1 x 10 ⁻⁶ % dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	11-22 pCi/g calcium	15 pCi/g calcium	7	Radiometry	Boston and New Orleans	Moller et al., 1964
	Not given	9.5 pCi/g calcium	2	Radiometry	Phoenix	Moller et al., 1964

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STRONTIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair (continued)	2.2×10^{-6} to 9.1×10^{-6} Z dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	11-22 pCi/g calcium	15 pCi/g calcium	7	Radiometry	Boston and New Orleans	Moller et al., 1964
	Not given	9.5 pCi/g calcium	2	Radiometry	Phoenix	Moller et al., 1964
	Not given	1.1 $\mu\text{g/g}$ dry wt. 0.75 $\mu\text{g/g}$ dry wt.	2	MS		Yurachek et al., 1969
Heart	0.014-0.19 micromole/g ash	Not given	100	ES		Perry, 1968
	0.012-0.081 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	1.1-7.1 $\mu\text{g/g}$ ash	2.6 $\mu\text{g/g}$ ash	140	ES		Tipton and Cook, 1963
Intestine	2.4-25 $\mu\text{g/g}$ ash	11 $\mu\text{g/g}$ ash	67	ES	Duodenum	Tipton and Cook, 1963
	3.1-33 $\mu\text{g/g}$ ash	11 $\mu\text{g/g}$ ash	100	ES	Jejunum	Tipton and Cook, 1963
	6.0-62 $\mu\text{g/g}$ ash	25 $\mu\text{g/g}$ ash	81	ES	Ileum	Tipton and Cook, 1963
	11-100 $\mu\text{g/g}$ ash	42 $\mu\text{g/g}$ ash	31	ES	Cecum	Tipton and Cook, 1963
	5.5-76 $\mu\text{g/g}$ ash	23 $\mu\text{g/g}$ ash	107	ES	Sigmoid colon	Tipton and Cook, 1963
	5.2-57 $\mu\text{g/g}$ ash	26 $\mu\text{g/g}$ ash	42	ES	Rectum	Tipton and Cook, 1963

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STRONTIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	0.047-0.16 micromole/g ash	Not given	100	ES		Perry, 1968
	0.033-0.14 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	2.8-12 μ g/g ash	5.2 μ g/g ash	143	ES		Tipton and Cook, 1963
Larynx	10-70 μ g/g ash	25 μ g/g ash	50	ES		Tipton and Cook, 1963
Liver	0	0	2	ES	White male, age 60; black male, age 78	Forbes et al., 1956
	Not given	1.70 $\pm$ 1.16 μ g/g ash	10	ES	5 white males, 5 black males; accident victims in St. Louis	Perry et al., 1973
	0.018-0.075 micromole/g ash	Not given	100	ES		Perry, 1968
	0.008-0.040 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	0.7-3.5 μ g/g ash	1.6 μ g/g ash	146	ES		Tipton and Cook, 1963
Lung	0	0	2	ES	White male, age 60; black male, age 48	Forbes et al., 1956
	0.073-0.16 micromole/g ash	Not given	100	ES		Perry, 1968
	0.050-0.19 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962

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STRONTIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung (continued)	0	0	168	Not given	Samples from 58 cities and 29 non-urban areas; amount retained in lungs	Schroeder, 1970
	0	460 μg (max); 5 μg (min)	168	Not given	Samples from 58 cities and 29 non-urban area	Schroeder, 1970
	4.5-17 $\mu\text{g/g}$ ash	8.2 $\mu\text{g/g}$ ash	141	ES		Tipton and Cook, 1963
	0.5-46 $\mu\text{g/g}$ ash	9.8 $\mu\text{g/g}$ ash	141	ES	Autopsy cases; nine U.S. cities	Tipton et al., 1964
Human milk	0.80-2.44 % ingested; 0.19 $\pm$ 0.5 to 0.50 $\pm$ 0.10 $\mu\text{Ci/kg}$ milk	Not given	5	Radiometry	Women, ages 17-22, Ithaca, N.Y.; fed controlled diet	Lough et al., 1960
Muscle	0	0	2	ES	Striated muscle. White male, age 60; black male, age 48	Forbes et al., 1956
	0.3-4.0 $\mu\text{g/g}$ ash	1.2 $\mu\text{g/g}$ ash	135	ES		Tipton and Cook, 1963
Nails	1.6×10^{-3} to 3.3×10^{-4} % dry tissue	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
Omentum	3.6-25 $\mu\text{g/g}$ ash	9.5 $\mu\text{g/g}$ ash	74	ES		Tipton and Cook, 1963
Ovary	4.0-33 $\mu\text{g/g}$ ash	11 $\mu\text{g/g}$ ash	16	ES		Tipton and Cook, 1963
Pancreas	1.5-9.5 $\mu\text{g/g}$ ash	3.3 $\mu\text{g/g}$ ash	133	ES		Tipton and Cook, 1963
Prostate	5.0-48 $\mu\text{g/g}$ ash	11 $\mu\text{g/g}$ ash	48	ES		Tipton and Cook, 1963

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STRONTIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Skla	3.2×10^{-8} to 4.5×10^{-8} % dry tissue	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	4.5-15 $\mu\text{g/g}$ ash	8.6 $\mu\text{g/g}$ ash	21	ES		Tipton and Cook, 1963
Spleen	0.013-0.11 micromole/g ash	Not given	100	ES		Perry, 1968
	0.012-0.068 micromole/g ash	Not given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	1.1-6.0 $\mu\text{g/g}$ ash	2.1 $\mu\text{g/g}$ ash	143	ES		Tipton and Cook, 1963
Stomach	3.4-28 $\mu\text{g/g}$ ash	9.9 $\mu\text{g/g}$ ash	130	ES		Tipton and Cook, 1963
Teeth	26-132 ppm	67 $\pm$ 20 ppm	35	AAS	9- to 15-year-old school children in Cambridge, Mass.	Brudevold et al., 1975
	69-148 ppm	91 $\pm$ 21 ppm	15	AAS	9- to 15-year-old school children in Cambridge, Mass.	Brudevold et al., 1975
	Not given	128.9 $\pm$ 8.39 ppm; 156.7 $\pm$ 10.87 ppm	208	MS	New England; South Carolina. Enamel. Less than 20 years old.	Curzon and Losee, 1977
	Not given	104.1 $\pm$ 9.14 ppm; 184.0 $\pm$ 14.68 ppm	208	MS	High caries; low caries. Combined areas of New England, South Carolina; less than 20 years old	Curzon and Losee, 1977
	384-649.3 ppm	Not given	87	MS	Enamel, surface. 12-14 years old; Oregon, Montana, California	Little and Barrett, 1976
	313-555 ppm	Not given	87	MS	Enamel, subsurface. 12-14 years old; Oregon, Montana, California	Little and Barrett, 1976

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STRONTIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Teeth (continued)	281.8-490.1 ppm	Not given	87	MS	Enamel, inner. 12-14 years old; Oregon, Montana, California	Little and Barrett, 1976
	64.6-266 ppm	Not given	87	MS	Enamel, bulk. 12-14 years old; Oregon, Montana, California	Little and Barrett, 1976
	21-280 µg/g	121 ± 11 µg/g	56	MS	Less than 20 years old	Loose et al., 1973
	1.73-2.79 pCi/g calcium	Not given	41	Not given	Children in St. Louis born between 1950 and 1958	Rosenthal et al., 1964
	1.72-3.54 pCi/g calcium	Not given	30	Not given	7- to 9-month fetuses; St. Louis	Rosenthal et al., 1964
	0.31-0.61 mg/g calcium		18	AAS		Rosenthal et al., 1972
Testis	1.9-13 µg/g ash	4.3 µg/g ash	69	ES		Tipton and Cook, 1963
Thyroid	5.3-21 µg/g ash	13 µg/g ash	21	ES		Tipton and Cook, 1963
Urinary bladder	5.5-23 µg/g ash	12 µg/g ash	110	ES		Tipton and Cook, 1963
Urine	Not given	25.0 µCi/g calcium	6	Not given	Alaska	Schubert, 1962
	Not given	0.12 ± 0.01 mg/day; 0.10 ± 0.01 mg/day	2	ES	Healthy, 23- and 25-year-old men at University of Cincinnati	Tipton et al., 1969
Uterus	2.3-21 µg/g ash	9.5 µg/g ash	32	ES		Tipton and Cook, 1963
Total body		120 mg	168	Not given	Samples from 58 cities and 29 nonurban areas	Schroeder, 1970

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TANTALUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.41 ppm	Not given	39	X-ray spectrometry	Healthy men, mean age 35.3 years. Serum	Gofman et al., 1964

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TELLURIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not given	1.8 $\mu\text{g/g}$ wet wt.	Not given	NAA		Schroeder et al., 1967
Blood	0.00-0.49 ppm	Not given	39	X-ray spectrometry	Healthy males. Mean age 35.3. Serum.	Gofman et al., 1964
	0.5-1.6 $\mu\text{g/ml}$; Not given	1.07 $\pm$ 0.12; 1.30 $\pm$ 1.95 $\mu\text{g/ml}$	10; 2	Not given	Serum; W. d blood cells.	Schroeder et al., 1967
Bone	Not given	77.0 $\mu\text{g/g}$ wet wt.	Not given	NAA		Schroeder et al., 1967
Brain	Not given	1.88 $\mu\text{g/g}$ wet wt.	4	AAS		Schroeder et al., 1967
Heart	Not given	0.83 $\mu\text{g/g}$ wet wt.	4	AAS		Schroeder et al., 1967
Kidney	Not given	0.88 $\mu\text{g/g}$ wet wt.	4	AAS		Schroeder et al., 1967
Liver	4.36-8.27 $\mu\text{g/g}$ wet wt.	Not given	3	AAS		Schroeder et al., 1967
Lung	0.12-0.99 $\mu\text{g/g}$ wet wt.	Not given	3	AAS		Schroeder et al., 1967
Muscle	0.35-0.63 $\mu\text{g/g}$ wet wt.	Not given	2	AAS		Schroeder et al., 1967
Ovary	Not given	0.14 $\mu\text{g/g}$ wet wt.	Not given	NAA		Schroeder et al., 1967
Pancreas	Not given	1.06 $\mu\text{g/g}$ wet wt.	3	AAS		Schroeder et al., 1967
Spleen	1.01-1.86 $\mu\text{g/g}$ wet wt.	Not given	Not given	NAA		Schroeder et al., 1967

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TELLURIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Testes	Not given	0.18 ug/g wet wt.	Not given	NAA		Schroeder et al., 1967
Urine	0.26-1.09 ug/ml	Not given	Not given	Not given		Schroeder et al., 1967

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TERBIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.23 ppm	Not given	19	X-ray spectrometry	Healthy men, mean age 35.3 years. Serum	Gofman et al., 1964

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THALLIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.02 ppm	Not given	39	X-ray spectrometry	Healthy men, mean age 35.1 years. Serum	Gofman et al., 1964
	Not given	0.02 $\mu\text{g}/\text{ml}$	Not given	Not given		Rentoul and Smith, 1973
	0.0-8.0 $\mu\text{g}/100\text{ ml}$	0.3 $\mu\text{g}/100\text{ ml}$	320	AAS	Children age 1 to 5 years; predominantly black and Spanish-speaking residents of Newark, N.J. Whole Blood.	Singh et al., 1973
Brain	Not given	0.5 $\mu\text{g}/\text{g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
Heart	Not given	0.4 $\mu\text{g}/\text{g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
Kidney	Not given	0.4 $\mu\text{g}/\text{g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973
Liver	Not given	0.4 $\mu\text{g}/\text{g}$ dry wt.	Not given	Not given		Rentoul and Smith, 1973

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THORIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.10 ppm	Not given	39	X-ray spectrometry	Healthy men, mean age 35.3 years. Serum	Cofman et al., 1964

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THULIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.36 ppm	Not given	19	X-ray spectrometry	Healthy men, mean age 55.3 years. Serum	Gofman et al., 1964

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TIN

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	5-72 $\mu\text{g/g}$ ash	23 $\mu\text{g/g}$ ash	14 of 15	ES		Tipton and Cook, 1963
Aorta	< 0.04-0.21 micromole/g dry wt.	Not Given	100	ES		Perry, 1968
	5-38 $\mu\text{g/g}$ ash	14 $\mu\text{g/g}$ ash	96 of 105	ES		Tipton and Cook, 1963
	0.042-0.32 micromole/g ash	Not Given	150	ES		Perry et al., 1962
Bladder	Not Given	5.2 ppm wet wt.	2	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	< 5-58 $\mu\text{g/g}$ ash	16 $\mu\text{g/g}$ ash	100 of 112	ES		Tipton and Cook, 1963
Blood	0.00-0.47 ppm	Not Given	39	X-ray spectrometry	Healthy men, mean age 35.3 years. Serum	Gofman et al., 1964
	Not Given	0.012 mg/100g	Not Given	ES		Kehoe et al., 1940
	Not Given	140 $\mu\text{g/ml}$	Not Given	Not Given		Mertz, 1974
	Not Given	0.12 $\mu\text{g/ml}$	Not Given	Not Given		Rentoul and Smith, 1973
Bone	Not Given	0.080 mg/100g wet wt.	Not Given	ES	Long bone	Kehoe et al., 1940
	Not Given	0.050 mg/100g wet wt.	Not Given	ES	Rib bone	Kehoe et al., 1940
	Not Given	0.3 ppm wet wt.	2	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Brain	Not Given	0.0 mg/100g wet wt.	Not Given	ES		Kohor et al., 1940
	Not Given	1.0 ppm wet wt.	3	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	Not Given	2 µg/g dry wt.	Not Given	Not Given		Mentoni and Smith, 1973
	< 5-65 µg/g ash	< 5 µg/g ash	7 of 129	ES		Tipton and Cook, 1963
Diaphragm	< 5-29 µg/g ash	5 µg/g ash	55 of 91	ES		Tipton and Cook, 1963
Esophagus	Not Given	0.3 ppm wet wt.	1	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	< 5-62 µg/g ash	18 µg/g ash	58 of 68	ES		Tipton and Cook, 1963
Feces	Not Given	3.6-0.7 mg/day, 3.6-0.5 mg/day	2	ES	Healthy 21 and 25-year-old man, University of Cincinnati	Tipton et al., 1969
Hair	0.034-8.30 µg/g	0.561 µg/g	265	ES	Children from Riverhead, Queens, and Bronx	Creason, 1975
	0.048-12.00 µg/g	0.785 µg/g	191	ES	Adults from Riverhead, Queens, and Bronx	Creason, 1975
	Not Given	0.54 µg/g	126	ES	Children from Riverhead	Creason, 1975
	Not Given	0.44 µg/g	90	ES	Children from Queens	Creason, 1975
	Not Given	0.83 µg/g	71	ES	Children from Bronx	Creason, 1975
	Not Given	0.4 µg/g; dry wt., 0.39 µg/g dry wt.	2	MS		Yurachek et al., 1969

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Heart	Not Given	0.022 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940
	< 0.04-0.13	Not Given	100	ES		Perry, 1968
	Not Given	0.2 µg/g dry wt.	Not Given	Not Given		Rentoul and Smith, 1962
	< 5-27 µg/g ash	5 µg/g ash	84 of 140	ES		Tipton and Cook, 1963
	< 0.04-0.23 micromole/g ash	Not Given	150	ES		Perry et al., 1962
Intestine	Not Given	0.016 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	0.2 ppm wet wt.	1	ES	Sudden accident victims, male, up to 56 years old, large intestine	Koch et al., 1956
	Not Given	0.4 ppm wet wt.	7	ES	Sudden accident victims, male, up to 56 years old, small intestine	Koch et al., 1956
	< 5-160 µg/g ash	28 µg/g ash	61 of 68	ES	Duodenum	Tipton and Cook, 1963
	8-110 µg/g ash	36 µg/g ash	100 of 104	ES	Jejunum	Tipton and Cook, 1963
	15-430 µg/g ash	79 µg/g ash	80 of 84	ES	Ileum	Tipton and Cook, 1963
	45-800 µg/g ash	130 µg/g ash	31	ES	Cecum	Tipton and Cook, 1963

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestine	10-330 μ g/g ash	45 μ g/g ash	107 of 109	ES	Sigmoid colon	Tipton and Cook, 1963
	5-180 μ g/g ash	57 μ g/g ash	39 of 42	ES	Rectum	Tipton and Cook, 1963
Kidney	Not Given	0.020 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	0.4 ppm wet wt.	6	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	0.9-7.8 μ g/g dry wt.	2.8 μ g/g dry wt.	6	ES		Koch et al., 1957
	1.1-6.0 μ g/g dry wt.	Not Given	2	ES		Koch et al., 1957
	< 0.04-0 micromole/g dry wt.	Not Given	100	ES		Perry, 1968
	0.042-0.39 micromole/g ash	Not Given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	Not Given	0.2 μ g/g dry wt.	Not Given	Not Given		Kontoul and Smith, 1962
	< 5-480 ppm ash	30 ppm ash	161	ES		Schroeder et al., 1964
	0-1.5+ mg/100g dry wt.	Not Given	Not Given	ES	Cancer patients	Tietz et al., 1957
	5-46 μ g/g ash	16 μ g/g ash	146 of 145	ES		Tipton and Cook, 1963

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Larynx	< 5-16 $\mu\text{g/g}$ ash	8 $\mu\text{g/g}$ ash	34 of 50	ES		Tipton and Cook, 1963
Liver	Not Given	0.060 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	2.5 ppm wet wt.	5	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	3.2-21.1 $\mu\text{g/g}$ dry wt.	12.0 $\mu\text{g/g}$ dry wt.	5	ES		Koch et al., 1957
	1.4-3.2 $\mu\text{g/g}$ dry wt.	Not Given	3	ES		Koch et al., 1957
	< 0.04-0.24 micromole/g dry wt.	Not Given	100	ES		Perry, 1968
	Not Given	37.50 $\pm$ 16.4 $\mu\text{g/g}$ tissue ash	10	ES	Healthy adult males from St. Louis, accident victims	Perry, 1973
	0.041-0.62 micromole/g ash	Not Given	150	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	Not Given	0.6 $\mu\text{g/g}$ dry wt.	Not Given	Not Given		Kentoul and Smith, 1962
	< 5-300 ppm ash	35 ppm ash	163	ES		Schroeder et al., 1964
	0-1.5+ mg/100g dry wt.	Not Given	Not Given	ES	Cancer patients	Tietz et al., 1957
	5-74 $\mu\text{g/g}$ ash	23 $\mu\text{g/g}$ ash	144 of 150	ES		Tipton and Cook, 1963
Lung	Not Given	0.045 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	Not Given	3.8 ppm wet wt.	4	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	1.6-49.1 µg/g dry wt.	22.4 µg/g dry wt.	4	ES	Normal subjects	Koch et al., 1957
	0.8-14.7 µg/g dry wt.	Not Given	5	ES	Patients with lymphomatous diseases	Koch et al., 1957
	< 0.04-0.62 micromole/g dry wt.	Not Given	100	ES		Perry, 1968
	0.093-0.93 micromole/g ash	Not Given	100	ES	Adults who died unexpectedly in St. Louis	Perry et al., 1962
	< 5-920 ppm ash	69 ppm ash	159	ES		Schroeder et al., 1964
		17 µg/g ash	168	Not Given	Samples from 58 cities and 29 nonurban areas, amount retained in lungs	Schroeder, 1970
		9200 µg(max), 200 µg(min)	168	Not Given	Samples from 58 cities and 29 nonurban areas	Schroeder, 1970
	Not Given	0-3.0 mg/100g dry wt.	Not Given	ES	Cancer patients	Tietz et al., 1957
	11-110 µg/g ash	37 µg/g ash	137 of 140	ES		Tipton and Cook, 1963
	<5-920 µg/g ash	37 µg/g ash	141	ES	Autopsy cases, nine U.S. cities	Tipton et al., 1964
Muscle	Not Given	0.011 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle	Not Given	0.7 ppm wet wt.	8	ES	Sudden accident victims, male, up to 55 years old	Koch et al., 1956
	< 5-10 µg/g ash	< 5 µg/g ash	26 of 137	ES		Tipton and Cook, 1963
Ovary	< 5-210 µg/g ash	15 µg/g ash	13 of 16	ES		Tipton and Cook, 1963
Omentum	5-48 µg/g ash	16 µg/g ash	69 of 74	ES		Tipton and Cook, 1963
Pancreas	Not Given	1.0 ppm wet wt.	2	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	< 5-24 µg/g ash	5 µg/g ash	73 of 169	ES		Tipton and Cook, 1963
Placenta	Not Given	0.003-0.003 µg/g wet wt.	58	Not Given	City hospitals in South and Southeast	Karp and Robertson, 1977
Prostate	Not Given	1.5 ppm wet wt.	4	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	< 5-39 µg/g ash	14 µg/g ash	42 of 50	ES		Tipton and Cook, 1963
Skin	7-74 µg/g ash	21 µg/g ash	21 of 22	ES		Tipton and Cook, 1963
Spleen	Not Given	0.022 mg/100g wet wt.	Not Given	ES		Kehoe et al., 1940
	Not Given	0.6 ppm wet wt.	3	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
	1.0-4.3 µg/g dry wt.	3.2 µg/g dry wt.	3	ES	Normal subjects	Koch et al., 1957

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen	0.9-3.1 $\mu\text{g/g}$ dry wt.	Not Given	2	ES	Patients with lymphomatous diseases	Koch et al., 1957
	< 0.04-0.11 micromole/g dry wt.	Not Given	100	ES		Perry, 1968
	< 5-35 $\mu\text{g/g}$ ash	11 $\mu\text{g/g}$ ash	120 of 143	ES		Tipton and Cook, 1963
	< 0.04-0.29 micromole/g ash	Not Given	150	ES		Perry et al., 1967
Stomach	Not Given	0.050 mg/100g wet wt.	Not Given	ES	Sudden accident victims, male, up to 56 years old	Kehoe et al., 1940
	Not Given	0.4 ppm wet wt.	3	ES		Koch et al., 1956
	< 5-74 $\mu\text{g/g}$ ash	16 $\mu\text{g/g}$ ash	111 of 131	ES		Tipton and Cook, 1963
Teeth	Not Given	0.24-0.08 ppm; 1.35-0.37 ppm	208	MS	High caries area (New England), low caries area (South Carolina), Enamel, less than 20 years old	Carzon and Lowee, 1977
	0.03-7.10 $\mu\text{g/g}$ dry wt.	0.53-0.14 $\mu\text{g/g}$ dry wt.	56	MS	Less than 20 years old	Lowee et al., 1973
	Not Given	1.0 ppm	Not Given	Not Given	External enamel from Pueblo Indians, 800-years-old	Anonymous, 1959
Testis	< 5-33 $\mu\text{g/g}$ ash	11 $\mu\text{g/g}$ ash	54 of 72	ES		Tipton and Cook, 1963
Thyroid	Not Given	0.2 ppm wet wt.	2	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Thyroid	< 5-47 $\mu\text{g/g}$ ash	13 $\mu\text{g/g}$ ash	16 of 21	ES		Tipton and Cook, 1963
Trachea	< 5-50 $\mu\text{g/g}$ ash	12 $\mu\text{g/g}$ ash	54 of 60	ES		Tipton and Cook, 1963
Urine	Not Given	0.011 mg/liter	Not Given	ES		Kehon et al., 1940
	10-20 $\mu\text{g/ml}$	Not Given	Not Given	Not Given		Hertz, 1974
	Not Given	-3 ppb	15	ES	Normal subjects	Perry, 1968
	Not Given	-7 ppb	15	ES	Hypertensive	Perry, 1968
	Not Given	-4.3 ppb	8	ES	Hypertensive, treated	Perry, 1968
	Not Given	-7 ppb	7	ES	Hypertensive, untreated	Perry, 1968
	3.0-4.0 $\mu\text{g/liter}$	16.6 $\mu\text{g/liter}$	24	ES	Normal, ages 4-69 years	Perry and Perry, 1959
	Not Given	16.4 $\mu\text{g/liter}$	10	ES	Normal females	Perry and Perry, 1959
	Not Given	16.8 $\mu\text{g/liter}$	14	ES	Normal males	Perry and Perry, 1959
	Not Given	17.9 $\mu\text{g/liter}$	10	ES	Normal Negroes	Perry and Perry, 1959
	Not Given	15.8 $\mu\text{g/liter}$	14	ES	Normal Caucasian	Perry and Perry, 1959
	Not Given	20.6 $\mu\text{g/liter}$	8	ES	Hypercholesterolemic patients before Na_2Ca EDTA administration	Perry and Perry 1959

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TIN (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	Not Given	14.8 ug/liter	8	ES	Hypercholesterolemic patients during Na ₂ Ca EDTA administration	Perry and Perry, 1959
	Not Given	21.6 ug/liter	4	ES	Hypercholesterolemic patients one day after Na ₂ Ca EDTA administration	Perry and Perry, 1959
	Not Given	23.2 ug/liter	3	ES	Hypercholesterolemic patients two days after Na ₂ Ca EDTA administration	Perry and Perry, 1959
	Not Given	0.01 ug/ml	Not Given	Not Given		Kentoul and Smith, 1962
	Not Given	0.085±0.011 mg/day. 0.058±0.006 mg/day	2	ES	Healthy 23 and 25-year-old men, University of Cincinnati	Tipton et al., 1969
Uterus	<5-65 ug/g ash	10 ug/g ash	24 of 32	ES		Tipton and Cook, 1963
Vena Cava	Not Given	Not Given	1	ES	Sudden accident victims, male, up to 56 years old	Koch et al., 1956
Total body	Not Given	17 mg	168	Not Given	Samples from 58 cities and 29 nonurban areas	Schroeder, 1970

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TITANIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	<5-45 $\mu\text{g/g}$ ash	15 $\mu\text{g/g}$ ash	8 of 13	ES	United States adults	Tipton and Cook, 1963
Aorta	<0.1-2.3 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	<5-25 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	45 of 104	ES	United States adults	Tipton and Cook, 1963
	<0.1-0.52 micromole/g ash	Not given	150	ES	Adult St. Louis area residents, unexpected deaths, less than 50% of the values, 10th and 90th percentiles	Perry et al., 1962
Bladder	<5-29 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	43 of 110	ES	United States adults	Tipton and Cook, 1963
Blood	0.00-0.18 ppm	Not given	39	X-ray spectrometry	Healthy males, mean age 35.3 years. Serum.	Gufman et al., 1964
Body, total content	9 mg	Not given	168 samples	Not given	38 urban and 29 nonurban autopsies	Schroeder, 1970
Brain	<0.1-0.42 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	<5-45 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	12 of 129	ES	United States adults	Tipton and Cook, 1963
Diaphragm	<5-14 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	33 of 91	ES	United States adults	Tipton and Cook, 1963
Esophagus	<5-44 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	32 of 66	ES	United States adults	Tipton and Cook, 1963
Feces	0.46 $\pm$ 0.09 and 0.82 $\pm$ 0.20 mg/day	Not given	2	ES	Healthy males, 23 and 25 years old	Tipton et al., 1969

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TITANIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	0.0000032-0.0000064 % dry tissue	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
	3.9 and 24.0 µg/g dry wt.	Not given	2	MS		Yurachek et al., 1969
Heart	<0.1-5.2 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	<5-5 µg/g ash	<5 µg/g ash	24 of 140	ES	Adults	Tipton and Cook, 1963
	<0.1-0.10 micromole/g ash	Not given	150	ES	Adult St. Louis area residents, unexpected deaths, less than 50% of the values, 10th and 90th percentiles	Perry et al., 1962
Intestine	Not given	5.2 ppm wet wt.	1	ES	Male sudden accident victim. Small intestine.	Koch et al., 1956
	<5-23 µg/g ash	<5 µg/g ash	25 of 67	ES	Adults. Duodenum.	Tipton and Cook, 1963
	<5-5 µg/g ash	<5 µg/g ash	15 of 102	ES	Adults. Jejunum.	Tipton and Cook, 1963
	<5-21 µg/g ash	<5 µg/g ash	36 of 84	ES	Adults. Ileum.	Tipton and Cook, 1963
	<5-11 µg/g ash	5 µg/g ash	16 of 31	ES	Adults. Cecum.	Tipton and Cook, 1963
	5-33 µg/g ash	<5 µg/g ash	36 of 108	ES	Adults. Sigmoid colon.	Tipton and Cook, 1963.
	<5-16 µg/g ash	5 µg/g ash	22 of 42	ES	Adults. Rectum.	Tipton and Cook, 1963.

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TITANIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	<0.1-0.84 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	Not given	1.2 ppm wet wt.	1	ES	Male sudden accident victim	Koch et al., 1968
	<0.1-0.12 micromole/g ash	Not given	150	ES	Adult St. Louis area residents, unexpected deaths, less than 50% of the values, 10th and 90th percentiles	Perry et al., 1962
	Trace-0.67 $\mu\text{g/g}$ ash wet wt.	Not given	168	ES	Urban area autopsies	Schroeder et al., 1956
	<5-5 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	22 of 144	ES	Adults	Tipton and Cook, 1963
Larynx	<5-10 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	11 of 50	ES	Adults	Tipton and Cook, 1963
Liver	<0.1-0.49 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	Not given	3.0 ppm wet wt.	1	ES	Male sudden accident victim	Koch et al., 1956
	Not given	15.20 $\pm$ 16.20 $\mu\text{g/g}$ ash	10	ES	Healthy adult male St. Louis area residents, 5 Caucasian and 5 Negro, accident victims	Perry et al., 1973
	<1-0.33 micromole/g ash	Not given	150	ES	Adult St. Louis area residents, unexpected deaths, less than 50% of the values, 10th and 90th percentiles	Perry et al., 1962
	Trace-0.50 $\mu\text{g/g}$ wet wt.	Not given	168	ES	Urban area autopsies	Schroeder et al., 1963
	<5-16 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	34 of 148	ES	Adults	Tipton and Cook, 1963

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TITANIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	0.72-21 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	Not given	3.2 ppm wet wt.	2	ES	Male sudden accident victim	Koch et al., 1956
	1.0-15 micromole/g ash	Not given	150	ES	Adult St. Louis area residents, unexpected deaths, 10th and 90th percentiles	Perry et al., 1962
	<50->700 $\mu\text{g/g}$	87 $\mu\text{g/g}$	168 samples	Not given	58 urban and 29 nonurban autopsies	Schroeder, 1970
	2.4-7.7 $\mu\text{g/g}$ wet wt.	Not given	168	ES	Urban area autopsies	Schroeder et al., 1960
	<5->2000 $\mu\text{g/g}$ ash	220 $\mu\text{g/g}$ ash	141	ES	Urban area autopsies	Tipton et al., 1964
	55-700 $\mu\text{g/g}$ ash	220 $\mu\text{g/g}$ ash	139 of 141	ES	Adults	Tipton and Cook, 1963
Muscle	Not given	2.2 ppm wet wt.	1	ES	Male sudden accident victim	Koch et al., 1956
	<5-5 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	17 of 136	ES	Adults	Tipton and Cook, 1963
Nails	0.0000163-0.000039 % dry tissue	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1953
Omentum	<5-74 $\mu\text{g/g}$ ash	21 $\mu\text{g/g}$ ash	67 of 75	ES	Adults	Tipton and Cook, 1963
Ovary	<5-13 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	6 of 16	ES	Adults	Tipton and Cook, 1963
Pancreas	<5-16 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	29 of 139	ES	Adults	Tipton and Cook, 1963

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TITANIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Prostate	Not given	11 ppm wet wt.	1	ES	Male sudden accident victim	Koch et al., 1956
	<5-33 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	16 of 50	ES	Adults	Tipton and Cook, 1963
Skin	0.000106-0.000277 $\pm$ dry wt.	Not given	18	ES	White males, 15-70 years old	Goldblum et al., 1955
	17-100 $\mu\text{g/g}$ ash	32 $\mu\text{g/g}$ ash	22	ES	Adults	Tipton and Cook, 1963
Spleen	<0.1-0.59 micromole/g ash	Not given	100	ES	10th and 90th percentiles	Perry, 1968
	Trace-1.0 ppm wet wt.	Not given	168	ES	Urban area autopsies	Schroeder et al., 1960
	<5-14 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	31 of 143	ES	Adults	Tipton and Cook, 1963
	<0.1-0.29	Not given	150	ES	Adult St. Louis area residents, unexpected deaths, less than 50% of the values, 10th and 90th percentiles	Perry et al., 1962
Stomach	Not given	6.6 ppm wet wt.	1	ES	Male sudden accident victim	Koch et al., 1956
	<5-5 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	26 of 130	ES	Adults	Tipton and Cook, 1963
Teeth	<0.1-4.80 $\mu\text{g/g}$ dry wt.	0.46 $\pm$ 0.13 $\mu\text{g/g}$ dry wt.	56	MS	20-year-olds, wide geographic area Enamel.	Loose et al., 1973
Testis	<5-10 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	19 of 72	ES	Adults	Tipton and Cook, 1963

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TITANIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Thyroid	<5-82 $\mu\text{g/g}$ ash	5 $\mu\text{g/g}$ ash	11 of 21	ES	Adults	Tipton and Cook, 1963
Trachea	<5-72 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	28 of 60	ES	Adults	Tipton and Cook, 1963
Urine	0.49 ± 0.07 and 0.47 ± 0.06	Not given	2	ES	Healthy males, 23 and 25 years old	Tipton et al., 1969
Uterus	<5-5 $\mu\text{g/g}$ ash	<5 $\mu\text{g/g}$ ash	5 of 32	ES	Adults	Tipton and Cook, 1963

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TUNGSTEN

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.18 ppm	Not Given	19	X-ray spectrometry	Healthy men, mean age 35.3 years. Serum	Gufman et al., 1964
Hair	0	0	13	NAA	Adults and children from Oak Ridge, Tennessee	Bate and Dyer, 1965

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URANIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.10 ppm	Not Given	39	X-ray spectrometry	Healthy men, mean age 35.3 years, Serum	Cofman et al., 1964

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VANADIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adrenal	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	1 of 13	ES		Tipton and Cook, 1963
Aorta	<0.02-0.065 micromol /g ash	Not given	100	Not given		Perry, 1968
	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 104	ES		Tipton and Cook, 1963
Bladder	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	3 of 110	ES		Tipton and Cook, 1963
Blood	>1 $\mu\text{g}/100$ ml to <2 $\mu\text{g}/100$ ml	Not given	6 of 89	Chem.	Whole blood from blood donors and pre-employment checks, method unable to detect <1 $\mu\text{g}/100$ ml	Allaway et al., 1968
	0.00-0.11 ppm	Not given	39	X-ray spectrometry	Healthy men, mean age 35.3 yrs. Serum.	Gofman et al., 1964
	Not given	10 $\mu\text{g}/\text{liter}$	Not given	Not given		Mertz, 1974
Brain	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 129	ES		Tipton and Cook, 1963
Diaphragm	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 91	ES		Tipton and Cook, 1963
Esophagus	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	5 of 66	ES		Tipton and Cook, 1963
Feces	Not given	0.12 $\pm$ 0.03 mg/day; 0.15 $\pm$ 0.02 mg/day	2	ES	Healthy men, 23 and 25 years old, University of Cincinnati	Tipton et al., 1969
Hair	0.010-2.90 $\mu\text{g/g}$	0.250 $\mu\text{g/g}$	267	ES	Children from Riverhead, Queens, and Bronx	Creason, 1975

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VANADIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair (continued)	0.009-2.20 $\mu\text{g/g}$	0.182 $\mu\text{g/g}$	193	ES	Adults from Riverhead, Queens, and Bronx	Creason, 1975
	Not given	0.20 $\mu\text{g/g}$	126	ES	Children from Riverhead	Creason, 1975
	Not given	0.24 $\mu\text{g/g}$	90	ES	Children from Queens	Creason, 1975
	Not given	0.40 $\mu\text{g/g}$	71	ES	Children from Bronx	Creason, 1975
	Not given	0.12 $\mu\text{g/g}$	85	ES	Adults from Riverhead	Creason, 1975
	Not given	0.20 $\mu\text{g/g}$	77	ES	Adults from Queens	Creason, 1975
	Not given	0.35 $\mu\text{g/g}$	49	ES	Adults from Bronx	Creason, 1975
Heart	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 140	ES		Tipton and Cook, 1963
Intestine	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	5 of 67	ES	Duodenum	Tipton and Cook, 1963
	<1-<1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	4 of 102	ES	Jejunum	Tipton and Cook, 1963
	<1-3 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	31 of 84	ES	Ileum	Tipton and Cook, 1963
	<1-4 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	14 of 31	ES	Cecum	Tipton and Cook, 1963
	<1-3 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	17 of 108	ES	Sigmoid colon	Tipton and Cook, 1963
	<1-2 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	11 of 42	ES	Rectum	Tipton and Cook, 1963

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VANADIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	<1-1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 141	ES		Tipton and Cook, 1963
Larynx	<1-1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 50	ES		Tipton and Cook, 1963
Liver	<1-4.8 ppm ash	<1 ppm ash	163	Colorimetry		Schroeder et al., 1963
	<1-1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	5 of 148	ES		Tipton and Cook, 1963
Lung	Not given	0.22 ppm wet wt.	1 of 8	ES	Sudden accident victims, male	Koch et al., 1956
	<0.02-0.2 $\mu\text{micromol/g}$ ash	Not given	100	ES		Perry, 1968
	<0.02-0.26 $\mu\text{micromol/g}$ ash	Not given	150	ES		Perry et al., 1962
	Not given	1.3 $\mu\text{g/yr.}$	168	Not given	Samples from 58 cities and 29 nonurban areas, amount retained in lung	Schroeder, 1970
	Not given	680 μg (max); 10 μg (min)	168	Not given	Samples from 58 cities and 29 nonurban areas	Schroeder, 1970
	0.01 + 0.0004 to 0.13 + 0.05 ppm	Not given	173	Colorimetry		Schroeder et al., 1963
	<1-13 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	73 of 141	ES		Tipton and Cook, 1963
Muscle	<1-1 $\mu\text{g/g}$ ash	<1 $\mu\text{g/g}$ ash (median)	0 of 136	ES		Tipton and Cook, 1963

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VANADIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Ovary	<1-<1 ug/g ash	<1 ug/g ash (median)	0 of 16	ES		Tipton and Cook, 1963
Omentum	<1-3 ug/g ash	<1 ug/g ash (median)	11 of 75	ES		Tipton and Cook, 1963
Pancreas	<1-<1 ug/g ash	<1 ug/g ash (median)	2 of 139	ES		Tipton and Cook, 1963
Placenta	Not given	0.010 $\pm$ 0.010 ug/g wet wt.	58	Not given	City hospitals in South and Southeast	Karp and Robertson, 1977
Prostate	<1-<1 ug/g ash	<1 ug/g ash (median)	1 of 50	ES		Tipton and Cook, 1963
Spleen	<1-<1 ug/g ash	<1 ug/g ash (median)	1 of 143	ES		Tipton and Cook, 1963
Skin	<1-<1 ug/g ash	<1 ug/g ash (median)	3 of 21	ES		Tipton and Cook, 1963
Stomach	<1-<1 ug/g ash	<1 ug/g ash (median)	1 of 130	ES		Tipton and Cook, 1963
Teeth	0.01-0.14 ug/g dry wt.	0.033 ug/g dry wt.	56	MS	Less than 20 years old	Lowee et al., 1973
Testis	<1-<1 ug/g ash	<1 ug/g ash (median)	0 of 72	ES		Tipton and Cook, 1963
Thyroid	<1-<1 ug/g ash	<1 ug/g ash (median)	1 of 21	ES		Tipton and Cook, 1963
Trachea	<1-<1 ug/g ash	<1 ug/g ash (median)	0 of 60	ES		Tipton and Cook, 1963

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VANADIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	Not given	<10 µg/liter	Not given	Not given		Meritz, 1974
	Not given	12 ppb	15	ES	Normal subjects	Perry, 1968
	Not given	10.95 ppb	15	ES	Hypertensive	Perry, 1968
	Not given	12 ppb	8	ES	Hypertensive, treated	Perry, 1968
	Not given	11.5 ppb	7	ES	Hypertensive, untreated	Perry, 1968
	<1.0-22 µg/liter	<6.12 µg/liter	24	ES	Normal Americans, St. Louis	Perry and Perry, 1959
	Not given	<3.98 µg/liter	10	ES	Normal females, St. Louis	Perry and Perry, 1959
	Not given	<7.60 µg/liter	14	ES	Normal males, St. Louis	Perry and Perry, 1959
	Not given	<6.85 µg/liter	10	ES	Negroes, normal, St. Louis	Perry and Perry, 1959
	Not given	<5.75 µg/liter	14	ES	Caucasians, normal, St. Louis	Perry and Perry, 1959
	Not given	10.2 µg/liter	8	ES	Hypercholesterolemic patients, ages 21-63 years, 3 females, 5 males, before Na ₂ Ca EDTA administration	Perry and Perry, 1959
	Not given	18.0 µg/liter	8	ES	Hypercholesterolemic patients, during Na ₂ Ca EDTA administration	Perry and Perry, 1959
	Not given	4.96 µg/liter	4	ES	Hypercholesterolemic patients, day one after Na ₂ Ca EDTA administration	Perry and Perry, 1959

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VANADIUM (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine (continued)		2.60 μ g/liter	3	ES	Hypercholesterolemic patients day two after Na_2Ca EDTA administration	Perry and Perry, 1959
	Not given	0.018 ± 0.002 mg/day; 0.023 ± 0.002 mg/day	2	ES	Healthy men, 23 and 25 years of age, University of Cincinnati	Tipton et al., 1969
Uterus	<1-1 μ g/g ash	<1 μ g/g ash (median)	1 of 12	ES		Tipton and Cook, 1963
Total body		22 mg	168	Not given	Samples from 58 cities and 29 nonurban areas	Schroeder, 1970

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VOLATILE ORGANIC COMPOUNDS

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (adult and newborn)	The following compounds were identified: Acetaldehyde ^{1,3} Acetone ^{1,2} Benzaldehyde ¹ Benzene ^{1,2,3} BHT ² 2-Butanone ¹ Carbon tetrachloride ^{1,2,3} Chloroform ^{1,2,3} Cyclohexane ¹ Cyclohexanone ¹ Dichlorobenzene ^{1,2,3} Dichloromethane ^{1,2} 1,1-Dichloro-1-nitroethane ¹ Dimethyl disulfide ¹ Dimethylethylbenzene ^{1,2} Dipropyl ketone ¹ Ethylbenzene ¹ γ-Heptalactone ¹ Isobutanol ¹ Methylcyclopentane ¹ Methyl ethyl ketone ¹ Methylfuran ¹ Methyl isobutyl ketone ¹ Methyl mercaptan ¹ Methyl propyl ketone ^{1,2} Pentan-2-one ¹ 2-Pyridinol ¹ Pyridine ¹ Styrene ^{1,2} Tetrachloroethylene ^{1,3} Toluene ^{1,3} Trimethylbenzene ^{1,2} 2,4,4-Trimethyl-2-pentane ¹ Xylene ^{1,3}	Identified:	Not given	GC/MS	Superscript 1, adult; 2, newborn; 3, identified in municipal water supplies in New Orleans area.	Laxeter and Dowdy, 1977

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VOLATILE ORGANIC COMPOUNDS (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood (maternal and cord)	<p>Chromatographic profiles compared. The following compounds were identified:</p> <ul style="list-style-type: none"> Acetone Benzaldehyde Benzene Carbon tetrachloride Chloroform Cyclohexane Dichlorobenzene 1,1-Dichloro-1-nitroethane Dimethyl disulfide Dimethylethylbenzene Ethylbenzene γ-Heptalactone Isobutanol Methylcyclopentane Methyl ethyl ketone Methyl isobutyl ketone Nonan-2-one Styrene Toluene Trimethylbenzene Xylene 	The following	11 pairs	GC/MS	<p>Some selective transfer of compounds to the fetus. For instance, benzene, carbon tetrachloride, and chloroform are present in cord blood in quantities > those in maternal blood. Possibility of elution of plasticizers from i.v. apparatus. Some of the compounds are in the municipal water supply in the New Orleans area.</p>	Dowty et al., 1976 (See Laster and Dowty, 1977, for distribution between adults and newborns.)

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YTTERBIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.31 ppm	Not given	19	X-ray spectrometry	Healthy males, age 35.1 yrs. Serum.	Gofman et al., 1964

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YTTRIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	0.00-0.05 ppm	Not given	39	X-ray spectrometry	Healthy males, age 35.3 yrs.	Gofman et al., 1964
Teeth	0.01-0.17 µg/g dry wt.	0.007 µg/g dry wt.	56	MS	Wide geographic area	Lowe et al., 1971

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ZINC

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	Not Given	1850±150 µg/g ash	28	AAS		Schroeder et al., 1967
Adrenal	8.1-30.2 µg/g dry wt.	19.2 and 99.5 g/g dry wt.	3	Colorimetry	Range - normal subjects (2), mean - normal and lymphomatous diseased subjects (1), respectively	Koch et al., 1957
	Not Given	1600±70 µg/g ash	15	AAS		Schroeder et al., 1967
	1300-2000 µg/g ash	1600 µg/g ash	15	ES	Adults	Tipton and Cook, 1963
Amniotic Fluid	10-65 µg/100ml	32 µg/100ml	15	AAS		Henkin, 1971
Aorta	27.9-240.0 µg/g dry wt.	49.9-103.0 µg/g dry wt.	46	AAS	Autopsies, Chicago area	Marku et al., 1972
	17-43 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	15-54 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1968
	1100-2700 mg/100g ash	1800 mg/100g ash	104	ES	Adults	Tipton and Cook, 1963
Bladder	Not Given	3200±130 µg/g ash	112	AAS		Schroeder et al., 1967
	1800-1900 µg/100g ash	3000 µg/100g ash	112	ES	Adults	Tipton and Cook, 1963
Blood	Not Given	36.5±7.9 µg/g dry wt.	704	NAA	Nashville, TN hospitals, maternal blood	Baglan et al., 1974
	Not Given	14.9±8.4 µg/g dry wt.	667	NAA	Nashville, TN hospitals, fetal blood	Baglan et al., 1974

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718C (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Blood	150-1730 μ g/100ml	520 μ g/100ml	282	AAS	Newark, NJ children (1-8 years)	Bogden et al., 1974
	Not Given	1.49 $\pm$ 0.05 and 4.28 $\pm$ 0.82 mg/liter	520	AAS	Hardwater area (Kansas City, KA) and softwater area (Kansas City, MO), respectively. Serum	Rosenbaum et al., 1975
	Not Given	0.466 $\pm$ 0.013 mg/100ml	48	ES	Los Angeles area normal individuals	Katz et al., 1964
	Not Given	0.149 $\pm$ 0.007, 0.152 $\pm$ 0.018 and 0.130 $\pm$ 0.006 mg/100ml	226	ES	Blood donors (122), patients and diseased individuals (96), and normal people (88), respectively. Serum	Pott et al., 1964
	Not Given	69-86 and 79-86 μ g/100ml	502	Not Given	Control (249) and lead mining area (253), respectively. Maternal blood	Fahim et al., 1976
	Not Given	34-38 and 32-41 μ g/100ml	502	Not Given	Control (249) and lead mining area (253), respectively. Fetal blood	Fahim et al., 1976
	0.93-1.03 ppm	0.98 ppm	19	X-ray spectrometry	Males. Serum	Coleman et al., 1964
	72-115 and 63-118 μ g/100ml	96-12 and 89-13 μ g/100ml	117	AAS	Adults (151) and children (66), respectively. Plasma	Malsted and Smith, 1970
	Not Given	85.7 $\pm$ 2.2 and 87.9 $\pm$ 2.6 μ g/100ml	20	ES	Males and females (20). Plasma	Hambidge and Oski, 1970
	Not Given	54-12 μ g/100ml	40	AAS	Lumber yard workers near fertilizer plant. Plasma	Hamber et al., 1971
	63-147 μ g/100ml	92 μ g/100ml	164	AAS	Male and female adults. Serum	Hecklin, 1971

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ZINC (continued)

Tissue	Range	Mean level	No. of Cases	Analytical Method	Comments	Reference
Blood	27-65 $\mu\text{g}/100\text{ml}$	48.3 and 90.3 $\mu\text{g}/100\text{ml}$	15	AAS	Range - pregnant women; mean - pregnant and non-pregnant women, respectively; number of non-pregnant women not given. Serum	Henkin, 1971
	70-102 $\mu\text{g}/100\text{ml}$	83 $\mu\text{g}/100\text{ml}$	15	AAS	Umbilical cord. Serum	Henkin, 1971
	Not Given	96.2 and 77.2 ppm	275	AAS; Fluorometry	Normal (150) and decreased taste activity (125) individuals, respectively. Serum	Henkin et al., 1975
	740-1300, 760-980, and 820-1090 $\mu\text{g}/\text{liter}$	950, 800, and 920 $\mu\text{g}/\text{liter}$	59	AAS	Men (33), women (15) and women on pill (11), respectively. Plasma	Hohnadel et al., 1973
	34-177 and 80-543 $\mu\text{g}/100\text{ml}$	120 and 140-216 $\mu\text{g}/100\text{ml}$	123	Colorimetry	Normal (58) and lymphomatous diseased (65) individuals, respectively. Plasma	Koch et al., 1957
	60-1987 $\mu\text{g}/100\text{ml}$	530 $\mu\text{g}/100\text{ml}$	243	AAS	Males, 19 cities	Kubota et al., 1968
	Not Given	7 $\mu\text{g}/\text{ml}$	Not Given	Not Given	Normal level	Kentoul and Smith, 1973
	Not Given	74-116 $\mu\text{g}/100\text{ml}$	4	Not Given	Ages 16-1/2-19, pregnancy, 3 sample times	Schraer et al., 1974
	49-85 $\mu\text{g}/100\text{ml}$	65.6 $\mu\text{g}/100\text{ml}$	14	Chem.; ES	Adult males	Vallee et al., 1957
Bone	155-372 ppm ash	181 ppm ash	13	ES	Kib.	Alexander and Nussbaum, 1962
	80.5-200.0 and 117-768 $\mu\text{g}/\text{g}$ dry wt.	147.1 and 465.8 $\mu\text{g}/\text{g}$ dry wt.	121	AAS	Normal bone (40) and osteogenic sarcomas (81), respectively	Jones et al., 1972

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Bone	18-34 and 26.4-274.7 $\mu\text{g/g}$ dry wt.	26 $\mu\text{g/g}$ dry wt.	6	Colorimetry	Range - normal (2) and lymphoma-toma diseased (4) subjects, respectively, mean - normal subjects	Koch et al., 1957
	Not Given	210-5 $\mu\text{g/g}$ ash	91	AAS		Schroeder et al., 1967
Brain	123-367 $\mu\text{g/g}$ ash	Not Given	1	AAS	40 samples from one skeleton	Strehlow, 1969
	3.75-12.08 $\mu\text{g/g}$ wet wt.	5.60 $\mu\text{g/g}$ wet wt.	36	AAS	Fetal brain	Chaube et al., 1973
	51.3-189.8 $\mu\text{g/g}$ dry wt.	154.4 and 66.9 $\mu\text{g/g}$ dry wt.	4	Colorimetry	Range - normal subjects, mean - normal (3) and lymphomatous diseased subjects (1), respectively	Koch et al., 1957
	Not Given	4.93-0.21 mg/100g dry wt.	84	ES	Above 1 year old	Nusbaum et al., 1968
	8.0-17.0 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	8.7-27.0 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1968
	Not Given	39.1 $\mu\text{g/g}$ dry wt.	Not Given	Not Given	Normal level	Kentoul and Smith, 1973
	520-1100 $\mu\text{g}/100\text{g}$ ash	760 $\mu\text{g}/100\text{g}$ ash	129	ES	Adults	Tipton and Cook, 1969
	Not Given	5000-170 $\mu\text{g/g}$ ash	91	AAS		Schroeder et al., 1967
Diaphragm	3100-7200 $\mu\text{g}/100\text{g}$ dry wt.	4600 $\mu\text{g}/100\text{g}$ dry wt.	91	ES	Adults	Tipton and Cook, 1969

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Esophagus	Not Given	1000-170 $\mu\text{g/g}$ ash	67	AAS		Schroeder et al., 1967
	1900-4500 $\mu\text{g}/100\text{g}$ dry wt.	2600 $\mu\text{g/g}$ dry wt.	67	ES	Adults	Tipton and Cook, 1963
Feces	1.54-1.92 mg/g dry wt.	1.65 mg/g dry wt.	4	Not Given	Ages 16-1/2 - 19, pregnancy	Schraer et al., 1974
	Not Given	14.0 $\pm$ 1.7 and 16.0 $\pm$ 1.4	2	AAS	Healthy males, Cincinnati, OH, ages 21 and 25 years old	Tipton et al., 1969
Hair	52-119 and 120 $\mu\text{g/g}$	Not Given	19	Not Given	Wrestlers and nonwrestlers, respectively	Anon., 1977
	51-602 ppm	117 ppm	33	NAA	Oak Ridge, TN adults and children	Bate and Dyer, 1965
	Not Given	136, 151, and 225 $\mu\text{g/g}$	144	AAS	Maternal scalp (50 samples), maternal pubic (51), and neonatal scalp hair (41), respectively	Baumslag et al., 1974
	10.50-450.0 and 20.10-313.0 $\mu\text{g/g}$	90.50 and 108.54 $\mu\text{g/g}$	391	AAS	Children (224) and adults (167), respectively, NY suburbs	Cresson, 1975
	75-454 and 65-308 ppm	156 and 173 ppm	50	AAS	Males (25) and females (25), respectively	Fade and Lambdin, 1973
	0.0064 and 0.0562 % dry wt.	Not Given	18	ES	White males	Goldblum et al., 1953
	40-260 ppm	145.2 $\pm$ 30.8 - 156.6 $\pm$ 26.0 ppm	168	AAS	Fourth grade boys, 5 cities	Hammet et al., 1977
	6.4-87.0 $\mu\text{g/g}$	18.6 $\mu\text{g/g}$	12	AAS	Males and females	Hinnerk et al., 1974

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Hair	Not Given	523.5, 526.0, and 517.0 $\mu\text{g/g}$	43	NAA	Control (13), dialysis (18), and uremic (12) subjects, respectively	Mahler et al., 1970
	Not Given	161.5 $\pm$ 14.1 ppm	10	NAA	Homogenized hair	Obrusnik et al., 1972
	Not Given	90-180 and 110-190 ppm	211	AAS	Males and females, respectively, various age groups	Petering et al., 1971
	Not Given	173 $\mu\text{g/g}$ dry wt.	Not Given	Not Given	Normal hair level	Bentoul and Smith, 1973
	Not Given	167 $\pm$ 5 and 172 $\pm$ 9.3 $\mu\text{g/g}$	180	AAS	Males and females, respectively	Schroeder and Mason, 1969
	Not Given	189.4 $\pm$ 1.0 $\mu\text{g/g}$	1	AAS		Sorenson et al., 1973
	30-150 ppm	119 $\pm$ 4.6 ppm	6	ES	Seasonal variations, hair analysis reliable	Strain et al., 1966
	Not Given	246.0 and 181.0 $\mu\text{g/g}$ ash	2	AAS; MS		Yurachek et al., 1969
	Not Given	11.85 $\pm$ 0.39 mg/100g dry wt.	163	ES	Above 1 year old	Husbaum et al., 1958
Nails	31-59 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	26-49 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1965
	Not Given	87.9 $\mu\text{g/g}$ dry wt.	Not Given	Not Given	Normal level	Bentoul and Smith, 1973
	2000-3700 $\mu\text{g}/100\text{g}$ dry wt.	2700 $\mu\text{g}/100\text{g}$ dry wt.	140	ES	Adults	Tipton and Cook, 1963

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestine	32.2-90.2 and 42.0-176.3 $\mu\text{g/g}$ dry wt.	60.6 $\mu\text{g/g}$ dry wt.	15	Colorimetry	Range - normal (10) and lymphomatous diseased (5) subjects, respectively, mean - normal subjects. Small intestine	Koch et al., 1957
	Not Given	2500 $\pm$ 74 $\mu\text{g/g}$ ash	68	AAS	Duodenum	Schroeder et al., 1967
	Not Given	2300 $\pm$ 67 $\mu\text{g/g}$ ash	103	AAS	Jejunum	Schroeder et al., 1967
	Not Given	3200 $\pm$ 230 $\mu\text{g/g}$ ash	84	AAS	Ileum	Schroeder et al., 1967
	Not Given	3300 $\pm$ 180 $\mu\text{g/g}$ ash	31	AAS	Cecum	Schroeder et al., 1967
	Not Given	1700 $\pm$ 88 $\mu\text{g/g}$ ash	73	AAS	Omentum	Schroeder et al., 1967
	Not Given	2700 $\pm$ 79 $\mu\text{g/g}$ ash	108	AAS	Sigmoid Colon	Schroeder et al., 1967
	Not Given	3500 $\pm$ 180 $\mu\text{g/g}$ ash	42	AAS	Rectum	Schroeder et al., 1967
	1700-3400 $\mu\text{g}/100\text{g}$ dry wt.	2400	68	ES	Duodenum	Tipton and Cook, 1963
	1600-3100 $\mu\text{g}/100\text{g}$ dry wt.	2200	103	ES	Jejunum	Tipton and Cook, 1963
	1700-4900 $\mu\text{g}/100\text{g}$ dry wt.	2800	84	ES	Ileum	Tipton and Cook, 1963
	1900-4400 $\mu\text{g}/100\text{g}$ dry wt.	3500	31	ES	Cecum	Tipton and Cook, 1963

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Intestine	1800-4000 $\mu\text{g}/100\text{g}$ dry wt.	2600 $\mu\text{g}/100\text{g}$ dry wt.	108	ES	Sigmoid colon	Tipton and Cook, 1963
	2400-4800 $\mu\text{g}/100\text{g}$ dry wt.	3300 $\mu\text{g}/100\text{g}$ dry wt.	42	ES	Rectum	Tipton and Cook, 1963
Kidney	11.74-20.1 $\mu\text{g}/\text{g}$ wet wt.	15.77 $\mu\text{g}/\text{g}$ wet wt.	36	AAS	Fetal kidney	Chaube et al., 1973
	726-7768 ppm ash	1832-3762 ppm ash	120	AAS	Autopsies - 14 under 6 years old, 106 adults. Renal cortex	Hammer et al., 1973
	270-5700 and 1300-8100 $\mu\text{g}/\text{g}$ ash	3500 and 4600 $\mu\text{g}/\text{g}$ ash	24	AAS	Autopsies, control (12) and emphysematic (12), respectively	Hirst et al., 1973
	83.9-550 and 167.8-1038.4 $\mu\text{g}/\text{g}$ dry wt.	375 $\mu\text{g}/\text{g}$ dry wt.	14	Colorimetry	Range - normal (7) and lymphomatous diseased (7) subjects, respectively, mean - normal subjects	Koch et al., 1957
	64-126 and 119-448 $\mu\text{g}/\text{g}$ dry wt.	91 and 218 $\mu\text{g}/\text{g}$ dry wt.	38	NAA	Infants (6) and adults (32), respectively, autopsies	Livingstone, 1971
	3267-9560, 2210-5858, 3124-10,110, and 3685-14,598 $\mu\text{g}/\text{g}$ ash	5168, 4939, 5204, and 7431 $\mu\text{g}/\text{g}$ ash	80	AAS	Control (traumatic or infectious diseases), chronic hypotensive (12), cardiac or cerebrovascular diseases (18), and malignant diseases (25), respectively	Morgan, 1969
	Not Given	5307-1797 and 5055-6791 $\mu\text{g}/\text{g}$ ash	104	AAS	Control (16) and emphysema and carcinoma (68) subjects, respectively, 103 males, 1 female	Morgan et al., 1971
	61-423 and 60-241 ppm dry wt.	181 and 125 ppm dry wt.	35	AAS	Cortex and medulla, respectively	Metaky et al., 1969
	Not Given	19.04-0.64 mg/100g dry wt.	244	ES	Above 1 year old	Husbaum et al., 1958

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Kidney	49-120 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	1110-8200 ug/g ash	7810-3850 ug/g ash	62	ES	St. Louis adults and children	Perry et al., 1961
	Not Given	4620:1960 and 3450:1630 ug/g ash	24	AAS	P-physomastic (12) and normal (12) subjects, respectively	Perry et al., 1972
	35-175 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1968
	Not Given	188 ug/g dry wt.	Not Given	Not Given	Normal level	Rontoul and Smith, 1973
	Not Given	287:126 ug/g dry wt.	40	AAS	Adults, no metallothionein	Syversen, 1975
	0.0-100+ ug/100g dry wt.	Not Given	Not Given	ES		Tietz et al., 1957
	3200-7400 ug/100g dry wt.	4500ug/100g dry wt.	145	ES	Adults	Tipton and Cook, 1963
Larynx	Not Given	1300:87 ug/g ash	48	AAS		Schroeder et al., 1967
	680-2300 ug/100g dry wt.	1200 ug/100g dry wt.	48	ES	Adults	Tipton and Cook, 1963
Liver	104.9-231.7 ug/g dry wt	167.7 ug/g dry wt.	36	AAS	Fetal liver	Chaube et al., 1973
	158-60,260 ppm ash	3297-6354 ppm ash	120	AAS	Autopsies - 14 under 4 years, 106 adults, highest level in 0-9 year age group	Hammer et al., 1973
	2500-10,000 and 1900-8300 ug/g ash	5700 and 5000 ug/g ash	24	AAS	Autopsies, control (12) and emphysematic (12), respectively	Hirst et al., 1973

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	223.4-517.0 and 147.2-395.8 ug/g dry wt.	379 ug/g dry wt.	14	Colorimetry	Range - normal (8) and lymphomatous diseased (6) subjects, respectively, mean - normal subjects	Keck et al., 1957
	3282-16,842, 4702-11,238, 2732-17950, and 3740-21,098 ug/g ash	6463, 7028, 7404, and 9678 ug/g ash	80	AAS	Control (traumatic or infectious diseases, (25), chronic hypertensives (12), cardiac or cerebrovascular diseases (18), and malignant diseases (25), respectively, 79 men, 1 woman	Morgan, 1969
	Not Given	6062±2311 and 6469-7322 ug/g ash	104	AAS	Control (36) and emphysema and carcinoma (68) subjects, respectively, 103 males, 1 female	Morgan et al., 1971
	51-504 ppm dry wt.	207 ppm dry wt.	35	AAS	Autopsies	Hatchky et al., 1969
	Not Given	21.92±0.70 mg/100g dry wt.	241	ES	Above 1 year old	Musbaum et al., 1958
	26-48, 53-101, and 14-26 ppm wet wt.	37.2, 80, and 18 ppm wet wt.	13	Not Given	Control (no cancer), cancer patient - uninvolved liver, and cancer patient - cancerous liver, respectively	Olsen et al., 1954
	34-92 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	1400-21,000 ug/g ash	3875-9800 ug/g ash	62	ES	St. Louis adults and children	Perry et al., 1961
	Not Given	5040±1670 and 5780±2800 ug/g ash	24	AAS	Emphysematic (12) and normal (12) subjects, respectively	Perry et al., 1972

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	44-230 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1968
	Not Given	4920±1810 µg/g ash	10	ES	5 blacks and 5 whites, St. Louis	Perry et al., 1973
	Not Given	169 µg/g dry wt.	Not Given	Not Given	Normal liver level	Bentoul and Smith, 1973
	Not Given	(a) 280±58 µg/g dry wt. (b) 221±69 µg/g dry wt.	14	AAS	Adults, no metallothionein detected, (a) aorta, (b) medulla	Syversen, 1975
	0.0-65+ mg/100g dry wt.	Not Given	Not Given	ES		Tiets et al., 1957
	2200-5900 µg/100g dry wt.	3500 µg/100g dry wt.	150	ES	Adults	Tipton and Coor, 1963
	Not Given	74 ppm wet wt.	14	Chem.; ES	Adult males	Vallee et al., 1957
Lung	100-1400 and 96-2100 µg/g ash	950 and 990 µg/g ash	24	AAS	Autopsies, control (12) and emphysematic (12), respectively	Hirst et al., 1973
	117.2-145.1 and 78.2-719.8 µg/g dry wt.	130.8 µg/g dry wt.	13	Colorimetry	Range - normal (5) and lymphomatous diseased (8) subjects, respectively, mean - normal subjects	Kosh et al., 1957
	24.0-140.0 µg/g dry wt.	51.2-102.2 µg/g dry wt.	26	AAS	Autopsies, Chicago area	Marks et al., 1972
	53-225 ppm dry wt.	85 ppm dry wt.	35	AAS	Autopsies	Metsky et al., 1969
	Not Given	8.63±0.39 mg/100g dry wt.	86	ES	Above 1 year old	Musbaum et al., 1958

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Lung	13-27 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	Not Given	978-410 and 830-410 $\mu\text{g/g}$ ash	24	AAS	Emphysematic (12) and normal (12) subjects, respectively	Perry et al., 1972
	13-36 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1968
	6.6-31 mg	Not Given	168	Not Given	Autopsies, urban and rural areas	Schroeder, 1970
	0-20+ mg/100g dry wt.	Not Given	Not Given	ES		Tietz et al., 1957
	880-1800 $\mu\text{g}/100\text{g}$ dry wt.	1300 $\mu\text{g}/100\text{g}$ dry wt.	141	ES	Adult	Tipton and Cook, 1963
	660-3100 $\mu\text{g/g}$ ash	1400 $\mu\text{g/g}$ ash	141	ES	Autopsies, 9 cities	Tipton et al., 1964
Membrane	Not Given	26-30 and 26.5-29.0 $\mu\text{g}/100\text{g}$	502	Not Given	Control area (249) and lead mining area (253), respectively. Fetal membrane	Fahim et al., 1976
Milk	Not Given	1.68-0.78 $\mu\text{g/ml}$	50	AAS		Picciano, 1976
Muscle	62.3-297.1 and 95.7-144.8 $\mu\text{g/g}$ dry wt.	213.4 $\mu\text{g/g}$ dry wt.	13	Colorimetry	Range - normal (6) and lymphomatous diseased (7) subjects, respectively, mean - normal subjects. Cardiac	Koch et al., 1957
	278-642 and 215.2-349.7 $\mu\text{g/g}$ dry wt.	413.6 $\mu\text{g/g}$ dry wt.	13	Colorimetry	Range - normal (7) and lymphomatous diseased (6) subjects, respectively, mean - normal subjects	Koch et al., 1957
	Not Given	4800-190 $\mu\text{g/g}$ ash	137	AAS	Striated	Schroeder et al., 1967

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Muscle	2900-6800 $\mu\text{g}/100\text{g}$ dry wt.	4300 $\mu\text{g}/100\text{g}$ dry wt.	137	ES	Adult	Tipton and Cook, 1963
Myocardium	102-284 $\mu\text{g}/\text{g}$ dry wt.	130-152 $\mu\text{g}/\text{g}$ dry wt.	25	AAS	Autopsies, Chicago area	Marb et al., 1972
Nails	0.0116-0.308 $\pm$ dry wt.	Not Given	18	ES	White males	Goldblum et al., 1953
	Not Given	242, 445, and 418 $\mu\text{g}/\text{g}$	43	NAA	Control (13), dialysis (18) and uremic (12) subjects, respectively. Finger	Mahler et al., 1970
Ovary	Not Given	1800 $\pm$ 210 $\mu\text{g}/\text{g}$ ash	16	AAS		Schroeder et al., 1967
	840-2700 $\mu\text{g}/100\text{g}$ dry wt.	1700 $\mu\text{g}/100\text{g}$ dry wt.	16	ES	Adult	Tipton and Cook, 1963
Omentum	940-2900 $\mu\text{g}/\text{g}$ ash	1600 $\mu\text{g}/\text{g}$ ash	73	ES	Adult	Tipton and Cook, 1963
Pancreas	114-195 and 92.4-180.6 $\mu\text{g}/\text{g}$ dry wt.	168 $\mu\text{g}/\text{g}$ dry wt.	9	Colorimetry	Range - normal (4) and lymphomatous diseased (5) subjects, respectively, mean - normal subjects	Koch et al., 1957
	1500-3500 $\mu\text{g}/100\text{g}$ dry wt.	2300 $\mu\text{g}/100\text{g}$ dry wt.	138	ES	Adult	Tipton and Cook, 1963
Placenta	Not Given	70.3 $\pm$ 13.5 $\mu\text{g}/\text{g}$ dry wt.	811	NAA	Nashville, TN hospitals	Baglan et al., 1974
	Not Given	28.8 $\pm$ 20.77 micromoles/g dry wt.	554	AAS	Normal deliveries, Houston	Dawson, 1969
	Not Given	13.80 $\pm$ 0.39-50.37 $\pm$ 3.58 micromoles/g	554	AAS	Range of monthly means	Dawson et al., 1968

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Placenta	Not Given	26.5-31.0 and 26.0-31.5 $\mu\text{g}/100\text{g}$	502	Not Given	Control (249) and lead mining area (253), respectively	Fahim et al., 1976
	Not Given	10.232 $\pm$ 0.481 $\mu\text{g}/\text{g}$ wet wt.	58	Not Given	South and Southeast city hospitals	Karp and Robertson, 1977
Prostate	Not Given	9200 $\pm$ 860 $\mu\text{g}/\text{g}$ ash	50	AAS		Schroeder et al., 1967
	3200-19000 $\mu\text{g}/100\text{g}$ dry wt.	7500 $\mu\text{g}/100\text{g}$ dry wt.	50	ES	Adults	Tipton and Cook, 1963
Saliva	Not Given	51.14 and 10.6 ppb	81	AAS	Normal (34) and idiopathic hypoguesia (47) individuals, respectively. Parotid saliva	Henkin et al., 1975
	Not Given	51.1 and 10.1 ppb	275	AAS; Flurometry	Normal (150) and decreased taste activity (125) individuals, respectively	Henkin et al., 1975
Skin	0.002-0.0678 % dry wt.	Not Given	18	ES	White males	Goldblum et al., 1951
	5.2-112.4 $\mu\text{g}/\text{g}$ dry wt.	Not Given	7	Colorimetry	Lymphomatous diseased subjects	Koch et al., 1957
	Not Given	1000 $\pm$ 230 $\mu\text{g}/\text{g}$ ash	21	AAS		Schroeder et al., 1967
	550-1000 $\mu\text{g}/100\text{g}$ dry wt.	780 $\mu\text{g}/100\text{g}$ dry wt.	21	ES	Adults	Tipton and Cook, 1963
Spleen	63.3-138.3 and 92.1-130.7 $\mu\text{g}/\text{g}$ dry wt.	113.4 $\mu\text{g}/\text{g}$ dry wt.	11	Colorimetry	Range - normal (6) and lymphomatous diseased (5) subjects, respectively, mean - normal subjects	Koch et al., 1957

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Spleen	62.2-154 $\mu\text{g/g}$ dry wt.	77.9-91.0 $\mu\text{g/g}$ dry wt.	26	AAS	Autopsies, Chicago area	Marks et al., 1972
	Not Given	8.57 $\pm$ 0.38 mg/100g dry wt.	87	ES	Above 1 year old	Musbaum et al., 1958
	15-29 micromoles/g ash	Not Given	150	ES	St. Louis adults	Perry et al., 1962
	15-36 micromoles/g ash	Not Given	100	ES	Adults	Perry, 1968
	1000-1900 $\mu\text{g}/100\text{g}$ dry wt.	1300 $\mu\text{g}/100\text{g}$ dry wt.	142	ES	Adults	Tipton and Cook, 1963
Stomach	78.7-185 and 73.7-144.2 $\mu\text{g/g}$ dry wt.	152.7 $\mu\text{g/g}$ dry wt.	7	Colorimetry	Range - normal (4) and lymphomatous diseased (3) subjects, respectively, mean - normal subjects	Koch et al., 1957
	Not Given	2600 $\pm$ 69 $\mu\text{g/g}$ ash	130	AAS		Schroeder et al., 1967
	1700-3400 $\mu\text{g}/100\text{g}$ dry wt.	2400 $\mu\text{g}/100\text{g}$ dry wt.	130	ES	Adults	Tipton and Cook, 1963
Sweat	130-1460 and 530-2620 $\mu\text{g}/\text{liter}$	500 and 1250 $\mu\text{g}/\text{liter}$	48	AAS	Men (13) and females (15), respectively, comparison to women on pill showed no difference	Mohnadel et al., 1973
	2.47-3.49 mg/day	2.84 mg/day	4	Not Given	Ages 16-1/2 - 19, pregnancy	Schraer et al., 1974
Teeth	1210-3950 ppm	1620 $\pm$ 460 ppm	35	AAS	Left maxillary central incisor, 9-15 year olds	Brudevold et al., 1975
	Not Given	151.0 $\pm$ 30.5 $\mu\text{g/g}$	38	X-ray spectrometry	Californians. Dentin	Muhlelein and Calloway, 1977

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Teeth	42-510 µg/g	203 µg/g	56	MS	Less than 20-year-old teeth. Enamel	Loose et al., 1973
Testis	Not Given	1500±64 µg/g ash	71	AAS		Schroeder et al., 1967
	900-2200 µg/100g dry wt.	1400 µg/100g dry wt.	71	ES	Adults	Tipton and Cook, 1963
Thyroid	Not Given	2900±260 µg/g ash	21	AAS		Schroeder et al., 1967
	1700-4000 µg/100g dry wt.	2700 µg/100g dry wt.	21	ES	Adults	Tipton and Cook, 1963
Trachea	Not Given	980±62 µg/g ash	60	AAS		Schroeder et al., 1967
	450-1800 µg/100g dry wt.	890 µg/100g dry wt.	60	ES	Adults	Tipton and Cook, 1963
Umbilical cord	Not Given	27-29 and 24-29 µg/100g	502	Not Given	Control area (249) and lead mining area (253), respectively	Fahim et al., 1976
Urine	166-323 and 400-800 µg/ 24-hr sample	Not Given	19	NG	Wrestlers and nonwrestlers, respectively	Anon., 1972
	Not Given	630-550 µg/100ml	40	AAS	Lumberyard workers near fertilizer plant	Hammer et al., 1971
	141-779 µg/100ml	353 µg/100ml	164	AAS	Male and female adults	Henkin, 1971
	82-740 µg/liter	318 µg/liter	24	ES	Black and white males and females	Perry and Perry, 1959
	Not Given	85, 125, and 85 ppb	18	NG	Normal (15), hypertensive (15) and treated hypertensive (8) subjects, respectively	Perry, 1968

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ZINC (continued)

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Urine	Not Given	0.5 ug/ml	Not Given	Not Given	Normal level	Rentoul and Smith, 1973
	0.49-0.82 mg/day	0.62 mg/day	4	Not Given	Ages 16-1/2 - 19. Pregnancy	Schraer et al., 1974
	Not Given	1.3±0.1 and 1.2±0.2 mg/day	2	AAS	Healthy males, Cincinnati OH, ages 23 and 25 years old	Tipton et al., 1969
	Not Given	2500±290 ug/g ash	12	AAS		Schroeder et al., 1967

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Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Adipose	2.94-42.27 $\mu\text{g/g}$ ash	18.71 $\mu\text{g/g}$ ash	3	Colorimetry	Autopsies, Dallas, Baltimore, and Miami	Schroeder and Balassa, 1966
Aorta	Not given	9.49 $\mu\text{g/g}$ ash	1	Colorimetry	Autopsies, Dallas, Baltimore, and Miami	Schroeder and Balassa, 1966
Bladder	Not given	13.92 $\mu\text{g/g}$ ash	1	Colorimetry	Autopsies, Dallas, Baltimore, and Miami	Schroeder and Balassa, 1966
Blood	0.00-0.20 ppm	Not given	39	X-ray spectrometry	Healthy males, age 35.3 yrs. Serum.	Gofman et al., 1964
	Not given	0.40; 1.25 $\mu\text{g/g}$	4	Colorimetry	18 yrs. old; 40 yrs. old. Serum.	Schroeder and Balassa, 1966
	Not given	6.40, 6.62 $\mu\text{g/g}$	4	Colorimetry	18 yrs. old; 40 yrs. old. Red blood cells.	Schroeder and Balassa, 1966
Brain	0.26-6.40 $\mu\text{g/g}$ ash	2.61 $\mu\text{g/g}$ ash	4	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Diaphragm	Not given	3.49 $\mu\text{g/g}$ ash	1	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Feces	Not given	0.12 ± 0.02 and 0.059 ± 0.008 mg/day	2	ES	Healthy males, age 23 and 25 yrs., University of Cincinnati	Tipton et al., 1969
Heart	0.74-4.13 $\mu\text{g/g}$ ash	1.81 $\mu\text{g/g}$ ash	4	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Intestine	0.36-1.16 $\mu\text{g/g}$ ash	0.76 $\mu\text{g/g}$ ash	2	Colorimetry	Autopsies, Dallas, Miami, and Baltimore. Jejunum.	Schroeder and Balassa, 1966
Kidney	0.65-5.39 $\mu\text{g/g}$ ash	2.70 $\mu\text{g/g}$ ash	4	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966

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ZIRCONIUM

Tissue	Range	Mean Level	No. of Cases	Analytical Method	Comments	Reference
Liver	1.35-9.19 $\mu\text{g/g}$ ash	6.28 $\mu\text{g/g}$ ash	3	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Lung	Max. 7890	Not given	168	Not given	58 cities and 29 nonurban areas	Schroeder, 1970
	1.18-7.49 $\mu\text{g/g}$ ash	3.46 $\mu\text{g/g}$ ash	4	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Muscle	Not given	2.63 $\mu\text{g/g}$ ash	1	Colorimetry	Autopsies, Dallas, Miami, and Baltimore (psoas muscle)	Schroeder and Balassa, 1966
Pancreas	1.32-3.50 $\mu\text{g/g}$ ash	2.06 $\mu\text{g/g}$ ash	3	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Spleen	0.65-3.39 $\mu\text{g/g}$ ash	1.88 $\mu\text{g/g}$ ash	4	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Stomach	1.52-1.76 $\mu\text{g/g}$ ash	1.64 $\mu\text{g/g}$ ash	2	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Teeth	Not given	0.27 $\pm$ 0.13 ppm 0.16 $\pm$ 0.09 ppm	208	MS	High caries; low caries; <20-year-olds	Curnon and Losee, 1977
	<0.02-2.60 $\mu\text{g/g}$ dry wt.	0.53 $\pm$ 0.08 $\mu\text{g/g}$ dry wt.	56	MS	<20-year-olds, wide geographic area	Losee et al., 1973
Testis	0.93-2.04 $\mu\text{g/g}$ ash	1.37 $\mu\text{g/g}$ ash	4	Colorimetry	Autopsies, Dallas, Miami, and Baltimore	Schroeder and Balassa, 1966
Urine	Not given	0.0	5	Colorimetry	1 female, 4 males, age 18-80 yrs.	Schroeder and Balassa, 1966
	Not given	0.084 $\pm$ 0.014 and 0.18 $\pm$ 0.06 $\mu\text{g/day}$	2	ES	Healthy males, age 23 and 25 years, University of Cincinnati	Tipton et al., 1969

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REFERENCES

- Adebonojo, F. O. 1974. Hematologic Status of Urban Black Children in Philadelphia. Clin. Pediatr. (Philadelphia) 13(10):874-888.
- Albert, R., et al. 1973. Accumulation of Toxic Metals with Special Reference to Their Absorption, Excretion and Biological Half-Times. Environ. Physiol. Biochem. 3:65-107.
- Alexander, G. V., and R. E. Nusbaum. 1962. Zinc in Bone. Nature (London) 195(4844):903.
- Allaway, W. H., J. Kubota, F. Losee, and M. Roth. 1968. Selenium, Molybdenum, and Vanadium in Human Blood. Arch. Environ. Health 16: 342-348.
- Altshuller, L. F., D. B. Halak, B. H. Landing, and R. A. Kehoe. 1962. Deciduous Teeth as an Index of Body Burden of Lead. J. Pediatr. 60:224-229.
- Anderson, D. G., and J. L. Clark. 1974. Neighborhood Screening in Communities throughout the Nation for Children with Elevated Blood Lead Levels. Environ. Health Perspect. 7:3-6.
- Anderson, H. A., R. Lillis, S. M. Daum, A. S. Fischbein, and I. J. Selikoff. Household-contact Asbestos Neoplastic Risk. Ann. N.Y. Acad. Sci. 271:311-323.
- Angle, C. R., and M. S. McIntire. 1974. Red Cell Lead, Whole Blood Lead, and Red Cell Enzymes. Environ. Health Perspect. 7:133-137.
- Angle, C. R., M. S. McIntire, and A. V. Colucci. 1974. Lead in Air, Dustfall, Soil, Housedust, Milk and Water: Correlation with Blood Lead of Urban and Suburban School Children. Proc. Univ. Mo. Annu. Conf. Trace Subst. Environ. Health 8:23-29.
- Anonymous. 1956. Trace Elements in Enamel and Dentin. Nutr. Rev. 14(8):230-232.
- Anonymous. 1959. Trace Elements in Enamel and Dentin. Nutr. Rev. 9:259-261.
- Anonymous. 1962. Storage of Insecticides in Human Fat. Nutr. Rev. 20:52-54.
- Anonymous. 1965. A Skeleton in Our Body-fat Cupboard? Lancet (Great Britain) 2:577-578.
- Anonymous. 1970. Evaluation of the Present Status of DDT with Respect to Man. J. Am. Med. Assoc. 212(6):1055-1056.

- Anonymous. 1971. Status Report on Cadmium. Bureau of Foods, Food and Drug Administration, Washington, D.C.
- Anonymous. 1972. Wrestlers Show Low Zn, Mg Levels. Chem. Eng. News p. 17.
- Anonymous. 1973. Lead-poisoning Prevention in Massachusetts. N. Engl. J. Med. 289(8):428-429.
- Anonymous. 1976. HCB Found by EPA in 75% of Mother's Milk Samples; Pesticide Use Being Examined. Pestic. Chem. News pp. 25-26.
- Anonymous. 1976. Final Report of the Subcommittee on the Health Effects of Polychlorinated Biphenyls and Polybrominated Biphenyls. Department of Health, Education and Welfare, Washington, D.C.
- Anonymous. 1976. Human Tissue Samples Analyzed for Mirex Will Be Analyzed for Kepone. Pestic. Chem. News 4(39):28.
- Anonymous. 1978. EPA Finds Polychlorinated Terphenyls in Human Adipose Tissue Samples. Pestic. Tox. Chem. News 6(26):20.
- Anonymous. 1978. EPA to Emphasize Human Sampling for Dioxin, Dip Session Told. Pestic. Tox. Chem. News 6(12):20-21.
- Anonymous. 1978. Mirex in Tissues of 20% of Southern Population, EPA Report Indicates. Pestic. Tox. Chem. News pp. 16-17.
- Anonymous. 1978. Potentially Dangerous Chemical in Memphis Plant. The Oak Ridger. July 10, 1978.
- Archer, V. E. 1972. Mercury Content of Human Tissues. Am. J. Public Health 62(11):1442-1443.
- Armstrong, W. D., I. Gedalia, L. Singer, J. A. Weatherell, and S. M. Weidmann. 1970. Distribution of Fluorides. Chapter 4. Fluorides and Human Health. World Health Organization, Geneva.
- Atallah, Y. H., D. M. Whitacre, and P. B. Polen. Artifacts in Monitoring-related Analysis of Human Adipose Tissue for Some Organochlorine Pesticides. Chemosphere 1:17-20.
- Auerbach, O., E. C. Hammond, I. J. Selikoff, V. R. Parks, H. D. Kaslow, and L. Garfinkel. 1977. Asbestos Bodies in Lung Parenchyma in Relation to Ingestion and Inhalation of Mineral Fibers. Environ. Res. 14:286-304.
- Ayres, S. M., R. Evans, D. Licht, J. Griesbach, F. Reimold, E. F. Ferrand, and A. Criscitiello. 1973. Health Effects of Exposure to High Concentrations of Automotive Emissions. Arch. Environ. Health 27:168-178.

- Baetjer, A. M. 1956. Relation of Chromium to Health. In: Chromium, Vol. I, Chemistry of Chromium and its Compounds. Reinhold Publishing Co., New York. pp. 76-103.
- Baetjer, A. M., C. Damron, and V. Budacz. 1959. The Distribution and Retention of Chromium in Men and Animals. Arch. Ind. Health 20:136-150.
- Baglan, R. J., A. B. Brill, A. Schulert, D. Wilson, K. Larsen, N. Dyer, M. Mansour, W. Schaffner, L. Hoffman, and J. Davies. 1974. Utility of Placental Tissue as an Indicator of Trace Element Exposure to Adult and Fetus. Environ. Res. 8:64-70.
- Barquet, A., C. Morgade, J. E. Andrews, Jr., and R. A. Graves. 1970. Changing Profile of Pesticide Analyses in Human Fat and Blood. Ind. Med. 39(7):54.
- Bate, L. C., and F. F. Dyer. 1965. Trace Elements in Human Hair. Nucleonics 23(10):74-81.
- Baumslag, N., D. Yeager, L. Levin, and H. G. Petering. 1974. Trace Metal Content of Maternal and Neonate Hair. Arch. Environ. Health 29(4):186-191.
- Benning, D. 1958. Outbreak of Mercury Poisoning in Ohio. Ind. Med. Surg. pp. 354-363.
- Benson, W. W., and J. Gabica. 1972. Pesticides in People. Pestic. Monit. J. 6(2):80-81.
- Bevenue, A. 1976. The "Bioconcentration" Aspects of DDT in the Environment. Residue Rev. 61:37-112.
- Bevenue, A., J. Wilson, L. J. Casarett, and H. W. Klemmer. 1967. A Survey of Pentachlorophenol Content in Human Urine. Bull. Environ. Contam. Toxicol. 2(6):319-332.
- Bierenbaum, M. L., A. I. Fleischman, J. Dunn, and J. Arnold. 1975. Possible Toxic Water Factor in Coronary Heart-disease. Lancet (Great Britain) 1(7914):1008-1010.
- Biros, F. J., A. C. Walker, and A. Medbery. 1970. Polychlorinated Biphenyls in Human Adipose Tissue. Bull. Environ. Contam. Toxicol. 5(4):317-323.
- Black, M. S., and R. E. Sievers. 1976. Determination of Chromium in Human Blood Serum by Gas Chromatography with a Microwave Excited Emission Detector. Anal. Chem. 48(13):1872-1874.
- Blanksma, L. A., H. K. Sachs, E. F. Murray, and M. J. O'Connell. 1969. Incidence of High Blood Lead Levels in Chicago Children. Pediatrics 44(5):661-667.

- Bloomer, A. W., S. I. Nash, H. A. Price, and R. L. Welch. 1977. Pesticides in People. *Pestic. Monit. J.* 11(3):111-115.
- Bogden, J. D., N. P. Singh, and M. M. Joselow. 1974. Cadmium, Lead, and Zinc Concentrations in Whole Blood Samples of Children. *Environ. Sci. Technol.* 8:740-742.
- Bosen, S. F., and D. R. Scheuing. 1976. A Rapid Microtechnique for the Detection of Trace Metals from Gunshot Residues. *J. Forensic Sci.* 21(1):163-170.
- Bradway, D. E., and T. M. Shafik. 1973. Parathion Exposure Studies. A Gas Chromatographic Method for the Determination of Low Levels of p-Nitrophenol in Human and Animal Urine. *Bull. Environ. Contam. Toxicol.* 9(3):134-139.
- Brudevold, F., A. Reda, R. Aasenden, and Y. Bakhos. 1975. Determination of Trace Elements in Surface Enamel of Human Teeth by a New Biopsy Procedure. *Arch. Oral Biol. (Great Britain)* 20:667-673.
- Budinger, T. F., J. R. Farwell, A. R. Smith, and H. Bichsel. 1972. Human Tissue Trace-element Detection by Neutron Activation without Chemical Separation. *Int. J. Appl. Radiat. Isot.* 23:49-56.
- Burch, R. E., H.K.J. Hahn, and J. F. Sullivan. 1975. Newer Aspects of the Roles of Zinc, Manganese, and Copper in Human Nutrition. *Clin. Chem.* 21(4):501-520.
- Burns, J. E. 1974. Organochlorine Pesticide and Polychlorinated Biphenyl Residues in Biopsied Human Adipose Tissue - Texas 1969-72. *Pestic. Monit. J.* 7(3/4):122-126.
- Burns, J. E., and F. M. Miller. 1975. Hexachlorobenzene Contamination: Its Effects in a Louisiana Population. *Arch. Environ. Health* 30:44-48.
- Butt, E. M., R. E. Nusbaum, T. C. Gilmour, and S. L. Didio. 1964. Trace Metal Levels in Human Serum and Blood. *Arch. Environ. Health* 8:60-65.
- Camp, W.J.R., and V. A. Gant. 1949. Arsenic Content of Normal Hair in the Chicago Area. *Pharmacol. Exp. Ther.* 8:279.
- Canna, D., R. S. Tollen, and P. Gross. 1965. Asbestos Bodies in Human Lungs at Autopsy. *J. Am. Med. Assoc.* 192(5):371-373.
- Cannon, A. B. 1936. Chronic Arsenical Poisoning. *N.Y. State J. Med.* 36:219-241.
- Cappon, C. J., and J. C. Smith. 1978. A Simple and Rapid Procedure for the Gas-Chromatographic Determination of Methylmercury in Biological Samples. *Bull. Environ. Contam. Toxicol.* 19:600-607.
- Caprio, R. J., H. L. Margulis, and M. M. Joselow. 1974. Lead Adsorption in Children and Its Relationship to Urban Traffic Densities. *Arch. Environ. Health* 28(4):195-197.

- Carpenter, S. J. 1974. Placental Permeability of Lead. *Environ. Health Perspect.* 7:129-131.
- Carroll, K. G., J. E. Mulhern, Jr., and V. L. O'Brien. 1971. Microprobe Analysis of Localized Concentrations of Metals in Various Human Tissues. *Oncology* 25:11-18.
- Carroll, K. G., H. Needleman, O. C. Tuncay, and I. M. Shapiro. 1972. The Distribution of Lead in Human Deciduous Teeth. *Experientia* 23(4):434-435.
- Carson, B. L., and I. C. Smith. 1977. Thallium: An Appraisal of Environmental Exposure. Technical Report No. 5. National Institute of Environmental Health Sciences, N.C.
- Casarett, L. J., G. C. Fryer, W. L. Yaeger, Jr., and H. W. Klemmer. 1968. Organochlorine Pesticide Residues in Human Tissue - Hawaii. *Arch. Environ. Health* 17:306-311.
- Casarett, L. J., A. Bevenue, W. L. Yaeger, Jr., and S. A. Whalen. 1969. Observations on Pentachlorophenol in Human Blood and Urine. *Am. Ind. Hyg. Assoc. J.* 30(4):360-366.
- Chamberlin, G. W. 1959. Radiological Diagnosis of Chronic Beryllium Disease. *Arch. Ind. Health* 19:126-131.
- Chatman, T., and D. J. Wilson. 1975. Lead Levels in Human Deciduous Teeth in Tennessee. *Environ. Lett.* 8(2):173-183.
- Chaube, S., H. Nishimura, and C. A. Swinyard. 1973. Zinc and Cadmium in Normal Human Embryos and Fetuses. *Arch. Environ. Health* 26:237-240.
- Chisolm, J. J., Jr., E. D. Mellits, J. E. Keil, and M. B. Barrett. 1974. A Simple Protoporphyrin Assay-microhematocrit Procedure as a Screening Technique for Increased Lead Absorption in Young Children. *J. Pediatr.* 84(4):490-496.
- Chisolm, J. J., Jr., E. D. Mellits, J. E. Keil, and M. B. Barrett. 1974. Variations in Hematologic Responses to Increased Lead Absorption in Young Children. *Environ. Health Perspect.* pp. 7-12.
- Chisolm, J. J., Jr., M. B. Barrett, and E. D. Mellits. 1975. Dose-effect and Dose-response Relationships for Lead in Children. *J. Pediatr.* 87(6):1152-1160.
- Chisolm, J. J., Jr., M. B. Barrett, and H. V. Harrison. 1975. Indicators of Internal Dose of Lead in Relation to Derangement in Heme Synthesis. *Johns Hopkins Med. J.* 137:6-12.

- Chisolm, J. J., Chairman. 1976. Recommendations for the Prevention of Lead Poisoning in Children. *Nutr. Rev.* 34(1):321-327.
- Cohen, C. J., G. N. Bowers, and M. L. Lepow. 1973. Epidemiology of Lead Poisoning: A Comparison Between Urban and Rural Children. *J. Am. Med. Assoc.* 226(12):1430-1433.
- Cohen, D. J., W. T. Johnson, and B. K. Caparulo. 1976. Pica and Elevated Blood Lead Level in Autistic and Atypical Children. *Am. J. Dis. Child.* 130:47-48.
- Cohn, S. H., C. Abesamis, S. Yasumura, J. F. Aloia, I. Zanzi, and K. J. Ellis. 1977. Comparative Skeletal Mass and Radial Bone Mineral Content in Black and White Women. *Metabolism* 26(2):171-178.
- Colucci, A. V., D. I. Hammer, M. E. Williams, T. A. Hinnners, C. Pinkerton, J. L. Kent, and G. J. Love. 1973. Pollutant Burdens and Biological Response. *Arch. Environ. Health* 27:151-154.
- Comstock, E. G., B. S. Comstock, and K. Ellison. 1967. A Turbidimetric Method for the Determination of Pentachlorophenol in Urine. *Clin. Chem.* 13(12):1050-1056.
- Cotzias, G. C. 1958. Manganese in Health and Disease. *Physiol. Rev.* 38:503-532.
- Cotzias, G. C., S. T. Miller, and J. Edwards. 1967. Neutron Activation Analysis: The Stability of Manganese Concentrations in Human Blood and Serum. *J. Lab. Clin. Med.* 67(5):836-849.
- Cranmer, M. F., J. J. Carroll, and M. F. Copeland. 1969. Determination of DDT and Metabolites, Including DDA, in Human Urine by Gas Chromatography. *Bull. Environ. Contam. Toxicol.* 4(4):214-223.
- Cranmer, M. 1970. Determination of p-Nitrophenol in Human Urine. *Bull. Environ. Contamin. Toxicol.* 5(4):329-332.
- Cranmer, M., and J. Freal. 1970. Gas Chromatographic Analysis of Pentachlorophenol in Human Urine by Formation of Alkyl Ethers. *Life Sci.* 9:121-128.
- Creason, J. P., T. A. Hinnners, J. E. Baumgarner, and C. Pinkerton. 1975. Trace Elements in Hair, as Related to Exposure in Metropolitan New York. *Clin. Chem.* 21(4):603-612.
- Cueto, C., A. G. Barnes, and A. M. Mattson. 1956. Determination of DDA in Urine Using an Ion Exchange Resin. *J. Agric. Chem.* 4(11):943-945.

- Curzon, M.E.J., and F. L. Losee. 1977. Dental Caries and Trace Element Composition of Whole Human Enamel: Eastern United States. *J. Am. Dent. Assoc.* 94(6):1146-1150.
- Dale, W. E., A. Curley, and C. Cueto, Jr. 1966. Hexane Extractable Chlorinated Insecticides in Human Blood. *Life Sci.* 5:47-54.
- Dale, W. E., A. Curley, C. Cueto, and W. J. Hayes, Jr. 1966. Chlorinated Insecticides in Human Serum. *Toxicol. Appl. Pharmacol.* 8:337.
- David, O. J. 1974. Association between Lower Level Lead Concentrations and Hyperactivity in Children. *Environ. Health Perspect.* 7:17-25.
- David, O., J. Clark, and K. Voeller. 1972. Lead and Hyperactivity. *Lancet* II:900-903.
- Davies, J. E., W. F. Edmundson, C. H. Carter, and A. Barquet. 1969. Effect of Anticonvulsant Drugs on Dicophane (D.D.T.) Residues in Man. *Lancet* pp. 7-9.
- Davies, J. E., W. F. Edmundson, A. Maceo, A. Barquet, and J. Cassady. 1969. An Epidemiologic Application of the Study of DDE Levels in Whole Blood. *Am. J. Public Health* 59(3):435-441.
- Davies, J. E., W. F. Edmundson, A. Maceo, G. L. Irvin, III, J. Cassady, and A. Barquet. 1971. Reduction of Pesticide Residues in Human Adipose Tissue with Diphenylhydantoin. *Food Cosmet. Toxicol.* 9:413-423.
- Davies, J. E., W. F. Edmundson, A. Raffonelli, J. C. Cassady, and C. Morgade. 1972. The Role of Social Class in Human Pesticide Pollution. *Am. J. Epidemiol.* 96(5):334-341.
- Davies, J. E., W. F. Edmundson, A. Raffonelli, J. C. Cassady, and C. Morgade. 1973. The Role of Social Class in Human Pesticide Pollution. *Am. J. Epidemiol.* 96:334-341.
- Davies, J. E., W. F. Edmundson, N. J. Schneider, and J. C. Cassady. 1968. Pesticides in People. *Pestic. Monit. J.* 2(2):80-85.
- Davies, J. E., J. O. Welke, and J. L. Radomski. 1965. Epidemiological Aspects of the Use of Pesticides in the South. *J. Occup. Med.* 7(12):612-618.
- Dawson, E. B., H. A. Croft, R. R. Clark, and W. J. McGarity. 1968. Study of Seasonal Variations in Nine Cations of Normal Term Placentas. *Am. J. Obstet. Gynecol.* 102(3):354-361.
- Dawson, E. B., H. A. Croft, R. R. Clark, and W. J. McGarity. 1969. Study of Nine Cation Levels in Term Placentas: II. Changes Associated with Toxemia of Pregnancy and Fetal Prematurity. *Am. J. Obstet. Gynecol.* 103:1144-1147.

Deichmann, W. B., and W. E. MacDonald. 1971. Organochlorine Pesticides and Human Health. Food Cosmet. Toxicol. 9:91-103.

Deichmann, W. B., and J. L. Radomski. 1968. Retention of Pesticides in Human Adipose Tissue - Preliminary Report. Ind. Med. Surg. 37:218-219.

de la Burd, B., and I. M. Shapiro. 1975. Dental Lead, Blood Lead, and Pica in Urban Children. Arch. Environ. Health 30:281-284.

D'Ercole, A. J., R. D. Arthur, J. D. Cain, and B. F. Barrentine. 1976. Insecticide Exposure of Mothers and Newborns in a Rural Agricultural Area. Pediatrics 57(6):869-874.

Dickinson, L., E. L. Reichert, R.C.S. Ho, J. B. Rivers, and N. Kominami. 1972. Lead Poisoning in a Family Due to Cocktail Glasses. Am. J. Med. 52:391-394.

Dillon, H. K., D. J. Wilson, and W. Schaffner. 1974. Lead Concentrations in Human Milk. Am. J. Dis. Child. 128:491-492.

Dingwall, A., and H. T. Beans. 1934. A Spectrographic Study of the Occurrence of Chromium and Molybdenum in Carcinoma of the Human Breast. Proc. Nat. Acad. Sci. 20:416-420.

Dinman, B. D. 1960. Arsenic: Chronic Human Intoxication. J. Occup. Med. 2:137-141.

Domanski, J. J., L. A. Nelson, F. E. Guthrie, R. E. Domanski, R. Mark, and R. W. Postlethwait. 1977. Relation between Smoking and Levels of DDT and Dieldrin in Human Fat. Arch. Environ. Health 32(5):196-199.

Domonkos, A. N. 1959. Neutron Activation Analysis of Arsenic in Normal Skin, Keratoses, and Epitheliomas. Arch. Dermatol. 80:672-677.

Dougherty, R. C., and K. Piotrowska. 1976. Screening by Negative Chemical Ionization Mass Spectrometry for Environmental Contamination with Toxic Residues: Application to Human Urines. Proc. Natl. Acad. Sci. 73(6):1777-1781.

Dowty, B. J., and J. L. Laseter. 1976. The Transplacental Migration and Accumulation in Blood of Volatile Organic Constituents. Pediat. Res. 10:696-701.

Duffield, F. V., A. Yoakum, J. Bumgarner, and J. Moran. 1976. Determination of Human Body Burden Baseline Data of Platinum through Autopsy Tissue Analysis. Environ. Health Perspect. 15:131-134.

Durham, W. F. 1965. Pesticide Exposure Levels in Man and Animals. Arch. Environ. Health 10:842-846.

Durham, W. F. 1969. Body Burden of Pesticides in Man. Ann. N.Y. Acad. Sci. 160(1):188-195.

- Durham, W. F. 1969. Body Burden of Pesticides in Man. In: Annals of the New York Academy of Sciences. 160:183-195.
- Dyment, P. G., L. M. Hebertson, and W. J. Decker. 1971. Relationship between Levels of Chlorinated Hydrocarbon Insecticides in Human Milk and Serum. Bull. Environ. Contamin. Toxicol. 6(5):445-452.
- Dyment, P. G., and L. M. Hebertson. 1971. Absence of Polychlorinated Biphenyls in Human Milk and Serum from Texas and Human Milk from New Guinea. Bull. Environ. Contamin. Toxicol. 6(6):532-534.
- Eads, E. A., and C. E. Lambdin. 1973. A Survey of Trace Metals in Human Hair. Environ. Res. 6:247-252.
- Eaton, D. F., G.W.A. Fowles, M. W. Thomas, and G. B. Turnbull. 1975. Chromium and Lead in Colored Printing Inks Used for Children's Magazines. Environ. Sci. Technol. 9:768-770.
- Edmundson, W. F., J. J. Freal, and J. E. Davies. 1967. Identification and Measurement of Dieldrin in the Blood and Urine of Man. Environ. Res. 1:240-246.
- Edmundson, W. F., J. E. Davies, and W. Hull. 1968. Dieldrin Storage Levels in Necropsy Adipose Tissue from a South Florida Population. Pestic. Monit. J. 2(2):86-89.
- Edmundson, W. F., J.E. Davies, M. Cranmer, and G. A. Nachman. 1969. Levels of DDT and DDE in Blood and DDA in Urine of Pesticide Formulators Following a Single Intensive Exposure. Ind. Med. 38(4):55-60.
- Elliott, G. C., and M. D. Smith. 1960. Dietary Fluoride Related to Fluoride Content of Teeth. J. Dent. Res. 39:93-98.
- Eyl, T. B. 1971. Tempest in a Teapot. Am. J. Clin. Nutr. 24(10):1199-1203.
- Eyl, T. B. 1971. Methyl Mercury Poisoning in Fish and Human Beings. Clin. Toxicol. 4(2):291-296.
- Fahim, M. S., Z. Fahim, and D. G. Hall. 1976. Effects of Subtoxic Lead Levels on Pregnant Women in the State of Missouri. Res. Commun. Chem. Pathol. Pharmacol. 13(2):309-331.
- Fernandez, A. A., C. Sobel, and S. L. Jacobs. 1963. Sensitive Method for the Determination of Submicrogram Quantities of Manganese and Its Application to Human Serum. Anal. Chem. 35:1721-1724.
- Filby, R. H., and W. L. Yakeley. 1969. Determination of Selenium in Eye-lenses by Neutron Activation Analysis Using ^{76}Se . Radiochem. Radioanal. Lett. 2(5):307-311.

Fishbein, L. 1973. *Chromatography of Environmental Hazards: Vol. II. Metals, Gaseous and Industrial Pollutants.* Elsevier Scientific Publishing Co., New York.

Flick, D. F., H. F. Kraybill, and J. M. Dimitroff. 1971. Toxic Effects of Cadmium: A Review. *Environ. Res.* 4:71-85.

Forbes, R. M., A. R. Cooper, and H. H. Mitchell. 1954. On the Occurrence of Beryllium, Boron, Cobalt, and Mercury in Human Tissues. *J. Biol. Chem.* 209:857-865.

Forbes, R. M., H. H. Mitchell, and A. R. Cooper. 1956. Further Studies on the Gross Composition and Mineral Elements of the Adult Human Body. *J. Biol. Chem.* 223:969-975.

Fry, B. W., and D. R. Taves. 1974. Maternal and Fetal Fluorometabolite Concentrations after Exposure to Methoxyflurane. *Am. J. Obstet. Gynecol.* 119(2):199-204.

Fukano, S., and M. Doguchi. 1977. PCT, PCB and Pesticide Residues in Human Fat and Blood. *Bull. Environ. Contamin. Toxicol.* 17(5):613-615.

Fung, H., S. J. Yaffe, M. E. Mattar, and M. C. Lanighan. 1975. Blood and Salivary Lead Levels in Children. *Clin. Chim. Acta (Amsterdam)* 61:423-424.

Gabica, J., W. Benson, and M. Loomis. 1975. Total Mercury Levels in Selected Human Tissues, Idaho - 1973-74. *Pestic. Monit. J.* 9(2):59-63.

Galster, W. A. 1976. Mercury in Alaskan Eskimo Mothers and Infants. *Environ. Health Perspect.* 15:135-140.

Ganor, S., I. Gedalia, and N. Brand. 1964. Iodine in Children's Hair: Its Relation to Urinary Iodine Levels. *J. Invest. Dermatol* 43:5-6.

Gardner, A. L., and R. E. Iverson. 1968. The Effect of Aerially Applied Malathion on an Urban Population. *Arch. Environ. Health* 16:823-826.

Gedalia, I. 1970. Distribution in Placenta and Foetus. In: *Fluorides and Human Health. Chapter 4, Distribution of Fluorides.* World Health Organization, Geneva. pp. 128-134.

Gedalia, J., A. Brzezinski, and B. Bercovici. 1959. Urinary Fluorine Levels in Women During Pregnancy and After Delivery. *J. Dent. Res.* 38(3):548-551.

Gedalia, I., H. Zukerman, and H. Leventhal. 1965. Fluoride Content of Teeth and Bones of Human Fetuses, in Areas with about 1 ppm of Fluoride in Drinking Water. *Am. Dent. Assoc. J.* 71:1121-1123.

- Gershanik, J. J., G. G. Brooks, and J. A. Little. 1974. Blood Lead Values in Pregnant Women and Their Offspring. *Am. J. Obstet. Gynecol.* 119(4):508-511.
- Gettler, A. O., and L. Ellerbrook. 1939. Toxicology of Fluorides. *Am. J. Med. Sci.* 197:625-638.
- Gills, T. E., L. T. McClendon, E. J. Maienthal, D. A. Becker, R. A. Durst, and P. D. LaFleur. 1974. Determination of Toxic Trace Elements in Body Fluid Reference Samples. In: *Trace Substances in Environmental Health-VIII. Proc. Conf. Univ. Mo.* pp. 273-280.
- Giovanoli-Jakubczak, T., and G. G. Berg. 1974. Measurement of Mercury in Human Hair. *Arch. Environ. Health* 28:139-144.
- Giovanoli-Jakubczak, T., M. R. Greenwood, J. C. Smith, and T. W. Clarkson. 1974. Determination of Total and Inorganic Mercury in Hair by Flameless Atomic Absorption, and of Methylmercury by Gas Chromatography. *Clin. Chem.* 20(2):222-229.
- Glomski, C. A., and H. Brody. 1971. Distribution and Concentration of Mercury in Autopsy Specimens of Human Brain. *Nature (London)* 232:200-201.
- Gofman, J. W., O. F. deLalla, E. L. Kovich, O. Lowe, W. Martin, D. L. Piluso, R. K. Tandy, and F. Upham. 1964. Chemical Elements of the Blood of Man. *Arch. Environ. Health* 8:105-109.
- Goldblum, R. W., S. Derby, and A. B. Lerner. 1953. The Metal Content of Skin, Nails, and Hair. *J. Invest. Dermatol.* 20:13-18.
- Goldsmith, J. R. 1964. The Body Burden and Air Quality Standards. *Arch. Environ. Health* 8:47-51.
- Goldwater, L. J., and A. Nicolau. 1966. Absorption and Excretion of Mercury in Man. *Arch. Environ. Health* 12:196-198.
- Goldwater, L. J., A. C. Ladd, and M. B. Jacobs. 1964. Absorption and Excretion of Mercury in Man. *Arch. Environ. Health* 9:735-741.
- Goldwater, L. J., and A. W. Hoover. 1967. An International Study of "Normal" Levels of Lead in Blood and Urine. *Arch. Environ. Health* 15:60-63.
- Gordon, P., P. P. Rosen, and A. Savino. 1976. The Ferruginous Body Content of Lungs at Autopsy in Boston - 1928-1932. *Acta Cytol.* 20(6): 521-524.
- Gowdy, J. M., R. Yates, and F. X. Demers. 1977. Blood Mercury Concentration in an Urban Population. *Sci. Total Environ.* 8:247-251.
- Green, V. A., G. W. Wise, and N. W. Smull. 1973. Lead Survey of Selected Children in Kansas City and Some Unusual Cases. *Clin. Toxicol.* 6(1):29-37.

- Griffith, F. D., and R. V. Blanke. 1974. Microcoulometric Determination of Organochlorine Pesticides in Human Blood. *J. Assoc. Off. Agric. Chem.* 57(3):595-603.
- Gross, P., L. J. Cralley, and R.T.P. deTreville. 1967. "Asbestos" Bodies: Their Nonspecificity. *Am. Ind. Hyg. Assoc. J.* 28:541-542.
- Gross, P., R.T.P. deTreville, and M. N. Haller. 1969. Pulmonary Ferruginous Bodies in City Dwellers. *Arch. Environ. Health* 19:186-188.
- Gross, P., R. A. Harley, J.H.G. Davis, and L. J. Cralley. 1974. Mineral Fiber Content of Human Lungs. *Am. Ind. Hyg. Assoc. J.* 35(3):148-151.
- Gross, S. B., E. A. Pfitzer, D. W. Yeager, and R. A. Kehoe. 1975. Lead in Human Tissues. *Toxicol. App. Pharmacol.* 32:638-651.
- Guinee, V. F. 1971. Pica and Lead Poisoning. *Nutr. Rev.* 29(12):267-269.
- Guinee, V. F. 1972. Lead Poisoning. *Am. J. Med.* 52(3):283-288.
- Guy, W., and D. Taves. 1972. Fluorocompound(s) of Human Plasma: Distribution and Purification. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* 31.
- Guy, W. S. 1975. Characteristics and Concentrations of Organic Fluorocompounds Found in Human Tissues. American Chemical Society 170th National Meeting. Port City Press, Inc., Baltimore, Md.
- Hadjimarkos, D. M. 1973. Selenium in Relation to Dental Caries. *Food Cosmet. Toxicol.* 11:1083-1095.
- Hadjimarkos, D. M., and T. R. Shearer. 1972. Selenium Concentration in Human Saliva. *Caries Res.* 6(1):70.
- Hagyard, S. B., W. H. Brown, J. W. Stull, and F. M. Whiting. 1973. DDT and DDE Content of Human Milk in Arizona. *Bull. Environ. Contam. Toxicol.* 9(3):169-172.
- Hall, S. K. 1972. Pollution and Poisoning. *Environ. Sci. Tech.* 6(1):31-35.
- Halsted, J. A., and J. C. Smith, Jr. 1970. Plasma-Zinc in Health and Disease. *Lancet* 1:322-324.
- Hambidge, K. M. 1971. Chromium Nutrition in the Mother and the Growing Child. In: *Newer Trace Elements in Nutrition*, W. Mertz and W. E. Cornatzer, eds. Marcel Dekker Inc., New York. pp. 169-194.
- Hambidge, K. M., and W. Droegemueller. 1974. Changes in Plasma and Hair Concentrations of Zinc, Copper, Chromium, and Manganese During Pregnancy. *Obstet. Gynecol.* 44(5):666-672.

Hambidge, K. M., and D. O. Rodgers. 1969. Comparison of Hair Chromium Levels of Nulliparous and Parous Women. *Am. J. Obstet. Gynecol.* 103(3): 320-321.

Hambidge, K. M., M. L. Franklin, and M. A. Jacobs. 1972. Changes in Hair Chromium Concentrations with Increasing Distances from Hair Roots. *Am. J. Clin. Nutr.* 25:380-383.

Hambidge, K. M., and J. D. Baum. 1972. Hair Chromium Concentrations of Human Newborn and Changes During Infancy. *Am. J. Clin. Nutr.* 25:376-379.

Hammer, D. I., A. V. Calocci, V. Hasselblad, M. E. Williams, and C. Pinkerson. 1973. Cadmium and Lead in Autopsy Tissues. *J. Occup. Med.* 15(12):956-963.

Hammer, D. I., J. F. Finklea, R. H. Hendricks, C. M. Shy, and R.J.M. Horton. 1971. Hair Trace Metal Levels and Environmental Exposure. *Am. J. Epidemiol.* 93(2):84-92.

Hammer, D. I., J. F. Finklea, L. E. Priester, J. E. Keil, S. H. Sandifer, and K. Bridbord. 1972. Polychlorinated Biphenyl Residues in the Plasma and Hair of Refuse Workers. *Environ. Health Perspect.* 1:83.

Hammer, D. I., J. F. Finklea, R. H. Hendricks, T. A. Hanners, W. B. Riggan, and C. M. Shy. 1971. Trace Metals in Human Hair as a Simple Epidemiologic Monitor of Environmental Exposure. In: *Trace Substances in Environmental Health - IV*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 25-38.

Hammer, D. I., J. F. Finklea, J. P. Creason, S. H. Sandifer, J. E. Keil, L. E. Priester, and J. F. Stara. 1971. Cadmium Exposure and Human Health Effects. In: *Trace Substances in Environmental Health - V*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 269-283.

Hammond, P. B. 1976. Air Standards for Lead and Other Metals. *J. Occup. Med.* 18(5):351-355.

Hammond, P. B. 1969. Lead Poisoning. An Old Problem with a New Dimension. In: *Essays in Toxicology*, Vol. I, F. R. Blood, ed. Academic Press, New York. pp. 115-155.

Harris, P., and M. R. Holley. 1972. Lead Levels in Cord Blood. *Pediatrics* 49(4):606-608.

Hartung, R., and B. D. Dinman, (eds.) 1972. International Conference on Environmental Mercury Contamination, Ann Arbor, Michigan. Ann Arbor Science Publishers, Inc. p. 330.

Hayes, W. J., Jr., and A. Curley. 1968. Storage and Excretion of Dieldrin and Related Compounds. *Arch. Environ. Health* 16:155-162.

Hayes, W. J., Jr., W. E. Dale, and C. I. Pirkle. 1971. Evidence of Safety of Long-Term, High, Oral Doses of DDT for Man. *Arch. Environ. Health* 22:119-135.

- Hayes, W. J., Jr., W. F. Durham, and C. Cueto, Jr. 1956. The Effect of Known Repeated Oral Doses of Chlorophenothane (DDT) in Man. *J. Am. Med. Assoc.* 162:890-897.
- Hayes, W. J., Jr., G. E. Quinby, K. C. Walker, J. W. Elliott, and W. M. Upholt. 1958. Storage of DDT and DDE in People with Different Degrees of Exposure to DDT. *AMA Arch. Ind. Health* 18:398-406.
- Hayes, W. J., Jr., W. E. Dale, and V. W. Burse. 1965. Chlorinated Hydrocarbon Pesticides in the Fat of People in New Orleans. *Life Sci.* 4:1611-1615.
- Hecker, L. H., H. E. Allen, B. D. Dinman, and J. V. Neel. 1974. Heavy Metal Levels in Acculturated and Unacculturated Populations. *Arch. Environ. Health* 29:181-185.
- Hefferren, J. J., D. Kim, N. W. Levin, F. del Greco, and M. Zimmerman. 1972. Fluoride Distribution in Wedge and Needle Bone Biopsies. *Fed. Am. Soc. Exp. Biol.* pp. 1-1074.
- Heggen, G. E., and L. W. Strock. 1953. Determinations of Trace Elements. *Anal. Chem.* 25(6):859-863.
- Henk, M., and J. Froom. 1975. Outreach by Primary-care Physicians. *J. Am. Med. Assoc.* 233(3):256-259.
- Henkin, R. I. 1971. Newer Aspects of Copper and Zinc Metabolism. In: *Newer Trace Elements in Nutrition*, W. Mertz and W. E. Cornatzer, eds. Marcel Dekker Inc. pp. 255-312.
- Henkin, R. I., C. W. Mueller, and R. O. Wolf. 1975. Estimation of Zinc Concentration of Parotid Saliva by Flameless Atomic Absorption Spectrophotometry in Normal Subjects and in Patients with Idiopathic Hypogeusia. *J. Lab. Clin. Med.* 86(1):175-180.
- Henkin, R. I., B. N. Patten, P. K. Re, and D. A. Bronzert. 1975. A Syndrome of Acute Zinc Loss. *Arch. Neurol.* 32:745-751.
- Henkin, R. I., R. E. Lippoldt, J. Bilstad, and H. Edelhoch. 1975. A Zinc Protein Isolated from Human Parotid Saliva. *Proc. Nat. Acad. Sci.* 72(2):488-492.
- Henzler, T. E., R. J. Korda, P. A. Helmke, M. R. Anderson, M. M. Jimenez, and L. A. Haskin. 1974. An Accurate Procedure for Multielement Neutron Activation Analysis of Trace Elements in Biological Materials. *J. Radioanal. Chem.* 20:649-663.
- Hesselberg, R. J., and D. D. Scherr. 1974. PCB's and p,p'DDE in the Blood of Cachectic Patients. *Bull. Environ. Contam. Toxicol.* 11(3): 202-205.

- Hilderbrand, D. C., and D. H. White. 1974. Trace-Element Analysis in Hair: An Evaluation. *Clin. Chem.* 20(2):148-151.
- Hinners, T. A., W. J. Terrill, J. L. Kent, and A. V. Colucci. 1974. Hair - Metal Binding. *Environ. Health Perspect.* 8:191-199.
- Hirst, R. N., Jr., H. M. Perry, Jr., M. G. Cruz, and J. A. Pierce. 1973. Elevated Cadmium Concentration in Emphysematous Lungs. *Am. Rev. Respir. Dis.* 108:30-39.
- Hodge, H. C., and F. A. Smith. 1965. Biological Properties of Inorganic Fluorides. In: *Fluoride Chemistry*, Vol. 4, J. H. Simons, ed. Academic Press, New York. 786 pp.
- Hodge, H. C., and F. A. Smith. 1970. Minerals: Fluorine and Dental Caries. In: *American Chemical Society Advances in Chemistry Series* 94. Washington, D.C. pp. 93-115.
- Hoerman, K. C., J. E. Klima, L. S. Birks, D. J. Nagel, W. E. Ludwick, and H. W. Lyon. 1966. Tin and Fluoride Uptake in Human Enamel in Situ: Electron Probe and Chemical Microanalysis. *J. Am. Dent. Assoc.* 73:1301-1305.
- Hoffman, W. S., R. H. Harrison, and R. F. Schaefer. 1964. Analysis of Human Adipose Tissue for Pesticide Residues by Means of Microcoulometric Gas Chromatography. *Am. J. Clin. Pathol.* 41(6):649-657.
- Hoffman, W. S., H. Adler, W. I. Fishbein, and F. C. Bauer. 1967. Relation to Pesticide Concentrations in Fat to Pathological Changes in Tissues. *Arch. Environ. Health* 15:758-765.
- Hofreuter, D. H., E. J. Catcott, R. G. Keenan, and C. Xintaras. 1961. The Public Health Significance of Atmospheric Lead. *Arch. Environ. Health* 3:568-574.
- Hohnadel, D. C., F. W. Sunderman, Jr., M. W. Nechay, and M. D. McNeely. 1973. Atomic Absorption Spectrometry of Nickel, Copper, Zinc, and Lead in Sweat Collected from Healthy Subjects during Sauna Bathing. *Clin. Chem.* 19(11):1288-1292.
- Hopkins, D. R., and V. N. Houk. 1976. Federally-Assisted Screening Projects for Childhood Lead Poisoning Control: The First Three Years (July 1972-June 1975). *Am. J. Public Health* 66(5):485-486.
- Hopps, H. C. 1974. The Biologic Bases for Using Hair and Nail for Analyses of Trace Elements. In: *Trace Substances in Environmental Health-VIII*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 59-73.
- Howell, D. E. 1948. A Case of DDT Storage in Human Fat. *Proc. Okla. Acad. Sci.* 29:31-32.

Hueper, W. C. 1965. Occupational and Nonoccupational Exposure to Asbestos. *Ann. N.Y. Acad. Sci.* 132(1):184-185.

Hughes, R. O., D. F. Wease, and R. G. Troxler. 1976. Collection of Blood Uncontaminated with Ca, Cu, Mg, or Zn, for Trace-Metal Analysis. *Clin. Chem.* 22(5):691-692.

Humphrey, H.E.B., and N. S. Hayner. 1975. Polybrominated Biphenyls: An Agricultural Incident and Its Consequences. II. An Epidemiological Investigation of Human Exposure. In: *Trace Substances in Environmental Health-IX*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 57-63.

Hunter, C. G., J. Robinson, and K. W. Jager. 1967. Aldrin and Dieldrin - The Safety of Present Exposures of the General Populations of the United Kingdom and the United States. *Food. Cosmet. Toxicol.* 5:781-787.

Imbus, H. R., J. Cholak, L. H. Miller, and T. Sterling. 1963. Boron, Cadmium, Chromium, and Nickel in Blood and Urine. *Arch. Environ. Health* 6(2):112-121.

Jacobs, M. B., A. C. Ladd, and L. J. Goldwater. 1964. Absorption and Excretion of Mercury in Man. *Arch. Environ. Health* 9:454-463.

Jacobs, M. B., A. C. Ladd, and L. J. Goldwater. 1964. Absorption and Excretion of Mercury in Man. *Arch. Environ. Health* 9:454-463.

Jacobs, M. B., S. Yamaguchi, L. J. Goldwater, and H. Gilbert. 1960. Determination of Mercury in Blood. *Am. Ind. Hyg. Assoc. J.* 21:475-480.

Jaeger, R. J., and R. J. Rubin. 1973. Extraction, Localization, and Metabolism of Di-2-ethylhexyl Phthalate from PVC Plastic Medical Devices. *Environ. Health Perspect.* 3:95-102.

Janes, J. M., J. T. McCall, and L. R. Elveback. 1972. Trace Metals in Human Osteogenic Sarcoma. *Mayo Clin. Proc.* 47:476-478.

Johnson, D. E., J. B. Tillery, and R. J. Prevost. 1975. Trace Metals in Occupationally and Nonoccupationally Exposed Individuals. *Environ. Health Perspect.* 10:151-158.

Johnson, D. E., J. B. Tillery, and R. J. Prevost. 1975. Levels of Platinum, Palladium, and Lead in Populations of Southern California. *Environ. Health Perspect.* 12:27-33.

Joselow, M. M., R. Ruiz, and L. J. Goldwater. 1968. Absorption and Excretion of Mercury in Man. *Arch. Environ. Health* 17:35-38.

Juselius, R. E., P. Lupovich, and R. Moriarty. 1975. Sampling Problems in the Micro Determination of Blood Lead. *Clin. Toxicol.* 8(1):53-58.

Kanabrocki, E. L., L. F. Case, T. Fields, L. Graham, E. B. Miller, Y. T. Oester, and E. Kaplan. 1965. Nondialyzable Manganese, Copper and Gold Levels in Saliva of Normal Adult Subjects. *J. Nucl. Med.* 6:489-493.

Kanabrocki, E. L., L. F. Case, T. Fields, L. Graham, E. B. Miller, Y. T. Oester, and E. Kaplan. 1965. Manganese and Copper Levels in Human Urine. *J. Nucl. Med.* 6:780-791.

Kanabrocki, E., L. F. Case, L. A. Graham, T. Fields, Y. T. Oester, and E. Kaplan. 1968. Neutron-Activation Studies of Trace Elements in Human Fingernail. *J. Nucl. Med.* 9:478-481.

Karp, W. B., and A. F. Robertson. 1977. Correlation of Human Placental Enzymatic Activity with Trace Metal Concentration in Placentas from Three Geographical Locations. *Environ. Res.* 13:470-477.

Kaufman, N., J. V. Klavins, and T. D. Kinney. 1962. Iron Content of Liver in Relation to Age. *J. Nutr.* 78:338-340.

Kazen, C., A. Bloomer, R. Welch, A. Oudbier, and H. Price. 1974. Persistence of Pesticides on the Hands of Some Occupationally Exposed People. *Arch. Environ. Health* 29:315-318.

Kay, K. 1977. Polybrominated Biphenyls (PBB) Environmental Contamination in Michigan, 1973-1976. *Environ. Res.* 13:74-93.

Keane, W. T., and M. R. Zavon. 1969. The Total Body Burden of Dieldrin, *Bull. Environ. Contam. Toxicol.* 4:1-16.

Kehoe, R. A. 1961. The Metabolism of Lead in Man in Health and Disease. *Inst. Public Health Hyg.* 24:81-96.

Kehoe, R. A. 1964. Normal Metabolism of Lead. *Arch. Environ. Health* 8:232-235.

Kehoe, R. A., J. Cholak, D. M. Hubbard, K. Bambach, and R. R. McNary. 1943. Experimental Studies on Lead Absorption and Excretion and Their Relation to the Diagnosis and Treatment of Lead Poisoning. *J. Ind. Hyg.* 25:71-79.

Kehoe, R. A., J. Cholak, D. M. Hubbard, K. Bambach, R. R. McNary, and R. V. Story. 1940. Experimental Studies on the Ingestion of Lead Compounds. *J. Ind. Hyg.* 22(9):381-400.

Kehoe, R. A., J. Cholak, D. M. Hubbard, K. Bambach, R. R. McNary, and R. V. Story. 1940. Experimental Studies on the Ingestion of Lead Compounds. *J. Ind. Hyg.* 22(9):381-400.

Kehoe, R. A., J. Cholak, and R. V. Story. 1940. A Spectrochemical Study of the Normal Ranges of Concentration of Certain Trace Metals in Biological Materials. *J. Nutr.* 19:579-592.

Keil, J. E., W. Weston, III, C. B. Loadholt, S. H. Sandifer, and J. J. Colcolough. 1972. DDT and DDE Residues in Blood from Children, South Carolina - 1970. Pestic. Monit. J. 6(1):1-3.

Kennedy, J. H. 1966. Analysis of Diseased and Normal Lung Tissue for Trace Antimony Content by Neutron Activation Analysis. Am. J. Med. Sci. 251(1):37-39.

Kevorkian, J., D. P. Cento, J. F. Uthe, and R. A. Hagstrom. 1973. Methylmercury Content of Selected Human Tissues Over the Past 60 Years. Am. J. Public Health 63(11):931-934.

Kevorkian, J., D. P. Cento, J. R. Hyland, W. M. Bagozzi, and E. van Hollebeke. 1972. Mercury Content of Human Tissues During the Twentieth Century. Am. J. Public Health. pp. 504-513.

Kim, Y. S. 1974. Human Tissues: Chemical Composition and Photo Dosimetry Data. Radiat. Res. 57:38-45.

Kim, Y. S. 1974. Human Tissues: Chemical Composition and Photon-Dosimetry Data. A Correction. Radiat. Res. 60:361-362.

King, B. G., A. F. Schaplowsky, and E. D. McCabe. 1972. Occupational Health and Child Lead Poisoning: Mutual Interests and Special Problems. Am. J. Public Health 62(8):1056-1059.

Klein, R. 1974. The Pediatrician and the Prevention of Lead Poisoning in Children. Pediatr. Clin. North Am. 21(2):277-290.

Klemmer, H. W. 1971. Human Health and Pesticides - Community Pesticide Studies. Residue Rev. 41:55-63.

Klemmer, H. W., A. M. Budy, and W. Takahashi. 1977. Human Tissue Distribution of Cyclodiene Pesticides - Hawaii 1964-1973. Clin. Toxicol. 11(1):71-82.

Klemmer, H. W., M. N. Rashad, and M. P. Mi. 1973. Age, Sex and Race Effects on the Distribution of Organochlorine Pesticide Residues in Serum. In: Pesticides and the Environment: A Continuing Controversy, W. B. Deichmann, ed. Intercontinental Medical Book Corp., New York. pp. 53-61.

Klevay, L. M. 1970. Hair as a Biopsy Material. II. Assessment of Copper Nutriture. Am. J. Clin. Nutr. 23(9):1194-1202.

Klevay, L. M. 1973. Hair as a Biopsy Material. Arch. Environ. Health 26:169-172.

Klevay, L. M. 1974. Hair as a Biopsy Material IV. Geographic Variations in the Concentration of Zinc. Nutr. Rep. Int. 10:181-187.

Knowles, J. A. 1974. Breast Milk: A Source of More than Nutrition for the Neonate. Clin. Toxicol. 7(1):69-82.

Koch, H. J., Jr., E. R. Smith, and J. McNelly. 1957. Analysis of Trace Elements in Human Tissues. II. The Lymphomatous Diseases. *Cancer* 10(1):151-160.

Koch, H. J., Jr., E. R. Smith, N. F. Shimp, and J. Connor. 1956. Analysis of Trace Elements in Human Tissues. *Cancer* 9:499-511.

Koos, B. J., and L. D. Longo. 1976. Mercury Toxicity in the Pregnant Woman, Fetus, and Newborn Infant. *Am. J. Obstet. Gynecol.* 126(3):390-409.

Kopito, L., and H. Shwachman. 1964. Spectroscopic Analysis of Tissues from Patients with Cystic Fibrosis and Controls. *Nature (London)* 202(4931):501-502.

Kopito, L. E., and H. Shwachman. 1975. Lead in Human Scalp Hair: Some Factors Affecting its Variability. *J. Invest. Dermatol.* 64(5):342-348.

Kraybill, H. F. 1965. The Pesticide Program of the Public Health Service. *Am. J. Public Health* 55(7):32-35.

Kraybill, H. F. 1969. Significance of Pesticide Residues in Foods in Relation to Total Environmental Stress. *Can. Med. Assoc. J.* 100:204-215.

Kroger, M. 1972. Insecticide Residues in Human Milk. *J. Pediatr.* 80(3):401-405.

Kubota, J., V. A. Lazar, and F. Losee. 1968. Copper, Zinc, Cadmium, and Lead in Human Blood from 19 Locations in the United States. *Arch. Environ. Health* 16:788-793.

Kuhnert, P. M., P. Erhard, and B. R. Kuhnert. 1977. Lead and δ -Aminolevulinic Acid Dehydratase in RBC's of Urban Mothers and Fetuses. *Environ. Res.* 14:73-80.

Kuhnlein, H. V., and D. H. Calloway. 1977. Minerals in Human Teeth: Differences Between Preindustrial and Contemporary Hopi Indians. *Am. J. Clin. Nutr.* 30(6):883-886.

Kutz, F. W., G. W. Sovocool, S. Strassman, and R. G. Lewis. 1976. *Trans*-nonachlor Residues in Human Adipose Tissue. *Bull. Environ. Contam. Toxicol.* 16(1):9-14.

Kutz, F. W., and S. C. Strassman. 1976. Residues of Polychlorinated Biphenyls in the General Population of the United States. National Conference on Polychlorinated Diphenyls, November 19-21, 1975. Chicago, Ill. pp. 139-143.

Kutz, F. W., and S. C. Strassman. 1977. Human Urinary Metabolites of Organophosphate Insecticides Following Mosquito Adulticiding. *Mosq. News* 37(2):211-218.

Kutz, F. W., S. C. Strassman, and J. F. Sperling. 1978. Residues of Selected Organochlorine Pesticides in Human Adipose Tissue: Fiscal Years 1970-1975. Presented at the 1978 Annual Meeting of the American Association for the Advancement of Science, February 14, 1978, Washington, D.C.

Kutz, F. W., S. C. Strassman, and A. R. Yobs. 1976. Survey of Pesticide Residues and Their Metabolites in the General Population of the United States. Ecological Monitoring Branch. U.S. Environmental Protection Agency, Washington, D.C.

Kutz, F. W., S. C. Strassman, and A. R. Yobs. 1977. Survey of Pesticide Residues and Their Metabolites in Humans. Pesticide Management and Insecticide Resistance 1977. Academic Press Inc., New York. pp. 523-539.

Kutz, F. W., A. R. Yobs, W. G. Johnson, and G. B. Wiersma. 1974. Pesticide Residues in Adipose Tissue of the General Population of the United States, FY 1970 Survey. Bull. Soc. Pharm. Environ. Pathol. 11(3).

Kutz, F. W., A. R. Yobs, W. G. Johnson, and G. B. Wiersma. 1974. Mirex Residues in Human Adipose Tissue. Environ. Entomol. 3(5):882-884.

Kutz, F. W., A. R. Yobs, and S. C. Strassman. 1977. Racial Stratification of Organochlorine Insecticide Residues in Human Adipose Tissue. J. Occup. Med. 19(9):619-622.

Kutz, F. W., A. R. Yobs, S. C. Strassman, and J. F. Viar, Jr. 1977. Pesticides in People. Pestic Monit. J. 11(2):61-63.

Kwalick, D. S. 1971. Anticonvulsants and DDT Residues. J. Am. Med. Assoc. 120-121.

Lamm, S., B. Cole, K. Glynn, and W. Ullmann. 1973. Lead Content of Milks Fed to Infants - 1971-1972. N. Eng. J. Med. 289(11):574-575.

Landrigan, P. J., R. W. Baloh, W. F. Barthel, K. H. Whitworth, N. W. Staehling, and B. F. Rosenblum. 1975. Neuropsychological Dysfunction in Children with Chronic Low-level Lead Absorption. Lancet 1(7909): 708-712.

Landrigan, P. J., S. H. Gehlbach, B. F. Rosenblum, J. M. Shovits, R. M. Candelaria, W. F. Barthel, J. A. Liddle, A. L. Smrek, N. W. Staehling, and J. F. Sanders. 1975. Epidemic Lead Absorption Near an Ore Smelter. N. Engl. J. Med. 292(3):123-129.

Landrigan, P. J., A. S. McKinney, L. C. Hopkins, W. W. Rhodes, Jr., W. A. Price, and D. H. Cox. 1975. Chronic Lead Absorption. J. Am. Med. Assoc. 234(4):394-397.

Langer, A. M., V. Baden, E. C. Hammond, and I. J. Selikoff. 1970. Inorganic Fibers, Including Chrysotile, in Lungs at Autopsy: Preliminary Report. Inhaled Particles, III. In: Proceedings of an International Symposium, W. H. Walton, ed. pp. 683-694.

Langer, A. M., I. J. Selikoff, and A. Sastre. 1971. Chrysotile Asbestos in the Lungs of Persons in New York City. Arch. Environ. Health 22:348-361.

Laseter, J. L., and B. J. Dowty. 1977. Association of Biorefractories in Drinking Water and Body Burden in People. Ann. N.Y. Acad. Sci. 298: 547-556.

Lau, H.K.Y., and H. Ashmead. 1975. Trace Minerals in Human Hair by Atomic Absorption Spectrophotometry - Recovery Study. Anal. Lett. 8(11):815-824.

Laug, E. P., F. M. Kunze, and C. S. Prickett. 1951. Occurrence of DDT in Human Fat and Milk. AMA Arch. Ind. Hyg. 3(3):245-246.

Laug, E. P., C. S. Prickett, and F. M. Kunze. 1950. Survey Analyses of Human Milk and Fat for DDT Content. Fed. Proc. 9:294-295.

Laurer, G. R., R. E. Albert, T. J. Kneip, B. Pasternack, C. Strehlow, N. Nelson, and F. S. Kent. 1973. The Distribution of Lead Paint in New York City Tenement Buildings. Am. J. Public Health 63(2):163-168.

Lepow, M. L., L. Bruckman, M. Gillette, S. Markowitz, R. Robino, and J. Kapish. 1975. Investigations into Sources of Lead in the Environment of Urban Children. Environ. Res. 10:415-426.

Lepow, M. L., L. Bruckman, R. A. Rubino, S. Markowitz, M. Gillette, and J. Kapish. 1974. Role of Airborne Lead in Increased Body Burden of Lead in Hartford Children. Environ. Health Perspect. 7:99-102.

Lerner, S. 1975. Blood Lead Analysis - Precision and Stability. J. Occup. Med. 17(3):153-154.

Levine, R. J., R. M. Moore, Jr., G. D. McLaren, W. F. Barthel, and P. J. Landrigan. 1976. Occupational Lead Poisoning, Animal Deaths, and Environmental Contamination at a Scrap Smelter. Am. J. Public Health 66(6):548-552.

Lewis, G. P., L. L. Coughlin, W. J. Jusko, and S. Hartz. 1972. Contribution of Cigarette Smoking to Cadmium Accumulation in Man. Lancet 1:291.

Lewis, R. G., R. C. Hanisch, K. E. MacLeod, and G. W. Sovocool. 1976. Photochemical Confirmation of Mirex in the Presence of Polychlorinated Biphenyls. J. Agric. Food Chem. 24(5):1030-1035.

- Lewis, G. P., W. J. Jusko, and L. L. Coughlin. 1972. Cadmium Accumulation in Man: Influence of Smoking, Occupation, Alcoholic Habit and Disease. *J. Chron. Dis.* 25:717-726.
- Lieben, J., J. A. Dattoli, and V. M. Vought. 1966. The Significance of Beryllium Concentrations in Urine. *Arch. Environ. Health* 12:331-334.
- Lieberman, K. W., and H. H. Kramer. 1970. Cadmium Determination in Biological Tissue by Neutron Activation Analysis. *Anal. Chem.* 42(2): 266-267.
- Lin-Fu, J. S. 1970. Screening for Lead Poisoning. *Pediatrics* 45:720-721.
- Lin-Fu, J. S. 1972. Undue Absorption of Lead Among Children - A New Look at an Old Problem. *N. Eng. J. Med.* 286(13):702-710.
- Lisella, F. S., K. R. Long, and H. G. Scott. 1972. Health Aspects of Arsenicals in the Environment. *J. Environ. Health* 34(5):511-518.
- Little, M. F., and K. Barrett. 1976. Trace Element Content of Surface and Subsurface Enamel Relative to Caries Prevalence on the West Coast of the United States of America. *Arch. Biol.* 21:651-657.
- Livingstone, H. D. 1971. Distribution of Zinc, Cadmium, and Mercury in the Human Kidneys. In: *Trace Substances in Environmental Health-V*, D. D. Hemphill, ed. pp. 399-411.
- Livingston, H. D. 1972. Measurement and Distribution of Zinc, Cadmium, and Mercury in Human Kidney Tissue. *Clin. Chem.* 18(1):67-72.
- Lockeretz, W. 1973. On the Lead Content of Human Hair (1871-1971). *Science* 180:1080.
- Lockeretz, W. 1975. Lead Content of Deciduous Teeth of Children in Different Environments. *Arch. Environ. Health* 30:583-587.
- Long, R. A. 1972. Determination of Trace Yttrium and Other Heavy Metals in Urine by X-ray Fluorescence Spectroscopy. *Am. Ind. Hyg. Assoc. J.* 33(5):343-345.
- Losee, F., T. W. Cutress, and R. Brown. 1973. Trace Elements in Human Dental Enamel. In: *Trace Substances in Environmental Health-VII*. pp. 19-24.
- Lutz, G. A., A. A. Levin, S. G. Bloom, K. J. Nielsen, J. L. Cross, and D. L. Morrison. 1970. Technical, Intelligence, and Project Information System for the Environmental Health Service Volume III. Lead Model Case Study. Battelle Memorial Institute, Columbus, Laboratories, Columbus, Ohio.
- MacDonald, R. A. 1967. Tissue Iron and Hemochromatosis. *Arch. Path.* 84:543-551.

- Machle, W., and E. J. Largent. 1943. The Absorption and Excretion of Fluoride. II. The Metabolism at High Levels of Intake. *J. Ind. Hyg. Toxicol.* 25(3):112-123.
- Machle, W., E. W. Scott, and E. J. Largent. 1942. The Absorption and Excretion of Fluorides. Part I. The Normal Fluoride Balance. *J. Ind. Hyg. Toxicol.* 24(7):199-204.
- Maddox, J. 1972. Pollution and Worldwide Catastrophe. *Nature (London)* 236:433-436.
- Magos, L., and T. W. Clarkson. 1972. Atomic Absorption Determination of Total, Inorganic, and Organic Mercury in Blood. *J. Assoc. Off. Agric. Chem.* 55(5):966-971.
- Mahaffey, K. R. 1977. Quantities of Lead Producing Health Effects in Humans: Sources and Bioavailability. *Environ. Health Perspect.* 19:285-295.
- Mahler, D. J., A. F. Scott, J. R. Walsh, and G. Haynie. 1970. A Study of Trace Metals in Fingernails and Hair using Neutron Activation Analysis. *J. Nucl. Med.* 11(12):739-742.
- Manton, W. I. 1977. Sources of Lead in Blood. *Arch. Environ. Health* 32(4):149-159.
- Marks, G. E., and C. E. Moore. 1972. Determination of Trace Elements in Human Tissue. I. Cd, Fe, Zr, Mg, and Ca. *Appl. Spectro.* 26(5):523-527.
- Martin, G. M. 1964. Copper Content of Hair and Nails of Normal Individuals and of Patients with Hepatolenticular Degeneration. *Nature (London)* 202:903-904.
- Massaro, E. J., S. J. Yaffe, and C. C. Thomas, Jr. 1974. Mercury Levels in Human Brain, Skeletal Muscle and Body Fluids. *Life Sci.* 14:1939-1946.
- Matsumura, F., and C. T. Ward. 1966. Degradation of Insecticides by the Human and the Rat Liver. *Arch. Environ. Health* 13:257-261.
- Matthews, H. B., J. J. Domanski, and F. E. Guthrie. 1976. Hair and Its Associated Lipids as an Excretory Pathway for Chlorinated Hydrocarbons. *Xenobiotica* 6(7):425-429.
- Mattson, A. M., J. Spillane, C. Baker, and G. W. Pearce. 1953. Determination of DDT and Related Substances in Human Fat. *Anal. Chem.* 25:1065-1070.
- Mazess, R. B. 1970. Bone Mineral Content in Wainwright Eskimos: Preliminary Report. *Arct. Anthropol.* 7(1):114-116.

- Mazess, R. B. 1974. Bone Mineral in Alaskan Eskimos. *Am. J. Phys. Anthropol.* 41(3):492-493.
- Mazess, R. B., and J. R. Cameron. 1974. Bone Mineral Content in Normal U.S. Whites. *Am. J. Phys. Anthropol.* 41(3):492-493.
- Mazess, R. B., and W. Mather. 1974. Bone Mineral Content of North Alaskan Eskimos. *Am. J. Clin. Nutr.* 27(9):916-925.
- Mazess, R. B., and W. E. Mather. 1975. Bone Mineral Content in Canadian Eskimos. *Human Biol.* 47(1):45-63.
- McClure, F. J., and C. A. Kinser. 1944. Fluoride Domestic Waters and Systemic Effects. *Public Health Rep.* 59(49):1575-1591.
- McConnell, K. P., W. L. Broghamer, Jr., A. J. Blotcky, and O. J. Hurt. 1975. Selenium Levels in Human Blood and Tissues in Health and Disease. *J. Nutr.* 105(8):1026-1031.
- McIntire, M. S., and C. R. Angle. 1972. Air Lead: Relation to Lead in Blood of Black School Children Deficient in Glucose-6-Phosphate Dehydrogenase. *Science* 177:520-522.
- McLaughlin, M., and G. J. Stopps. 1973. Smoking and Lead. *Arch. Environ. Health* 26:131-136.
- McLaughlin, M., A. L. Lynch, and R. D. Snee. 1973. Longitudinal Studies of Lead Levels in a US Population. *Arch. Environ. Health* 27:305-311.
- McLellan, J. S., B. J. Thomas, and J. H. Fremlin. 1975. Cadmium - Its in vivo Detection in Man. *Phys. Med. Biol.* 20(1):88-95.
- McNeely, M. D., M. W. Nechay, and F. W. Sunderman, Jr. 1972. Measurements of Nickel in Serum and Urine as Indices of Environmental Exposure to Nickel. *Clin. Chem.* 18(9):992-995.
- McNeely, M. D., F. W. Sunderman, Jr., M. W. Nechay, and H. Levine. 1971. Abnormal Concentrations of Nickel in Serum in Cases of Myocardial Infraction, Stroke, Burns, Hepatic Cirrhosis, and Uremia. *Clin. Chem.* 17(11):1123-1128.
- Mathies, J. C. 1974. X-ray Spectrographic Microanalysis of Human Urine for Arsenic. *Appl. Spectro.* 28(2):165-170.
- Meester, W. D., and D. J. McCoy. 1977. Human Toxicology of Polybrominated Biphenyls. Presented in the Symposium on Environmental Toxicology, August 4, 1976. Blodgett Memorial Medical Center, Grand Rapids, Mich.
- Mertz, W. 1974. The Newer Essential Trace Elements, Chromium, Tin, Vanadium, Nickel and Silicon. *Proc. Nutr. Soc.* 33:307-313.

- Metcalf, D. R., and J. H. Holmes. 1969. Egg, Psychological, and Neurological Alterations in Humans with Organophosphorus Exposure. *Ann. N.Y. Acad. Sci.* 160(1):357-365.
- Milby, T. H., and A. J. Samuels. 1971. Human Exposure to Lindane. *J. Occup. Med.* 13(5):255-258.
- Milham, S., Jr., and T. Strong. 1974. Human Arsenic Exposure in Relation to a Copper Smelter. *Environ. Res.* 7:176-182.
- Mitchell, D. G. 1974. Increased Lead Absorption: Paint is Not the Only Problem. *Pediatrics* 53(2):142-143.
- Mitchell, H. W. 1965. Pesticides and Other Agricultural Chemicals as a Public Health Problem. *Am. J. Public Health* 55(7):10-15.
- Moeller, D. W., E. J. Baratta, and I. E. Leonard. 1964. Human Hair and Strontium 90. *Public Health Rep.* 79(11):1030-1031.
- Mooty, J., C. F. Ferrand, and P. Harris. 1975. Relationship of Diet to Lead Poisoning in Children. *Pediatrics* 55(5):636-639.
- Morgan, J. M. 1969. Tissue Cadmium Concentration in Man. *Arch. Intern. Med.* 123:405-408.
- Morgan, J. M. 1972. Hepatic Copper, Manganese, and Chromium Content in Bronchogenic Carcinoma. *Cancer* 29:710-713.
- Morgan, J. M. 1972. "Normal" Lead and Cadmium Content of the Human Kidney. *Arch. Environ. Health* 24:364-368.
- Morgan, J. M. 1972. Tissue Copper and Lead Content in Ischemic Heart Disease. *Arch. Environ. Health* 25:26-28.
- Morgan, J. M., H. B. Burch, and J. B. Watkins. 1971. Tissue Cadmium and Zinc Content in Emphysema and Bronchogenic Carcinoma. *J. Chron. Dis.* 24:107-110.
- Morgan, D. P., and C. C. Roan. 1970. Chlorinated Hydrocarbon Pesticide Residue in Human Tissues. *Arch. Environ. Health* 20:452-455.
- Morgan, D. P., and C. C. Roan. 1971. Absorption, Storage, and Metabolic Conversion of Ingested DDT and DDT Metabolites in Man. *Arch. Environ. Health* 22:301-308.
- Morgan, D. P., and C. C. Roan. 1972. Loss of DDT from Storage in Human Body Fat. *Nature (London)* 238:221-223.
- Mottet, N. K., and R. L. Body. 1974. Mercury Burden of Human Autopsy Organs and Tissues. *Arch. Environ. Health* 29:18-24.

- Musial, C. J., O. Hutzinger, V. Zitko, and J. Crocker. 1974. Presence of PCB, DDE and DDT in Human Milk in the Provinces of New Brunswick and Nova Scotia, Canada. *Bull. Environ. Contam. Toxicol.* 12:258-267.
- Needleman, H. L. 1975. Lead-Paint Poisoning Prevention: An Opportunity Forfeited. *N. Eng. J. Med.* 292(11):588-589.
- Needleman, H. L., I. Davidson, E. M. Sewell, and I. M. Shapiro. 1974. Subclinical Lead Exposure in Philadelphia School Children. *N. Eng. J. Med.* 290(5):245-248.
- Needleman, H. L., and I. M. Shapiro. 1974. Dentine Lead Levels in Asymptomatic Philadelphia School Children: Subclinical Exposure in High and Low Risk Groups. *Environ. Health Perspect.* 7:27-31.
- Needleman, H. L., O. C. Tuncay, and I. M. Shapiro. 1972. Lead Levels in Deciduous Teeth of Urban and Suburban American Children. *Nature (London)* 235:111-112.
- Nelson, J. A., R. F. Struck, and R. James. 1978. Estrogenic Activities of Chlorinated Hydrocarbons. *J. Toxicol. Environ. Health* 4:325-339.
- Nelson, K. W. 1965. Lead in Urine by Atomic Absorption. *Am. Ind. Hyg. Assoc. J.* 26:442-443.
- Nelson, N., T. C. Byerly, A. C. Kolbye, L. T. Kurland, R. E. Shapiro, S. I. Shibko, W. H. Stickel, J. E. Thompson, L. A. Van Den Berg, and A. Weissler. 1971. Hazards of Mercury. *Environ. Res.* 4:1-69.
- Neri, B. P., and C. S. Frings. 1975. Improved Method for Determining Lead in Whole Blood and Urine using a Delves Cup Atomic Absorption Procedure. *Clin. Chem.* 21(7):994.
- Netsky, M. G., W. W. Harrison, M. Brown, and C. Benson. 1969. Tissue Zinc and Human Disease. *Am. J. Clin. Pathol.* 51:358-365.
- Newton, K. G., and N. C. Greene. 1970. Organochlorine Pesticide Residue Levels in Human Milk - Victoria, Australia - 1970. *Pest. Monit. J.* 6(1):4-8.
- Niedermeier, W., J. H. Griggs, and J. Webb. 1974. Matrix Effects in the Emission Spectrometric Analysis of Trace Metals in Biological Specimens. *Appl. Spectrosc.* 28(1):1-4.
- Nord, P. J., M. P. Kadaba, and J.R.J. Sorenson. 1973. Mercury in Human Hair. *Arch. Environ. Health* 27:40-44.
- Nusbaum, R. E., G. V. Alexander, E. M. Butt, T. C. Gilmour, and S. L. Didio. 1958. Some Spectrographic Studies of Trace Element Storage in Human Tissues. *Soil Sci.* 85:95-99.

Obrusnik, I., J. Gislason, D. K. McMillan, J. D'Auria, and B. D. Pate. 1972. The Variation of Trace Element Concentrations in Single Human Head Hairs. *J. Forensic. Sci.* 17(3):426-439.

O'Leary, J. A., J. E. Davies, W. F. Edmundson, and M. Feldman. 1970. Correlation of Prematurity and DDE Levels in Fetal Whole Blood. *Am. J. Obstet. Gynecol.* 106(6):939.

O'Leary, J. A., J. E. Davies, and M. Feldman. 1970. Spontaneous Abortion and Human Pesticide Residues of DDT and DDE. *Am. J. Obstet. Gynecol.* 198(8):1291-1292.

Oleru, U. G. 1975. Epidemiological Implications of Environmental Cadmium. *Am. Ind. Hyg. Assoc. J.* 36(3):229-233.

Oleru, U. G. 1976. Kidney, Liver, Hair and Lungs as Indicators of Cadmium Absorption. *Am. Ind. Hyg. Assoc. J.* 37:617-620.

Olson, K. B., G. Heggen, C. F. Edwards, and L. W. Gorham. 1954. Trace Element Content of Cancerous and Noncancerous Human Liver Tissue. *Science* 119:772-773.

Ong, P. S., P. K. Lund, and W. M. Conrad. 1972. Trace Metal Analysis of Human Serum with an Electron Probe Micro Analyzer. *Texas Rep. Biol. Med.* 30(2):190.

Ortelee, M. F. 1958. Study of Men with Prolonged Intensive Occupational Exposure to DDT. *Arch. Ind. Health* 18(5):433-440.

Oudbier, A. J., A. W. Bloomer, H. A. Price, and R. L. Welch. 1974. Respiratory Route of Pesticide Exposure as a Potential Health Hazard. *Bull. Environ. Contam. Toxicol.* 12(1):1-9.

Owen, C. A., E. R. Dickson, N. P. Goldstein, A. H. Baggenstoss, and J. T. McCall. 1977. Hepatic Subcellular Distribution of Copper in Primary Biliary Cirrhosis. *Mayo Clin. Proc.* 52:73-80.

Page, A. L., and F. T. Bingham. 1973. Cadmium Residues in the Environment. *Residue Rev.* 48(0):1-44.

Parkins, F. M., N. Tinanoff, M. Moutinho, M. B. Anstey, and M. H. Waziri. 1976. Relationships of Human Plasma Fluoride and Bone Fluoride to Age. *Fluoride* 9(4):218-219.

Parr, R. M., and D. M. Taylor. 1963. The Determination of Gold in Human Liver by Thermal Neutron Activation Analysis. *Phys. Med. Biol.* 8(2):43-50.

Paschal, E. H., C. C. Roan, and D. P. Morgan. 1974. Evidence of Excretion of Chlorinated Hydrocarbon Pesticides by the Human Liver. *Bull. Environ. Contam. Toxicol.* 12(5):547-554.

Pawel, M. A., C. N. Frantz, and I. B. Pisetsky. 1971. Screening for Lead Poisoning with the Urinary ALA Test. HSMHA Health 86(11):1030-1036.

Perkons, A. K., and R. E. Jervis. 1966. Trace Elements in Human Head Hair. J. Forensic Sci. 11:50-63.

Perron, R. C., and B. F. Barrentine. 1970. Human Serum DDT Concentration Related to Environmental DDT Exposure. Arch. Environ. Health 20:368-376.

Perry, H. M. 1960. Systematizing and Extending the Collection of Samples for Assaying Trace Elements. Washington University School of Medicine, St. Louis, Mo.

Perry, H. M., Jr. 1968. Hypertension and Trace Metals, with Particular Emphasis on Cadmium. In: Trace Substances in Environmental Health-II, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 101-125.

Perry, H. M., Jr., and E. F. Perry. 1959. Normal Concentrations of Some Trace Metals in Human Urine: Changes Produced by Ethylenediaminetetraacetate. J. Clin. Invest. 38:1452-1463.

Perry, H. M., Jr., E. F. Perry, J. E. Purifoy, and J. N. Erlanger. 1973. A Comparison of Intra- and Interhepatic Variability of Trace Metal Concentrations in Normal Men. In: Trace Substances in Environmental Health-VII, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 281-288.

Perry, H. M., Jr., J. A. Pierce, R. N. Hirst, J. E. Purifoy, E. F. Perry, and M. Cruz. 1972. Elevated Pulmonary Cadmium in Emphysematous Subjects Without Known Cadmium Exposure. In: Trace Substances in Environmental Health-VI, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 207-214.

Perry, H. M., Jr., I. H. Tipton, H. A. Schroeder, and M. J. Cook. 1962. Variability in the Metal Content of Human Organs. J. Lab. Clin. Med. 60:245-253.

Perry, H. M., Jr., I. H. Tipton, H. A. Schroeder, R. L. Steiner, and M. J. Cook. 1961. Variation in the Concentration of Cadmium in Human Kidney as a Function of Age and Geographic Origin. J. Chron. Dis. 14(2):253-271.

Perry, K., R. G. Bowler, H. M. Buckell, H. A. Druett, and R.S.F. Schilling. 1948. II. Clinical and Environmental Investigations. Br. J. Ind. Med. 5:6-15.

Petering, H. G., D. W. Yeager, and S. O. Witherup. 1971. Trace Metal Content of Hair. Arch. Environ. Health 23:202-207.

Petering, H. G., D. W. Yeager, and S. O. Witherup. 1973. Trace Metal Content of Hair. *Arch. Environ. Health* 27:327-330.

Picciano, M. F., and H. A. Guthrie. 1976. Copper, Iron, and Zinc Contents of Mature Human Milk. *Am. J. Clin. Nutr.* 29:242-254.

Pinkerton, C., J. P. Creason, C. M. Shy, D. I. Hammer, R. W. Buechley, and G. K. Murthy. 1971. Cadmium Content of Milk and Cardiovascular Disease Mortality. In: *Trace Substances in Environmental Health-V*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 285-292.

Pinkerton, C., D. I. Hammer, K. Bridbord, J. P. Creason, J. L. Kent, and G. K. Murthy. 1972. Human Milk as a Dietary Source of Cadmium and Lead. In: *Trace Substances in Environmental Health-VI*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 39-43.

Piomelli, S., B. Davidow, V. F. Guinee, P. Young, and G. Gay. 1973. The FEP (Free Erythrocyte Porphyrins) Test: A Screening Micromethod for Lead Poisoning. *Pediatrics* 51(2):254-259.

Pitkin, R. M., J. A. Bahns, L. J. Filer, Jr., and W. A. Reynolds. 1976. Mercury in Human Maternal and Cord Blood, Placenta, and Milk. *Proc. Soc. Exp. Biol. Med.* 151:565-567.

Pocock, S. J. 1977. Blood-Lead in Mentally Retarded Children. *Lancet* 1:1260-1261.

Poklis, A. 1975. The Lead Content of the Aorta in Male Residents of Baltimore, Maryland. *Bull. Environ. Contam. Toxicol.* 13(4):417-419.

Poklis, A., and H. C. Freimuth. 1975. The Lead Content of the Trachea in Baltimore Residents. *Bull. Environ. Contam. Toxicol.* 14(2):168-170.

Poklis, A., and H. C. Freimuth. 1976. Lead Distribution in Soft Tissues of Baltimore Residents, 1973. *Bull. Environ. Contam. Toxicol.* 15(3):311-315.

Polishuk, Z. W., M. Ron, M. Wassermann, S. Cucos, D. Wassermann, and C. Lemesch. 1977. Pesticides in People: Organochlorine Compounds in Human Blood Plasma and Milk. *Pestic. Mont. J.* 10(4):121-129.

Preuss, O. P. 1975. Beryllium and Its Compounds. In: *Proceedings of the Symposium on Toxicity of Metals*. Industrial Health Foundation, Pittsburgh, Pa.

Price, H. A., and R. L. Welch. 1972. Occurrence of Polychlorinated Biphenyls in Humans. *Environ. Health Perspect.* 1:73-78.

Price, N. O., R. W. Young, and J. K. Dickinson. 1972. Pesticide Residues and Polychlorinated Biphenyl Levels in Diets, Urine, and Fecal Matter of Preadolescent Girls. *Proc. Soc. Exp. Biol. Med.* 139(4):1280-1283.

Pueschel, S. M. 1974. Neurological and Psychomotor Functions in Children with an Increased Lead Burden. Environ. Health Perspect. 7:13-16.

Pueschel, S. M., L. Kopito, and H. Schwachman. 1972. Children with an Increased Lead Burden: A Screening and Follow-up Study. J. Am. Med. Assoc. 222(4):462-466.

Quaife, M. L., J. S. Winbush, and O. G. Fitzhugh. 1967. Survey of Quantitative Relationships between Ingestion and Storage of Aldrin and Dieldrin in Animals and Man. Food Cosmet. Toxicol. 5:39-50.

Quinby, G. E., J. F. Armstrong, and W. F. Durham. 1965. DDT in Human Milk. Nature (London) 207:726-728.

Quinby, G. E., W. J. Hayes, Jr., J. F. Armstrong, and W. F. Durham. 1965. DDT Storage in the US Population. J. Am. Med. Assoc. 191(3):109-113.

Rabinowitz, M., G. Wetherill, and J. Kopple. 1975. Absorption, Storage and Excretion of Lead by Normal Humans. In: Trace Substances in Environmental Health-IX, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 361-368.

Radomski, J. L. 1966. The Determination of Chlorinated Hydrocarbon Pesticides in Human and Animal Tissues. Ind. Med. Surg. 35(7):602.

Radomski, J. L., W. B. Deichmann, E. E. Clizer, and A. Rey. 1968. Pesticide Concentrations in the Liver, Brain and Adipose Tissue of Terminal Hospital Patients. Food Cosmet. Toxicol. 6:209-220.

Radomski, J. L., W. B. Deichmann, A. A. Rey, and T. Merkin. 1971. Human Pesticide Blood Levels as a Measure of Body Burden and Pesticide Exposure. Toxicol. Appl. Pharmacol. 20:175-185.

Radomski, J. L., and V. Fiserova-Bergerova. 1965. The Determination of Pesticides in Tissues with the Electron Capture Detector without Prior Clean-up. Ind. Med. Surg. 34:934-939.

Radomski, J. L., and V. Fiserova-Bergerova. 1967. Determination of Chlorinated Hydrocarbon Pesticides in Human and Animal Tissues. Ind. Med. Surg. 36(4):281-285.

Radomski, J. L., and A. Rey. 1969. Determination of Chlorinated Hydrocarbon Pesticides in Human and Animal Tissues. II. Blood, Brain, Liver, Kidney, Gonad, and Fat. Ind. Med. 38(2):34-40.

Rappolt, R. T., and W. E. Hale. 1968. p,p'-DDE and p,p'-DDT Residues in Human Placentas, Cords, and Adipose Tissue. Clin. Toxicol. 1(1): 57-61.

- Rappolt, R. T., D. Mengle, W. Hale, B. Hartman, and B. Salmon. 1968. Kern County: Annual Generic Pesticide Input; Blood Dyscrasias; p,p'-DDE and p,p'-DDT Residues in Human Fat, Placentas with Related Stillbirths and Abnormalities. *Ind. Med. Surg.* 37(7):513.
- Rashad, M. N., and M. P. Mi. 1976. Association Between Serum Cholesterol and Serum Organochlorine Residues. *Bull. Environ. Contamin. Toxicol.* 15(4):475-477.
- Reigart, J. R., and C. D. Garber. 1976. Evaluation of the Humoral Immune Response of Children with Low Level Lead Exposure. *Bull. Environ. Contam. Toxicol.* 16(1):112-117.
- Rentoul, E., and H. Smith, eds. 1973. Normal Levels of Trace Elements in Human Tissue and Fluids. In: *Medical Jurisprudence and Toxicology*, Churchill Livingstone, London.
- Rivers, J. B. 1972. Gas Chromatographic Determination of Pentachlorophenol in Human Blood and Urine. *Bull. Environ. Contamin. Toxicol.* 8(5):294-296.
- Roan, C., D. Morgan, and E. H. Paschal. 1971. Urinary Excretion of DDA Following Ingestion of DDT and DDT Metabolites in Man. *Arch. Environ. Health* 22:309-315.
- Robbins, W. B., B. M. DeKoven, and J. A. Caruso. 1975. Copper in Erythrocytes by Flameless Atomic Absorption Spectroscopy. *Biochem. Med.* 14:184-190.
- Robinson, F. R., S. F. Brokeshoulder, A. A. Thomas, and J. Cholak. 1968. Microemission Spectrochemical Analysis of Human Lungs for Beryllium. *Am. J. Clin. Pathol.* 49:821-825.
- Robinson, J. 1969. The Burden of Chlorinated Hydrocarbon Pesticides in Man. *Can. Med. Assoc. J.* 100:180-191.
- Rosen, J. F. 1972. The Microdetermination of Blood Lead in Children by Flameless Atomic Absorption: The Carbon Rod Atomizer. *J. Lab. Clin. Med.* 80(4):567-576.
- Rosen, J. F., and E. E. Trinidad. 1974. Significance of Plasma Lead Levels in Normal and Lead-intoxicated Children. *Environ. Health Perspect.* 7:139-144.
- Rosen, P., M. Melamed, and A. Savino. 1972. The "Ferruginous Body" Content of Lung Tissue: A Quantitative Study of Eighty-six Patients. *Acta Cytol.* 16(3):207-211.

- Rosenthal, H. L., S. Austin, S. O'Neill, and K. Takeuchi. 1964. Incorporation of Fall-out Strontium-90 in Deciduous Incisors and Fetal Bone. *Nature* 203:615-616.
- Rosenthal, H. L., O. A. Cochran, and M. M. Eves. 1972. Strontium Content of Mammalian Bone, Diet and Excreta. *Environ. Res.* 5:182-191.
- Russo, R. M., T. Laude, S. Rajkumar, and J. E. Allen. 1973. Incidence of Plumbism and Pica in Accidentally Poisoned Children. *N.Y. State J. Med.* 73(14):1881-1885.
- Sachs, H. K. 1974. Effect of a Screening Program on Changing Patterns of Lead Poisoning. *Environ. Health Perspect.* 7:41-45.
- Savage, E. P., J. D. Tessari, J. W. Malberg, H. W. Wheeler, and J. R. Bagby. 1972. A Search for Polychlorinated Biphenyls in Human Milk in Rural Colorado. In: *Trace Substances in Environmental Health-VI*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 45-48.
- Savage, E. P., J. D. Tessari, J. W. Malberg, H. W. Wheeler, and J. R. Bagby. 1973. A Search for Polychlorinated Biphenyls in Human Milk in Rural Colorado. *Bull. Environ. Contam. Toxicol.* 9(4):222-226.
- Savage, E. P., J. D. Tessari, J. W. Malberg, H. W. Wheeler, and J. R. Bagby. 1973. Organochlorine Pesticide Residues and Polychlorinated Biphenyls in Human Milk, Colorado - 1971-72. *Pestic. Monit. J.* 7(1):1-5.
- Savage, E. P. 1976. National Study to Determine Levels of Chlorinated Hydrocarbon Insecticides in Human Milk - 1975-76. Colorado State University, Ft. Collins, Colorado.
- Sax, N. I., and J. J. Gabay. 1965. Occurrence of ^{54}Mn in Human and Bovine Livers. *Health Phys.* 11:585-591.
- Scanlon, J. 1971. Umbilical Cord Blood Lead Concentration. *Amer. J. Dis. Child.* 121:325-326.
- Schafer, M. L. 1968. Pesticides in Blood. *Residue Rev.* 24:19-39.
- Schafer, M. L., and J. E. Campbell. 1966. Distribution of Pesticide Residues in Human Body Tissues from Montgomery County, Ohio. In: *Organic Pesticides in the Environment, Advances in Chemistry Series 60*, American Chemical Society, Washington, D.C., pp. 89-98.
- Schechter, M. S. 1967. Chemicals Monitoring Guide for National Pesticide Monitoring Program. *Pestic. Monit. J.* 1(1):20-21.

- Scheinberg, I. H., C. D. Cook, and J. A. Murphy. 1954. The Concentration of Copper and Ceruloplasmin in Maternal and Infant Plasma at Delivery. *Amer. Soc. Clin. Invest.* 33:963.
- Schlesinger, E. R., D. E. Overton, and H. C. Chase. 1956. Study of Children Drinking Fluoridated and Nonfluoridated Water. *J. Am. Med. Assoc.* 160(1):21-24.
- Schoor, W. P. 1973. In vivo Binding of p,p'-DDE to Human Serum Proteins. *Bull. Environ. Contam. Toxicol.* 9(2):70-74.
- Schraer, K. K., and D. H. Calloway. 1974. Zinc Balance in Pregnant Teenagers. *Nutr. Metab.* 17:205-212.
- Schroeder, H. A. 1960. Possible Relationships Between Trace Metals and Chronic Diseases. In: *Metal-Binding in Medicine*, M. J. Seven and L. A. Johnson (eds.), J. B. Lippincott Co., Philadelphia, Pennsylvania, pp. 59-67.
- Schroeder, H. A. 1970. A Sensible Look at Air Pollution by Metals. *Arch. Environ. Health* 21:798-806.
- Schroeder, H. A. 1964. Renal Cadmium and Essential Hypertension. *J. Am. Med. Assoc.* :358.
- Schroeder, H. A. 1965. Cadmium as a Factor in Hypertension. *J. Chron. Dis.* 18:647-656.
- Schroeder, H. A. 1967. Cadmium, Chromium, and Cardiovascular Disease. *Circulation* 35:570-582.
- Schroeder, H. A. 1970. Air Quality Monographs. Monograph #70-15 Chromium. American Petroleum Institute, Washington, D.C.
- Schroeder, H. A. 1974. The Poisons Around Us: Toxic Metals in Food, Air, and Water. Indiana University Press.
- Schroeder, H. A., and J. J. Balassa. 1965. Abnormal Trace Metals in Man: Niobium. *J. Chron. Dis.* 18:229-241.
- Schroeder, H. A., and J. J. Balassa. 1966. Abnormal Trace Metals in Man: Arsenic. *J. Chron. Dis.* 19:85-106.
- Schroeder, H. A., and J. J. Balassa. 1966. Abnormal Trace Metals in Man: Zirconium. *J. Chron. Dis.* 19:573-586.
- Schroeder, H. A., and J. J. Balassa. 1967. Abnormal Trace Metals in Man: Germanium. *J. Chron. Dis.* 20:211-224.
- Schroeder, H. A., and J. J. Balassa. 1961. Abnormal Trace Metals in Man: Cadmium. *J. Chron. Dis.* 14(2):236-258.

- Schroeder, H. A., J. J. Balassa, F. S. Gibson, and S. N. Valanju. 1961. Abnormal Trace Metals in Man: Lead. J. Chron. Dis. 14(4): 408-425.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1962. Abnormal Trace Metals in Man - Chromium. J. Chron. Dis. 15:941-964.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1962. Abnormal Trace Metals in Man - Nickel. J. Chron. Dis. 15:51-65.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1963. Abnormal Trace Metals in Man - Vanadium. J. Chron. Dis. 16:1047-1071.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1963. Abnormal Trace Metals in Man: Titanium. J. Chron. Dis. 16:55-69.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1964. Abnormal Trace Metals in Man: Tin. J. Chron. Dis. 17:483-502.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1966. Essential Trace Metals in Man: Manganese. J. Chron. Dis. 19:545-571.
- Schroeder, H. A., J. Buckman, and J. J. Balassa. 1967. Abnormal Trace Elements in Man: Tellurium. J. Chron. Dis. 20:147-161.
- Schroeder, H. A., D. V. Frost, and J. J. Balassa. 1970. Essential Trace Metals in Man: Selenium. J. Chron. Dis. 23:227-243.
- Schroeder, H. A., and A. P. Nason. 1969. Trace Metals in Human Hair. J. Invest. Dermatol. 53(1):71-78.
- Schroeder, H. A., and A. P. Nason. 1971. Trace-Element Analysis in Clinical Chemistry. Clin. Chem. 17(6):461-474.
- Schroeder, H. A., A. P. Nason, and I. H. Tipton. 1967. Essential Trace Metals in Man: Cobalt. J. Chron. Dis. 20:869-890.
- Schroeder, H. A., A. P. Nason, and I. H. Tipton. 1969. Essential Metals in Man: Magnesium. J. Chron. Dis. 21:815-841.
- Schroeder, H. A., J. J. Balassa, and I. H. Tipton. 1970. Essential Trace Metals in Man: Molybdenum. J. Chron. Dis. 23:481-499.
- Schroeder, H. A., A. P. Nason, I. H. Tipton, and J. J. Balassa. 1966. Essential Trace Metals in Man: Copper. J. Chron. Dis. 19:1007-1034.
- Schroeder, H. A., A. P. Nason, I. H. Tipton, and J. J. Balassa. 1967. Essential Trace Metals in Man: Zinc. Relation to Environmental Cadmium. J. Chron. Dis. 20:179-210.

- Schroeder, H. A., and I. H. Tipton. 1968. The Human Body Burden of Lead. Arch. Environ. Health 17:965-978.
- Schroeder, H. A., I. H. Tipton, and A. P. Nason. 1972. Trace Metals in Man: Strontium and Barium. J. Chron. Dis. 25:491-517.
- Schulert, A. R. 1962. Strontium-90 in Alaska. Science 136:146-148.
- Searle, B., W. Chan, and B. Davidow. 1973. Determination of Lead in Blood and Urine by Anodic Stripping Voltammetry. Clin. Chem. 19(1): 76-80.
- Selby, L. A., K. W. Newell, G. A. Hauser, and G. Junker. 1969. Comparison of Chlorinated Hydrocarbon Pesticides in Maternal Blood and Placental Tissues. Environ. Res. 2:247-255.
- Selikoff, I. J., R. A. Bader, M. E. Bader, J. Churg, and E. C. Hammond. 1967. Asbestosis and Neoplasia. Am. J. Med. 42(4):487-496.
- Selikoff, I. J., W. J. Nicholson, and A. M. Langer. 1972. Asbestos Air Pollution. Arch. Environ. Health 25:1-12.
- Selikoff, I. J., and E. C. Hammond. 1968. III. Community Effects of Nonoccupational Environmental Asbestos Exposure. Am. J. Public Health 58(9):1658-1666.
- Sell, J. L., F. D. Deitz, and M. L. Buchanan. 1975. Concentration of Mercury in Animal Products and Soils of North Dakota. Arch. Environ. Contam. Toxicol. 3:278-288.
- Serat, W. F., M. K. Lee, A. J. Van Loon, D. C. Mengle, J. Ferguson, J. M. Burks, and T. R. Bender. 1977. DDT and DDE in the Blood and Diet of Eskimo Children from Hooper Bay, Alaska. Pestic. Monit. J. 11(1):1-4.
- Shafik, E. M. 1973. The Determination of Pentachlorophenol and Hexachlorophene in Human Adipose Tissue. Bull. Environ. Contam. Toxicol. 10(1):57-63.
- Shafik, T., D. E. Bradway, H. F. Enos, and A. R. Yobs. 1973. Human Exposure to Organophosphorus Pesticides. A Modified Procedure for the Gas-Liquid Chromatographic Analysis of Alkyl Phosphate Metabolites in Urine. J. Agr. Food Chem. 21(4):625-629.
- Shamberger, R. J., S. Tytko, J. W. Price, and C. E. Willis. 1971. Concentrations of Selenium in Blood of Normal and Cancer Patients. Clin. Chem. 17(7):643.

- Shamberger, R. J., E. Rukovena, A. K. Longfield, S. A. Tytko, S. Deodhar, and C. E. Willis. 1973. Antioxidants and Cancer. I. Selenium in the Blood of Normals and Cancer Patients. *J. Nat. Cancer Inst.* 50:863-870.
- Shamberger, R. J., and C. E. Willis. 1971. Selenium Distribution and Human Cancer Mortality. *CRC Crit. Rev. Clin. Lab. Sci.* 2:211-221.
- Shapiro, I. M., G. Mitchell, I. Davidson, and S. H. Katz. 1975. The Lead Content of Teeth. *Arch. Environ. Health* 30:483-486.
- Shapiro, I. M., H. L. Needleman, and O. C. Tuncay. 1972. The Lead Content of Human Deciduous and Permanent Teeth. *Environ. Res.* 5:467-470.
- Shearer, T. R., and D. M. Kadjimarkos. 1975. Geographic Distribution of Selenium in Human Milk. *Arch. Environ. Health* 30:230-233.
- Shen, Y. W., and D. R. Taves. 1974. Fluoride Concentrations in the Human Placenta and Maternal and Cord Blood. *Am. J. Obstet. Gynecol.* 119(2): 205-207.
- Shuman, M. S., A. W. Voors, and P. N. Gallagher. 1974. Contribution of Cigarette Smoking to Cadmium Accumulation in Man. *Bull. Environ. Contam. Toxicol.* 12(5):570-576.
- Silberger, I. 1972. Ultrastructural Identification of Mercury in Epidermis. *Arch. Environ. Health* 24:129-144.
- Silbergeld, E. K., and J. J. Chisolm, Jr. 1976. Lead Poisoning: Altered Urinary Catecholamine Metabolites, as Indicators of Intoxication in Mice and Children. *Science* 192:153-155.
- Simpson, W. J., and J. Tuba. 1968. An Investigation of Fluoride Concentration in the Milk of Nursing Mothers. *J. Oral Med.* 23:104-106.
- Singer, L., and W. D. Armstrong. 1959. Determination of Fluoride in Blood Serum. *Anal. Chem.* 31:105-109.
- Singer, L., and W. D. Armstrong. 1960. Regulation of Human Plasma Fluoride Concentration. *J. Appl. Physiol.* 15:508-510.
- Singer, L., and W. D. Armstrong. 1962. Comparison of Fluoride Contents of Human Dental and Skeletal Tissues. *J. Dent. Res.* 41:154-157.
- Singer, L., and W. D. Armstrong. 1969. Total Fluoride Content of Human Serum. *Arch. Oral Biol.* 14:1343-1347.
- Singh, N. P., J. D. Bogden, and M. M. Joselow. 1975. Distribution of Thallium and Lead in Children's Blood. *Arch. Environ. Health* 30(11): 557-558.

Smith, F. A. 1966. Metabolism of Inorganic Fluoride. In: Pharmacology of Fluorides, Part 1, F. A. Smith (ed.), Springer-Verlag, New York, pp. 103-141.

Smith, F. A., and D. E. Gardner. 1955. The Determination of Fluoride in Urine. Amer. Ind. Hyg. Assoc. J. 16:215-220.

Smith, F. A., D. E. Gardner, N. C. Leone, and H. C. Hodge. 1960. The Effects of the Absorption of Fluoride. Arch. Ind. Health 21:330-332.

Smith, F. A., and H. C. Hodge. 1959. Fluoride Toxicity. In: Fluoride and Dental Health. The Pharmacology and Toxicology of Fluoride, J. C. Muhler and M. K. Hine (eds.), Indiana University Press, Bloomington, Indiana, pp. 11-37.

Smith, P. J., D. M. Nelson, and R. E. Stewart. 1976. Lead Poisoning Among Migrant Children in New York State. Am. J. Public Health 66(4): 383-384.

Smith, R. G. 1975. Discussion of a Justification for NIOSH Recommended Biological Limits. J. Occup. Med. 17(2):97-99.

Smith, T. J., A. R. Temple, and J. C. Reading. 1976. Cadmium, Lead, and Copper Blood Levels in Normal Children. Clin. Toxicol. 9(1):75-87.

Somers, E., and D. M. Smith. 1971. Source and Occurrence of Environmental Contaminants. Food Cosmet. Toxicol. 9:185-193.

Sorenson, J.R.J., E. G. Melby, P. J. Nord, and H. G. Petering. 1947. Interferences in the Determination of Metallic Elements in Human Hair. Arch. Environ. Health 27(1):36-39.

Sorrell, M., J. F. Rosen, and M. Roginsky. 1977. Interactions of Lead, Calcium, Vitamin D, and Nutrition in Lead-Burdened Children. Arch. Environ. Health 32(4):160-164.

Sovocool, G. W., and R. G. Lewis. 1975. The Identification of Trace Levels of Organic Pollutants in Human Tissues: Compounds Related to Chlordane/Heptachlor Exposure. In: Trace Substances in Environmental Health-IX, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 265-280.

Sowden, E. M. 1958. Trace Elements in Human Tissue. 3. Strontium and Barium in Non-Skeletal Tissues. Biochem. J. 70:712.

Sowden, E. M., and S. R. Stich. 1957. Trace Elements in Human Tissue. 2. Estimation of the Concentrations of Stable Strontium and Barium in Human Bone. Biochem. J. 67:104-109.

Speizer, F. E., and B. G. Ferris, Jr. 1973. Exposure to Automobile Exhaust. Arch. Environ. Health 26:313-318.

- Spencer, H., I. Lewin, J. Fowler, and J. Samachson. 1969. Effect of Sodium Fluoride on Calcium Absorption and Balances in Man. *Am. J. Clin. Nutr.* 22(4):381-390.
- Spencer, H., I. Lewin, E. Wistrowski, and J. Samachson. 1970. Fluoride Metabolism in Man. *Am. J. Med.* 49:807-813.
- Spyker, J. M. 1975. Assessing the Impact of Low Level Chemicals on Development: Behavioral and Latent Effects. *Fed. Proc. Fed. Am. Soc. Exp. Biol.* 34(9):1835-1844.
- Stein, P. C., E. E. Campbell, W. D. Moss, and P. Trujillo. 1974. Mercury in Man. *Arch. Environ. Health* 29:25-27.
- Stein, V. C., and K. A. Pittman. 1976. Gas-Liquid Chromatographic Determination of Azinphos Ethyl in Human Plasma and in Mouse Plasma, Tissue, and Fat. *J. Assoc. Off. Anal. Chem.* 59(5):1094-1096.
- Steinfeld, J. L., and R. E. Novick. 1971. Medical Aspects of Childhood Lead Poisoning. *HSMHA Health Rep.* 86(2):140-143.
- Stepnick, R. J., T. M. Nakata, and I. Zipkin. 1975. The Effects of Age and Fluoride Exposure on Fluoride, Citrate and Carbonate Content of Human Cementum. *J. Periodontol* 46:45-50.
- Sterner, J. H., and V. Lidfeldt. 1941. The Selenium Content of "Normal" Urine. *J. Pharmacol. Exp. Ther.* 73:205-211.
- Strain, W. H., W. J. Pories, A. Flynn, and O. A. Hill, Jr. 1971. Trace Element Nutriture and Metabolism Through Head Hair Analysis. In: *Trace Substances in Environmental Health-V*, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 383-397.
- Strain, W. H., L. T. Steadman, C. A. Lankau, Jr., W. P. Berliner, and W. J. Pories. 1966. Analysis of Zinc Levels in Hair for the Diagnosis of Zinc Deficiency in Man. *J. Lab. Clin. Med.* 68:244-249.
- Strassman, S. C., and F. W. Kutz. 1977. Insecticide Residues in Human Milk from Arkansas and Mississippi, 1973-74. *Pestic. Monit. J.* 10(4): 130-133.
- Strehlow, C. D., and T. J. Kneip. 1969. The Distribution of Lead and Zinc in the Human Skeleton. *Am. Ind. Hyg. Assoc. J.* 30:372.
- Stringer, C. A., Jr., R. A. Zingaro, B. Creech, and F. L. Kolar. 1974. Lead Concentrations in Human Lung Samples. *Arch. Environ. Health* 29:268-270.
- Subryan, V. L., C. C. Solomons, S. G. Gordon, K. H. Neldner, and E. B. Reeve. 1975. A Micromethod for the Quantitative Analysis of Calcium, Magnesium, and Phosphorus in Human Skin. *J. Lab. Clin. Med.* 86(6): 1056-1060.

Sunderman, F. W., Jr., S. Nomoto, and M. Nechay. 1970. Nickel Metabolism in Myocardial Infarction: II. Measurements of Nickel in Human Tissues. In: Trace Substances in Environmental Health-IV, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 352-356.

Syversen, T.L.M. 1975. Cadmium-Binding in Human Liver and Kidney. Arch. Environ. Health 30:158-161.

Taves, D. R. 1966. Normal Human Serum Fluoride Concentrations. Nature 211:192-193.

Taves D. R., W. S. Grey, and W. S. Brey, Jr. 1976. Organic Fluoride in Human Plasma: Its Distribution and Partial Identification. In: Abstracts of Papers Society of Toxicology Fifteenth Annual Meeting, March 1976, Atlanta, Georgia, No. 69.

Tears, R. J., B. A. Barnes, J. G. Batsakis, and D. M. Bloch. 1977. Serum Magnesium: A Cap Survey - 1975. Am. J. Clin. Pathol 68(1 Suppl.): 159-161.

Tepper, L. B. 1972. Beryllium. CRC Crit. Rev. Toxicol. 2:235-259.

Tessmer, C. F., W. Krohn, D. Johnston, F. B. Thomas, M. Hrgovcic, and B. Brown. 1973. Serum Copper in Children (6-12 Years Old): An Age-correction Factor. Am. J. Clin. Pathol. 60(6):870-876.

Thomas, C. W., J. L. Rising, and J. K. Moore. 1976. Blood Lead Concentrations of Children and Dogs from 83 Illinois Families. J. Am. Vet. Med. Assoc. 169(11):1237-1240.

Thomas, H. V., B. K. Milmore, G. A. Heidbreder, and B. A. Kogan. 1967. Blood Lead of Persons Living Near Freeways. Arch. Environ. Health 15:695-702.

Thomson, J. G., and W. M. Graves. 1966. Asbestos as an Urban Air Contaminant. Arch. Pathol. 81:458-464.

Tietz, N. W., E. F. Hirsch, and B. Neyman. 1957. Spectrographic Study of Trace Elements in Cancerous and Noncancerous Human Tissues. J. Am. Med. Assoc. 165(17):2187-2192.

Tillery, J. B., and D. E. Johnson. 1975. Determination of Platinum, Palladium, and Lead in Biological Samples by Atomic Absorption Spectrophotometry. Environ. Health Perspect. 12:19-26.

Tinker, J. 1971. Measuring the Elements in Man. New Sci. Sci. J. September 30, 1971.

Tipton, I. H. 1952. Spectrographic Analysis of Trace Elements in Human Tissues. Phys. Rev. 87:179.

- Tipton, I. H. 1956. Spectrographic Procedure for Analysis of Human Tissue.
- Tipton, I. H. 1960. Summary of Program for Spectrographic Analysis of Trace Elements.
- Tipton, I. H. 1969. Stable Element Metabolism: Elemental Composition of Total Body and Certain Tissues. Oak Ridge National Laboratory, Oak Ridge, Tenn. Report ORNL-4446, pp. 299-305.
- Tipton, I. H., and M. J. Cook. 1963. Trace Elements in Human Tissue Part II. Adult Subjects from the United States. Health Phys. 9:103-145.
- Tipton, I. H., M. J. Cook, R. L. Steiner, C. A. Boye, H. M. Perry, Jr., and H. A. Schroeder. 1963. Trace Elements in Human Tissue: Part I. Methods. Health Phys. 9:89-101.
- Tipton, I. H., W. D. Foland, F. C. Bobb, and W. C. McCorkle. 1953. Spectrographic Analysis of Human Tissue. Phys. Rev. 91:214.
- Tipton, I. H., J. C. Johns, and M. Boyd. 1968. The Variation with Age of Elemental Concentrations in Human Tissue. Proceedings of the First International Congress of Radiation Protection, Rome, Italy, September 5-10, 1966. Pergamon Press-Oxford & New York, pp. 759-767.
- Tipton, I. H., and J. J. Shafer. 1964. Statistical Analysis of Lung Trace Element Levels. Arch. Environ. Health 8:58-67.
- Tipton, I. H., and P. L. Stewart. 1969. Analytical Methods for the Determination of Trace Elements-Standard Man Studies. In: Trace Substances in Environmental Health-III, D. D. Hemphill, ed. University of Missouri, Columbia, Mo. pp. 305-330.
- Tipton, I. H., P. L. Stewart, and J. Dickson. 1969. Patterns of Elemental Excretion in Long Term Balance Studies. Health Phys. 16:455-462.
- Tipton, I. H., P. L. Stewart, and P. G. Martin. 1966. Trace Elements in Diets and Excreta. Health Phys. 12:1683-1689.
- Tocci, P. M., J. B. Mann, J. E. Davies, and W. F. Edmundson. 1969. Biochemical Differences Found in Persons Chronically Exposed to High Levels of Pesticides. Ind. Med. 38(6):40-46.
- Ullucci, P. A., and J. Y. Hwang. 1974. Determination of Cadmium in Biological Materials by Atomic Absorption. Talanta 21:745-750.
- Ulmer, D. D. 1973. Metals - from Privation to Pollution. Fed. Proc. Fed. Am. Soc. Exp. Biol. 32(7):1758-1762.

Urone, P. F., and H. K. Anders. 1950. Determination of Small Amounts of Chromium in Human Blood, Tissues, and Urine. *Anal. Chem.* 22(10): 1317-1321.

Utidge, M. D., P. Gross, and R.T.P. deTreville. 1968. Ferruginous Bodies in Human Lungs. *Arch. Environ. Health* 17:327-333.

Vallee, B. L., W.E.C. Wacker, A. F. Bartholomay, and F. L. Hoch. 1957. Zinc Metabolism in Hepatic Dysfunction. II. Correlation of Metabolic Patterns with Biochemical Findings. *N. Eng. J. Med.* 257(22):1055-1065.

Voors, A. W., and M. S. Shuman. 1977. Liver Cadmium Levels in North Carolina Residents Who Died of Heart Disease. *Bull. Environ. Contam. Toxicol.* 17(6):692-696.

Wagner, S. L., and P. Weswig. 1974. Arsenic in Blood and Urine of Forest Workers. *Arch. Environ. Health* 28:77-79.

Waldbott, G. L. 1966. Fluoride and Calcium Levels in the Aorta. *Experientia* XXII(12):835-837.

Warnick, S. L. 1972. Organochlorine Pesticide Levels in Human Serum and Adipose Tissue, Utah - Fiscal Years 1967-71. *Pestic. Monit. J.* 6(1):9-13.

Warnick, S. L., and J. D. Eldredge. 1972. Human and Environmental Exposure to Pesticides in Utah. *Proc. Utah Acad. Sci. Arts Lett.* 49(1):11-20.

Watson, M., W. W. Benson, and J. Gabica. 1970. Serum Organochlorine Pesticide Levels in People in Southern Idaho. *Pestic. Monit. J.* 4(2): 47-50.

Watson, M., B. Pharaoh, J. Gabica, and W. W. Benson. 1973. A Note on Serum p,p'-DDE and p,p'-DDT Residues in Persons Taking Sustained Oral Doses of Vitamin B₆. *Bull. Environ. Contam. Toxicol.* 10(2):65-69.

Weaver, J. C., L. Kamm, and R. L. Dooson. 1960. Excretion of Radioiodine in Human Milk. *J. Am. Med. Assoc.* 173(8):92-95.

Wedeer, R. P., J. K. Maesaka, B. Weiner, G. A. Lipat, M. M. Lyons, L. F. Vitale, and M. M. Joselow. 1975. Occupational Lead Nephropathy. *Am. J. Med.* 59:630-641.

Wessel, M. A., and A. Dominski. 1977. Our Children's Daily Lead. *Am. Sci.* 65(3):294-298.

West, I. 1964. Pesticides as Contaminants. *Arch. Environ. Health* 9:626-633.

- West, R. W., D. J. Wilson, and W. Schaffner. 1975. Hexachlorophene Concentrations in Human Milk. *Bull. Environ. Contam. Toxicol.* 13(2):167-169.
- Whanger, P. D., P. H. Weswig, and J. C. Stoner. 1977. Arsenic Levels in Oregon Waters. *Environ. Health Perspect.* 19:139-143.
- Wood, O. L. 1969. Comparison of Naturally Occurring Rubidium and Potassium in Human Erythrocytes, Plasma and Urine. *Health Phys.* 17:513-514.
- Wood, O. L. 1970. Determination of Rubidium in Human Erythrocytes, Plasma, and Urine by Atomic Absorption Spectrometry. *Biochem. Med.* 3:458-464.
- World Health Organization. 1976. Polychlorinated Biphenyls and Terphenyls. *Environmental Health Criteria* 2. Geneva, 1976.
- Wyllie, J., J. Gabica, and W. W. Benson. 1972. Comparative Organochlorine Pesticide Residues in Serum and Biopsied Lipoid Tissue: A Survey of 200 Persons in Southern Idaho - 1970. *Pestic. Monit. J.* 6(2):84-88.
- Wysowski, D. K., P. J. Landrigan, S. W. Ferguson, R. E. Fontaine, T. A. Tsongas, and B. Porter. 1978. Cadmium Exposure in a Community Near a Smelter. *Am. J. Epidemiol.* 107(1):27-35.
- Yobs, A. R. 1967. Criteria for Monitoring Pesticides in People Include High- and Low-Exposure Conditions, Age, Sex Differences. *Pestic. Monit. J.* 1(1):6-7.
- Yobs, A. R. 1971. The National Human Monitoring Program for Pesticides. *Pestic. Monit. J.* 5(1):44-46.
- Yoon, S. H., F. Brudevold, F. A. Smith, D. E. Gardner, and N. Soni. 1960. Distribution of Fluorine in Teeth and Alveolar Bone. *J. Am. Dent. Assoc.* 61:565-570.
- Yudkin, E. P., J. Czerniejewski, J. R. Blayney, and W. G. Zoller. 1954. Evanston Dental Caries Study. XIII. Preliminary Report on Comparative Fluorine Retention in Human Tissue. *J. Dent. Res.* 33(5):691-692.
- Yurachek, J. P., G. G. Clemena, and W. W. Harrison. 1969. Analysis of Human Hair by Spark Source Mass Spectrometry. *Anal. Chem.* 41:1666-1668.
- Zavon, M. R. 1963. Pesticide Residues. *Am. J. Public Health* 53:1437-1438.
- Zingaro, R. A., and W. C. Cooper (eds.). 1974. Selenium. Van Nostrand Reinhold Company, New York, pp. 658-700.
- Zipkin, I. 1960. The Effects of the Absorption of Fluoride. IV. The Deposition of Fluoride in Human Skeletal Tissues as Related to Fluoride in Drinking Water. *Arch. Ind. Health* 21:329.

Zipkin, I. 1970. Effects on the Skeleton of Man. In: Fluorides in Human Health, World Health Organization, Geneva, pp. 185-186.

Zipkin, I., R. C. Likins, F. J. McClure, and A. C. Steere. 1956. Urinary Fluoride Levels Associated with Use of Fluoridated Waters. Public Health Rep. 71(8):767-772.

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