

# Liver Cadmium Levels in North Carolina Residents Who Died of Heart Disease\*

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SCHROEDER (1966) and CARROLL (1966) have suggested that abnormal levels of cadmium may be causative in heart failure and death. HAWLEY and KOPP (1975) induced bradycardia and an increase in the PR interval of the electrocardiogram by administering cadmium to rats in dosages bracketing the ranges for cadmium found in human blood. By means of autopsy studies the hypothesis that cadmium exposure is associated with cardiac arrest, may be tested effectively.

Cadmium accumulates in the liver and kidney. Because its concentration in the kidney rises till age 50 and then decreases, whereas its concentration in the liver remains more constant after age 30, liver concentrations may be a more consistent index of past exposure to cadmium than kidney concentrations (FRIBERG et al., 1971).

## MATERIALS AND METHODS

We examined a North Carolina autopsy population by atomic absorption spectrometry after dry ashing, under low temperature, for a number of trace metals in various organs, as described elsewhere (VOORS et al., 1975). Deaths resulting from heart disease were ascertained from routine autopsy summary sheets. In view of the relation between cadmium concentration in the liver and age, all decedents below the age of 30 were excluded from the calculations. From an original population of 106 autopsies, we found 90 cases applicable to our study.

## RESULTS

Table 1 lists the diagnoses for the 28 patients of age 30 and over who died of heart disease. The relationship between death from heart disease and

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cadmium concentration in the liver is shown in Figure 1. The geometric mean level of cadmium in the liver was 288 ppm ash weight for those who died of heart disease and 139 ppm for the others. This difference is significant at the 0.0005 level (N = 86; 4 cases had missing data).

TABLE 1

Heart-related death causes by liver cadmium level, N.C. autopsy study for patients aged 30 and over, 1971

<u>Description of Cause</u>	<u>Cd in Liver (ppm ash)</u>
Myocardial infarction (MI)	1720
Atherosclerosis, renal infarction, MI	684
Congestive heart failure, obstructive lung disease	605
Cardiac arrest, surgery for mitral valve replacement	460
Cardiac arrest, hypertension, arteriolar nephrosclerosis	449
Acute coronary insufficiency	391
MI	390
Renal failure due to arterionephrosclerosis, cardiomyopathy	375
MI	368
Bacteremia and myocarditis, cardiorenal atherosclerosis	353
Atherosclerotic heart disease, cardiac arrest, aortic aneurysma	350
MI	282
Coronary thrombosis, aortic aneurysma	281
Congestive heart failure due to severe kyphoscoliosis	279
Arteriosclerotic occlusion of the iliac arteries, diabetes mellitus, congestive heart failure	273
MI	273
Cardiac arrest, obstructive lung disease	265
Ventricular fibrillation, surgery for aortic stenosis	247
MI, diabetes mellitus	236
Cerebral infarction, MI	224
Thrombi, myocardial insufficiency, lung-tbc	214
Acute coronary insufficiency	181
MI, pulmonary congestion, fatty liver	147
Postoperative cholecystitis, congestive heart failure	111
Atherosclerotic coronary insufficiency	92
Cerebral infarction, MI	71
Pulmonary thromboembolic disease, cor pulmonale	unkwn
Bronchopneumonia, MI, fatty liver	unkwn

## DISCUSSION

Our finding of an association between cadmium level in the liver and death from heart disease contrasts with the finding of TIPTON (1960), who studied a different population and found no similar association.

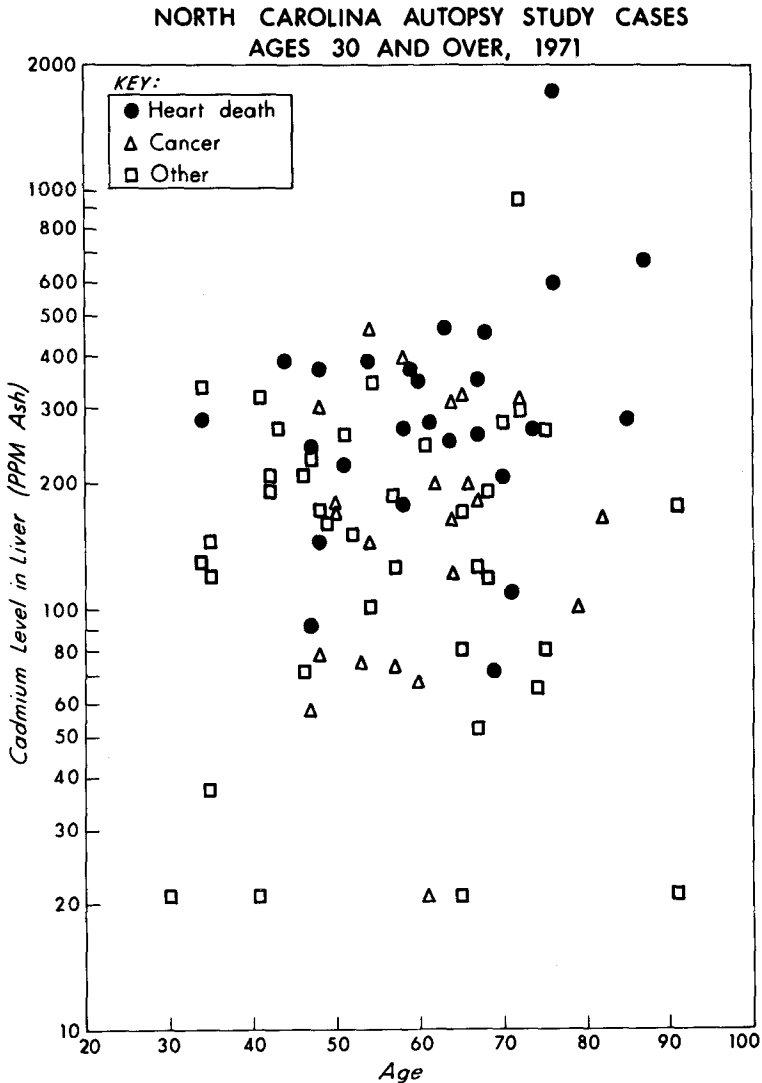


Figure 1. Cadmium concentrations in the liver, by age and by cause of death. N.C. autopsy study for patients aged 30 and over, 1971.

Soft water overnight stagnating may dissolve cadmium from the water pipes (SCHROEDER et al., 1967; STRAIN et al., 1975). Softness of the local water supply is associated with sudden death and ischemic heart disease (ANDERSON et al., 1969; PETERSON et al., 1970).

One may ask whether our correlation between death from heart disease and liver cadmium level cannot be attributed to cigarette smoking, because cigarettes seem to be a major source of the body cadmium burden (LEWIS et al., 1972; SHUMAN et al., 1974). A questionnaire on the decedents' smoking habits was answered by relatives of 59 out of 86 deceased persons. Results are given in Table 2. No association was noted between reported cigarette smoking and death from heart disease or between smoking and cadmium liver concentration. Hence, cigarette smoking is an unlikely explanation for our observed correlation.

TABLE 2

Liver cadmium concentration (ppm ash\*) by smoking habit  
N.C. autopsy study, persons aged 30 and over, 1971

Cause of Death	Daily Packs Smoked the Last 5 Years						Total
	0	<½†	½	1	1½	2+	
Heart	312 (4)‡	208 (5)	214 (1)	337 (5)	317 (2)	--- (0)	277 (17)
Other	134 (16)	108 (9)	146 (4)	180 (9)	170 (1)	169 (3)	145 (42)
Total	169 (20)	138 (14)	157 (5)	225 (14)	258 (3)	169 (3)	175 (59)

\* Geometric means.

† Including ex-smokers and light non-cigarette smokers.

‡ Number of observations in parentheses.

## SUMMARY

Using data from an autopsy series, we found a strong positive correlation between liver concentration of cadmium and death from heart disease. In view of recent experiments reported in the literature, the possibility that a low level of cadmium has a toxic effect on the cardiac conduction system is supported.

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