# GROWTH AND CONDITION COMPARISONS OF WHITE CRAPPIE IN TWO SIMILAR LARGE RESERVOIRS

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## ABSTRACT

The status of the white crappie *(Pomoxis annularis)* populations of Kentucky and Barkley lakes was investigated through the determination of age structure, growth rate, and length-weight relationships. During 1982, 525 fish from Kentucky Lake and 324 from Lake Barkley were assigned to age groups, lengths at previous ages were back calculated, and relative weight condition values were calculated. White crappie from both lakes had similar overall growth rates and condition values. Compared to other reservoirs in the region and at similar latitude, the growth rates of the white crappie in Kentucky and Barkley lakes were intermediate, but these populations were composed of higher percentages of older individuals. The status of the Kentucky Lake white crapie population in 1982 was not noticeably changed from that in 1953. No previous white crappie data on Lake Barkley were available for comparison.

## INTRODUCTION

Kentucky Lake and Lake Barkley are parallel mainstream reservoirs located in western Kentucky and Tennessee (Fig. 1). Kentucky Lake, a 64,064-ha reservoir of the Tennessee River, was completed in 1944 by the U.S. Tennessee Valley Authority. Lake Barkley, a 23,440-ha reservoir of the Cumberland River, was completed in 1966 by the U.S. Army Corps of Engineers. The two reservoirs are connected by a 1.6-km canal located at the northern end of TVA's Land Between the Lakes and even though they differ in age by 20 years, are characteristically more similar than not.

Kentucky and Barkley Lakes are known among anglers as excellent white crappie *(Pomoxis annularis)* reservoirs. White crappie comprise approximately 50% of the total fish harvest by weight from both lakes (McLemore 1981). Every spring during white crappie nesting and spawning, the tourist trade increases during a period of excellent fishing known as the "crappie run". Thus, the white crappie populations of these two lakes are important to the lake fisheries and are economically important to the surrounding area.

In recent years, anglers have suggested that the quality of the white crappie populations of Kentucky and Barkley lakes has declined and that a population disparity has developed between the two lakes (i.e., Lake Barkley white crappie are generally smaller according to anglers). This angler dissatisfaction was of concern to fishery biologists, but because of a paucity of data, it was impossible to address the anglers' assertions. No data existed from a comprehensive aging study on Lake Barkley white crappie and Carter (1953) conducted the only known study on Kentucky Lake. Therefore, the impetus for this study was provided by the lack of information from Lake Barkley, the 30-year lapse since the Kentucky Lake study, and the implication from anglers of a reduction in the quality of the white crappie fisheries in both lakes.

We sought to provide a scientific framework for addressing questions concerning the white crappie populations in Kentucky and Barkley lakes. The objectives of our study were: (1) to determine differences in growth rates, age structures, and relative weight condition values between the white crappie populations of the two reservoirs; (2) to relate the growth indices of these populations to white crappie in other lakes of similar latitudes; and (3) to determine differences in Kentucky Lake white crappie growth rates and age structure between 1953 and 1982.

## METHODS

We sampled Kentucky Lake in April and May 1982. Fish were collected by two methods, shoreline electrofishing and angler harvest (Parrish et al. 1985). Data were collected from angler creels before processing at fish cleaning stations located on Jonathan Creek, Ledbetter Creek, and the Big Sandy embayments. Electrofishing locations were within the area between Jonathan Creek embayment at TRK (Tennessee River Kilometer) 62 and the Big Sandy embayment at TRK 109.4. Extensive electrofishing was conducted in Blood River embayment at TRK 83.7. All Lake Barkley sampling was done in March and April 1982. Fish were collected by electrofishing or angling from Taylor Bay at CRK (Cumberland River Kilometer) 90.6 to Dry Creek embayment at CRK 118. Although the reservoirs are connected by a canal, samples were taken a minimum distance of 64.4 km apart between lakes. Sampling locations of both reservoirs are given (Figure 1).

Total length (mm), weight (g), sex, and location were recorded for each fish, and scale samples were taken. When possible, females were classifed by ovary condition (gravid, ripe, or spent). The Fraser-Lee formula was used to determine growth rates by back-calculation after each fish was assigned to an age group from scale analysis (Bagenal and Tesch 1978). Because the sample size of young fish was inadequate to determine an accurate intercept of the body:scale relationship, the standard intercept of 35 mm for white crappie was used (Carlander 1982). Relative weight condition values ($Wr=W/Ws \times 100$), were calculated for all fish with the standard weight (Ws) equation developed for white crappie (Wege in Anderson 1980): $\log Ws=-5.102 + 3.112 \log L$, where L=total length in millimeters and Ws=standard weight in grams. This formula was developed from the extensive summary of length-weight data of Carlander (1977). Statistical procedures were performed with Statistical Analysis System (SAS) computer programs (Helwig and Council 1979).

## RESULTS

A large percentage of the white crappie age 2 or older were ages 3 and 4, 37% in Kentucky Lake and 47% in Lake Barkley. In both lakes, the length at capture was the same as the calculated length of the last annulus because the fish were in the process of forming annuli when collected. Absolute growth and incremental growth showed a similar pattern in both lakes (Figure 2). Ages 1 and 2 had approximately the same rate of growth in both lakes, but growth rates of ages 3, 4, and 5 (year-classes 1979, 1978, and 1977) were significantly different between lakes according to an analysis of variance of those three year-classes ($P < 0.05$).

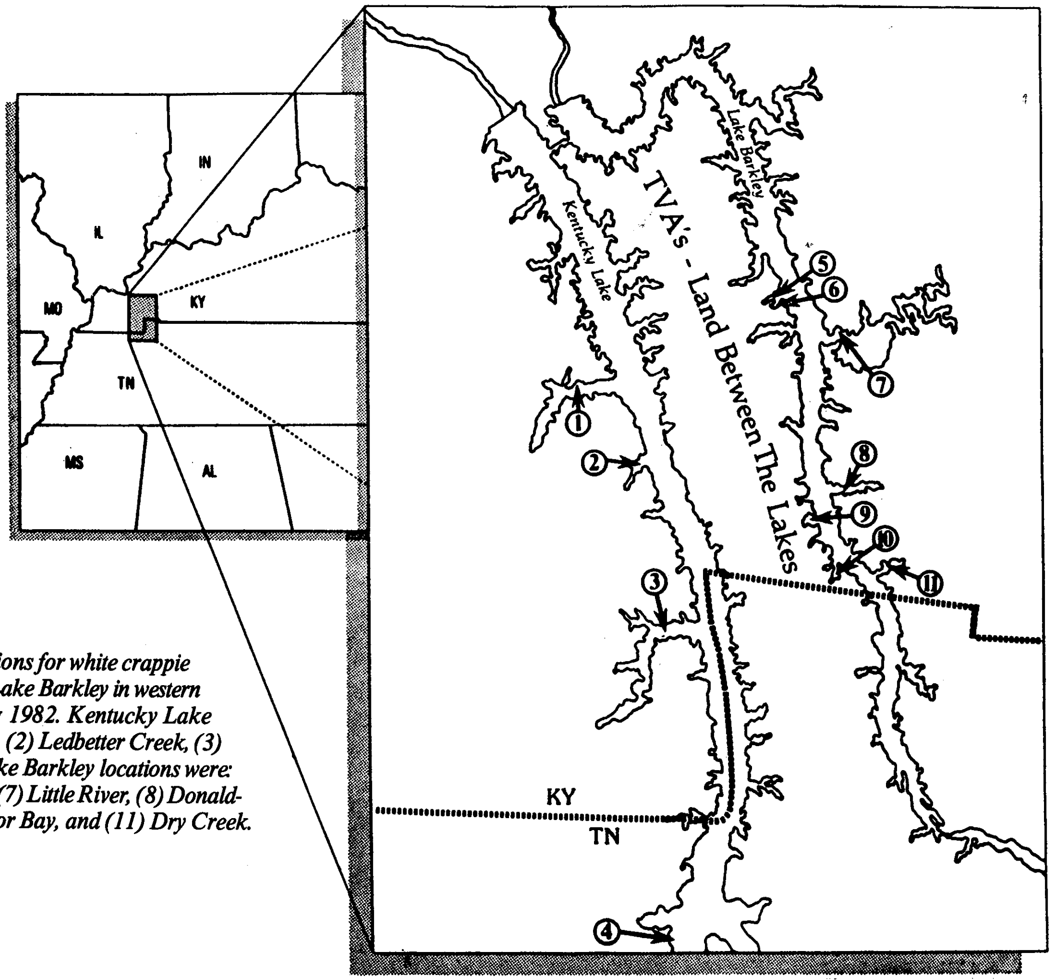


**FIGURE 1.** *Map of sampling locations for white crappie collected from Kentucky Lake and Lake Barkley in western Kentucky and Tennessee in spring 1982. Kentucky Lake locations were: (1) Jonathan Creek, (2) Ledbetter Creek, (3) Blood River, and (4) Big Sandy. Lake Barkley locations were: (5) Taylor Bay, (6) Jake Fork Bay, (7) Little River, (8) Donaldson Creek, (9) Fords Bay, (10) Prior Bay, and (11) Dry Creek.*

The growth rate of white crappie in Kentucky and Barkley lakes was compared to growth in other regional reservoirs: Cumberland Lake, KY; Dale Hollow Reservoir, TN; and Lake Wappapello, MO (Table 1). The calculated total lengths and incremental growths at each annulus indicated the white crappie growth rates in both Kentucky and Barkley lakes were moderate, but ages 4 and 5 had greater incremental growth in Kentucky and Barkley lakes than in Lake Wappapello, MO.

The age structure and growth pattern of Kentucky Lake white crappie reported by Carter (1953) was compared to the pattern found in this study. Of fish age 2 or older, 30% were ages 4 and 5 in 1953. Even though the early age groups showed better growth in 1953, by age 5 growth was greater in 1982. The 1953 study showed greatest incremental growth at age 1 (117 mm), then decreased rapidly each succeeding year. In the present study age 2 showed the greatest incremental growth, with smaller decreases in incremental growth each year.

Slopes of the length-weight relationships were significantly different ($P \leq 0.05$). The Lake Barkley white crappie were heavier at most lengths. Relative weight (Wr) values of males and females were not different, so the sexes were combined unless otherwise noted. The range of white crappie Wr values was greater in Lake Barkley than in Kentucky Lake (Figure 3). Lake Barkley white crappie had the lower Wr values in the smaller fish and the higher Wr values in the larger fish. Wr values versus length in relation to ovary condition of 59 Kentucky Lake females and 63 Lake Barkley females were analyzed with the Duncans Multiple Range test. Spent females had significantly lower Wr values than ripe and gravid females in Kentucky Lake; in Lake Barkley, spent and ripe females had lower Wr values than the gravid females. Lake Barkley females of all categories had higher Wr values than the Kentucky Lake females.

**Table 1.** Comparison of white crappie growth in Kentucky and Barkley lakes with growth in other regional reservoirs.

| Location | N | Calculated total length (and increments) in mm at each annulus 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|---|
| Cumberland Lake, TN | 531 | 79 (79) | 157 (78) | 231 (74) | — | — | (Carter 1967) |
| Dale Hollow Reservoir, TN | 144 | 75 (75) | 172 (97) | 235 (63) | — | — | (Range 1972) |
| Kentucky Lake, KY | 925 | 117 (117) | 201 (84) | 264 (63) | 302 (38) | 325 (23) | (Carter 1953) |
| Kentucky Lake, KY | 525 | 75 (75) | 163 (88) | 234 (71) | 296 (62) | 343 (47) | (present study) |
| Lake Barkley, KY | 324 | 78 (78) | 164 (86) | 230 (66) | 280 (50) | 322 (42) | (present study) |
| Lake Wappapello, MO | 468 | 76 (76) | 178 (102) | 259 (81) | 297 (38) | 320 (23) | (Patriarche 1953) |

## DISCUSSION

Few differences in the white crappie populations of Kentucky and Barkley lakes were revealed by the age and growth comparisons. Age group distributions were approximately the same, absolute and incremental growth rates were similar, and the three-way ANOVA indicated only slight variations in the growth rates of year-classes in the two lakes.

Compared to other lakes in the region (Carlander 1977), the growth rates of the white crappie of Kentucky and Barkley lakes are moderate. However, because large numbers of ages 3, 4, and 5 year-old fish were collected from Kentucky and Barkley lakes, the age structures of these populations were better than those of some other reservoirs (Carlander 1977). In the 1950's, similar age structures were found in Illinois (Lewis 1950), Missouri (Patriarche 1953), and South Carolina (Stevens 1958); but have since become scarce. In most Missouri reservoirs, approximately 95% of the white crappie harvest are ages 2 and 3 with few fish reaching beyond age 3 (Mike Colvin, Missouri Department of Conservation, personal communication). Kentucky Lake and Lake Barkley are highly acclaimed for their quality white crappie fisheries and this may be because of the high percentage of fish of age-groups 4 and 5.

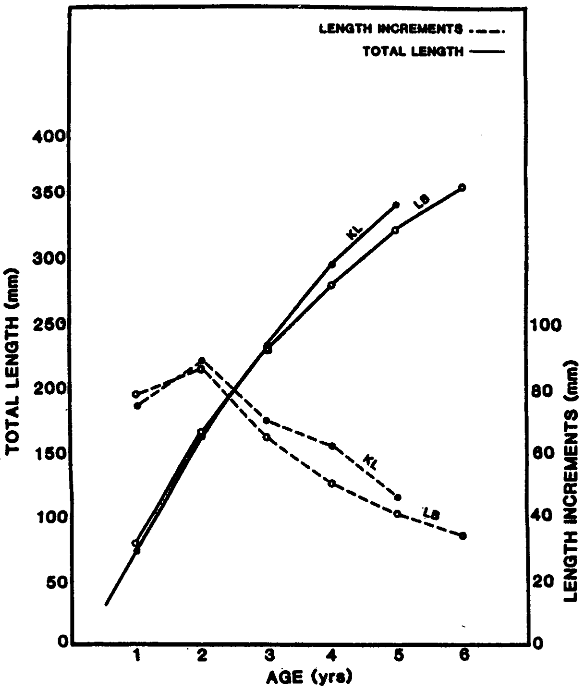


FIG. 2. *Absolute and incremental growth of white crappie of Kentucky (KL) and Barkley (LB) lakes collected in spring 1982.*

In comparing the two Kentucky Lake studies, the white crappie examined by Carter (1953) attained greater lengths much earlier than in 1982, but the white crappie in 1982 maintained greater incremental growth each year. Therefore, by ages 4 and 5 the total lengths achieved were similar. Fewer white crappie were ages 4 and 5 in 1953 than in 1982, but large numbers of age 3 fish were present indicating good age structure.

Whatever changes occurred in Kentucky Lake in the past 30 years and in Lake Barkley since 1966, the overall effect on white crappie growth indices has been minimal. We found no evidence that the aging of the reservoirs, increased angling pressure, or alterations in the prey bases have presented major problems for the crappie populations (i.e., stunted or depleted populations). Also, the differing ages of the reservoirs apparently produced no discernible differences between the populations. In light of recent work indicating that the nature of prey available to black and white crappie affects their growth and survivorship (Ellison 1984), future studies should investigate the conditions present in these lakes that contribute to high survival of older crappie.

A probable explanation for the differences in slopes of the length-weight relationship between the populations should be noted. The Lake Barkley white crappie were collected in March and April 1982 at their peak gonad development and the Kentucky Lake white crappie were collected during or after spawning in late April-early May. The different collecting times might account for the weight differences (Siefert 1969).

The effect of the weight of the gonads on the relative condition and its seasonal changes were demonstrated by Le Cren (1951). Spring samples from Kentucky and Barkley lakes were analyzed statistically to detect differences in Wr values as related to ovary condition. The differences might have been related to sampling time or total length. Ripe and spent females from Lake Barkley had essentially the same mean total length. The gravid and ripe females of Kentucky Lake did not have the same mean lengths, but their mean lengths were closer than the mean lengths of the ripe and the spent females.

Le Cren (1951) stated that the effect of length on comparisons of conditions of fish might be eliminated with a relative condition factor based upon an empirically derived length-weight relationship. Wege and Anderson (1978) developed relative weight (Wr) to overcome the length bias and other limitations associated with condition factors, such as gonad development and seasonal fluctuations coinciding with fat deposition. Even so, the results of this study indicated a difference in Wr values according to length; smaller fish had lower Wr values than larger fish. Either these fish are in poor condition as young adults or the standard weight equation contains an inherent bias possibly associated with the high degree of allometric growth exhibited by this species.

Our results show that angler perceptions are not always reliable indicators of the true status of a fishery. While angler opinion provides feedback on resource status and use, biological data are necessary for accurately evaluating the status of fish populations. This study provides initial information on white crappie in Kentucky and Barkley lakes and as stated previously, future research should attempt to identify the mechanisms responsible for high survival of older (ages 4 and 5) white crappie in these reservoirs.

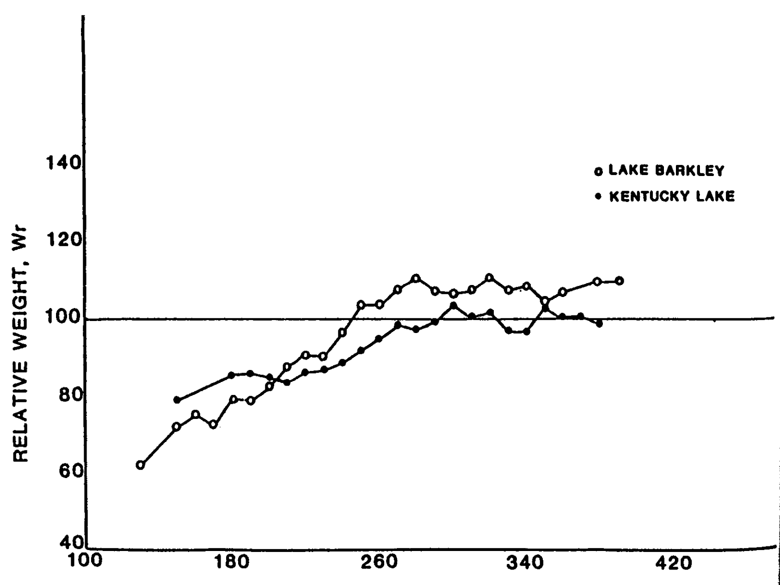


FIG. 3. *Average relative weight (Wr) values related to total lengths of white crappie of Kentucky and Barkley lakes sampled in spring 1982.*

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# CORONARY HEART DISEASE AND THE ZINC-TO-COPPER RATIO IN HUMAN AORTA AND DRINKING WATER

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ABSTRACT

Trace levels of zinc and copper have been determined in the aorta from individuals with known histories of coronary heart disease (experimental group) and from individuals without a history of heart disease (control group) or any condition with an alleged or known association with trace zinc and copper. Subjects for the experimental and control groups were matched in terms of age, sex, and race. The zinc-to-copper ratio in the aorta for the experimental group was found to be significantly higher than the zinc-to-copper ratio in the control group at the 90% level of confidence. The results suggest that an imbalance in the zinc-to-copper ratio is a risk factor in coronary artery disease. Data for trace elements in major water sources for different geographical areas of the United States from 1962-1967 were compiled and correlations with mortality rates for heart diseases from 1969-1971 were made. The results revealed that there was an extremely high correlation between the zinc-to-copper ratio in water and mortality rates of non-white females with coronary heart disease.

## INTRODUCTION

Cardiovascular diseases, principally coronary heart disease, constitute the leading cause of death in the United States (Braunwald, 1980).

Each year over 600,000 Americans succumb to coronary heart disease and over 200,000 die from atherothrombotic disease of major arterial vessels in other parts of the body (Vital Statistics, 1967). It has been estimated by the 1960-62 National Examination Survey that 3.1 million American adults had definite coronary heart disease and about 2.4 million had suspect coronary heart disease (Coronary Heart Disease, 1960-62).

Although the mortality rate from cardiovascular diseases had declined somewhat in the general population during the past decade, the alarming statistics still show that the death rate due to coronary heart disease is almost twice the rate for malignant neoplasms. Coronary heart disease accounts for over 30% of all deaths in the United States. In addition, statistics on hypertension in the general population do not paint a significantly brighter picture (Gillum, 1979, Messerli, 1979, Monthly Report, 1978).

Development of prevention and therapy strategies has been complicated by the fact that a number of factors have been associated with increased risk for coronary heart disease. Some of these factors include sucrose intake, fat intake, sedentary life style, water softness and low dietary fiber intake.

Some research has reported possible correlations among water hardness, trace metals, and the incidence mortality rates stemming from cardiovascular diseases (Chipperfield, 1979, Shaper, 1979, Borhani, 1981, Chipperfield, 1978). However, the single chemical factor that has been most closely linked to risk due to coronary heart disease is blood cholesterol. Elevation of serum cholesterol has been highly correlated with an increased incidence of clinical coronary heart disease (Fredrickson, 1972). Based on the Framingham study in which the efficacy of several serum lipids were investigated as predictors of coronary heart disease, cholesterol made the most significant independent contribution to risk (Kannel, 1964).

Klevay has presented data which showed that an increase in the zinc-to-copper ratio leads to hypercholesterolemia in rats (Klevay, 1973, 1975, 1980).

It has been postulated by some researchers that an imbalance in the zinc-to-copper ratio in humans may be associated with hypercholesterolemia and coronary heart disease.

This paper reports data which further support the hypothesis that there is a correlation between zinc-to-copper ratio in human aorta, drinking water and mortality of human subjects due to coronary heart disease.

## EXPERIMENTAL

### *Reagents*

Stock standard solutions of zine and copper were prepared from 99.8% zinc and 99.998% copper metals (K & K Laboratories, Incorporated, Plainview, New York). Working standards were prepared daily by serially diluting the stock standard solutions.

Ultrex grade nitric acid and hydrogen peroxide (J.T. Baker Company, Philipsburg, New Jersey) were used to digest aorta samples. Demineralized-distilled water was used throughout this study.

### *Instrumentation*

Diluted digestates of aorta samples were analyzed for copper by graphite furnance atomic absorption spectrophotometry using a Perkin-Elmer Model 503 Atomic Absorption Spectrophotometer equipped with a 2200 Graphite Furnance and a Deuterium Arc Background Corrector (Perkin-Elmer Corporation, Norwalk, Connecticut). Zinc was determined using an air-acetylene flame with a triple slot burner head. A hollow cathode lamp was used as a source for copper while an eletrodeless discharge lamp was the source for zinc.

### *Procedures*

Aorta samples were collected postmortem from two groups of human subjects: an experimental group consisting of individuals who had a history of coronary heart disease and a control group consisting of individuals without a history of coronary heart disease or any other disorder that has known or an alleged association with zinc and copper. Samples were collected with nonmetallic utensils and were frozen immediately or placed in formaldehyde for preservation. An aliquot of each batch of formalin was also analyzed for zinc and copper as a quality control measure. Each sample was dried at approximately 50°C for 72 hours, weighed to the nearest milligram and digested in a nitric acid/hydrogen peroxide mixture under reflux. The digestate was diluted to 100 ml with demineralized-distilled water and was placed under refrigeration until analyzed. A blank was refluxed prior to digesting each sample. All utensils and volumetric apparatus were leached in 3F reagent grade nitric acid for 24 hours and rinsed thoroughly with demineralized-distilled water. Quantitation was performed by using calibration curves and the method of standard additions. Standards were prepared by adding aliquots of stock standards to refluxed blanks. A computerized linear regression was conducted for each set of standard data to find the best straight line fit.

Trace metal concentrations in water were obtained from computer print-outs from local and state health departments, the United States Environmental Protection Agency and a comprehensive study by Kopp and Kroner (Kopp, 1967). Mortality data for coronary heart disease were collected, evaluated and compiled by interacting with vital statistics offices, hospitals, coroners, and pathologists. A DEC 11/70 Digital Computer (Digital Equipment Corporation, Maynard, MA) was used to form the data bank and conduct the correlation studies.

## RESULTS AND DISCUSSION

Data on zinc, copper and the zinc-to-copper ratio in human aorta for unmatched subjects are given in TABLE 1.

The mean values for zinc and copper are lower in the experimental group than in the control group. However, the zinc-to-copper ratio is considerably higher in the experimental group than in the control group.

**Table 1.** Comparison of Data from Aorta for Unmatched Subjects.

| Parameter | Experimental n=9 | Control n=12 |
|---|---|---|
| Zn | 13.0 ±4.0* | 26.1 ±6.5* |
| Cu | 0.81±0.30* | 2.59±0.61* |
| Zn/Cu | 16 | 10 |

*µg metal /g aorta

**Table 2.** Comparison of Data from Aorta for Matched Subjects.

| Group* | Age | Sex | Race** | Zn/Cu |
|---|---|---|---|---|
| E | 49 | M | B | 15.2 |
| C | 54 | M | B | 10.2 |
| E | 67 | M | W | 9.30 |
| C | 74 | M | W | 9.90 |
| E | 84 | F | B | 21.4 |
| C | 84 | F | B | 17.4 |
| E | 67 | M | W | 9.30 |
| C | 73 | M | W | 4.11 |
| E | 68 | F | B | 21.0 |
| C | 49 | F | B | 7.63 |

*E-Experimental, C-Control
**B-Black, W-White

Data from matched subjects are given in TABLE 2. Human subjects were matched in terms of age, sex, and race. The paired t-test on this data was conducted, giving a t(calculated)=2.33 and a t(tabulated)=2.13. Thus, the zinc-to-copper ratio in the aorta in the experimental group was found to be higher than this ratio in the control group at 90% level of confidence. Although the number of subjects is limited and further research needs to be conducted, the results support the hypothesis that an increased imbalance in the zinc-to-copper ratio may be a risk factor in coronary heart disease.

This correlation is somewhat supported through previous research conducted by Wester (Wester, 1978) who used myocardial tissue of accident victims and subjects who died from myocardial infarction. The amount of copper was lower in the experimental group than in the control group while no significant difference was found in zinc between the two groups. Therefore, it

**Table 3.** Geographic Divisions for Water Parameters Data Used to Generate Tables 4 & 5.

| Geographic Division | States |
|---|---|
| East South Central | Kentucky, Tennessee, Alabama, Mississippi |
| East North Central | Ohio, Indiana, Illinois, Michigan, Wisconsin |
| Middle Atlantic | New York, New Jersey, Pennsylvania |
| South Atlantic | Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida |
| West South | Arkansas, Louisiana, Oklahoma, Texas |
| New England | Maine, Vermont, Massachusetts, Rhode Island, Connecticut |
| Pacific | Washington, Oregon, Alaska, Hawaii, California |
| West North Central | Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas |
| Mountain | Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada |

is presumable that the zinc-to-copper ratio was higher for the victims of infarction than for the control group.

Data on water parameters were compiled from various geographic divisions of the country. A complete list of these divisions and the corresponding states are given in TABLE 3.

For other tables in this report the following symbols and groups are NWM-nonwhite males, NWF-nonwhite females, WM-white males, and WF-white females.

The matrix of the product-moment correlation coefficients between age-adjusted death rates for major cardiovascular disease of nonwhite males and females and concentrations of zinc, copper and the zinc-to-copper ratio in water are given in TABLE 4. There is a slightly positive correlation between the death rates and the water parameters, with the strongest correlation existing with zinc. It may be important to note that the correlation of death rate with the zinc-to-copper ratio for nonwhite males is practically equivalent to the correlation for nonwhite females.

The data in TABLE 5 give the matrix of the product-moment correlation coefficients for age-adjusted mortality rates per 100,000 population due to coronary heart disease by color and sex for geographic divisions in the United States, 1969-71, and the mean concentrations of zinc, copper, and the zinc-to-copper ratio in sources of drinking water. There is an extremely high correlation between the nonwhite female mortality rate from coronary heart disease and the zinc-to-copper ratio. This is a significant finding. The term "white" used in this report refers to white persons and individuals reported to be Mexican or Puerto Rican who by self identification indicated themselves as white. The term nonwhite includes Blacks, American Indians, Chinese and Japanese. Blacks comprised the greatest percentage of any single group in this category. Although this extremely high correlation exists for nonwhite female mortality rates due to coronary heart disease and the zinc-to-copper ratio, the authors are not at liberty to label the zinc-to-copper ratio intake as causal. It can only be stated that there is an association between the Zn/Cu parameter in water and the mortality rate. However, this finding provides "fertile" grounds for further investigations and study designs for hypothesis testing. A correlation or scatter plot of the raw data for this observation is given in Figure 1. It may be important also to notice that the lowest correlation between mortality rates for ischemic or coronary heart disease and the zinc-to-copper ratio exists for white females, while the correlations for white males and nonwhite males are practically equal.

**Table 4.** Matrix of Product-Moment Correlation Coefficients for Age-Adjusted Death Rates* for Major Cardiovascular Diseases in Non-Whites and Concentrations of Trace Zinc, Copper and the Zinc-to-Copper Ratio in Drinking Water.

| | NWM | NWF | Zn | Cu | Zn/Cu |
|---|---|---|---|---|---|
| NWM | 1.0000 | 0.8925 | 0.2399 | 0.1567 | 0.1654 |
| NWF | | 1.0000 | 0.2255 | 0.1484 | 0.1477 |
| Zn | | | 1.0000 | 0.1294 | 0.9402 |
| Cu | | | | 1.0000 | -0.2042 |
| Zn/Cu | | | | | 1.0000 |

*Per 100,000 Population (1969-71)

**Table 5.** Matrix of Product-Moment Correlation Coefficients for Age-Adjusted Death Rates* Due to Coronary Heart Disease and Concentrations of Trace Zinc, Copper and the Zinc-to-Copper Ratio in Drinking Water.

| | NWM | NWF | WM | WF | Zn | Cu | Zn/Cu |
|---|---|---|---|---|---|---|---|
| NWM | 1.0000 | 0.3407 | 0.9611 | 0.5587 | 0.2903 | 0.0846 | 0.2316 |
| NWF | | 1.0000 | 0.3019 | 0.2029 | 0.8510 | -0.1438 | 0.9053 |
| WM | | | 1.0000 | 0.6833 | 0.2955 | 0.0640 | 0.2368 |
| WF | | | | 1.0000 | 0.1800 | -0.0349 | 0.1628 |
| Zn | | | | | 1.0000 | 0.1294 | 0.9402 |
| Cu | | | | | | 1.0000 | -0.2042 |
| Zn/Cu | 0.2316 | 0.9053 | 0.2368 | 0.1628 | 0.9402 | -0.2042 | 1.0000 |

*Per 100,000 Population (1969-71)

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