

Malignant Melanoma and Drinking Water Contamination

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In Brevard County, Florida, there are three principal population centers (Figure 1) served by five medical facilities. One of these institutions reported potential clustering of malignant melanoma from 1975-77. Malignant melanoma was defined as new, primary melanomas, metastatic melanoma without known primary, but not metastatic lesions with known primary, or recurrent lesions. The specific community served by the reporting hospital is South Brevard County (pop. 63,011); 26 cases of melanoma were diagnosed in this population between 1975 and 1977. Seven of these cases formed the proposed cluster. Using two different statistical analyses (Pinkel-Nefzger 1959, Mantel 1967), no evidence of space time clustering could be demonstrated in the South Brevard area using the residence data provided for the three year experience.

In the process of the data analysis, one comparison criterion was national incidence rates from the Third National Cancer Survey (Cancer Incidence, 1974). The significance level of the analysis resulting from the national comparison was so striking as to raise a larger question: Is the entire melanoma experience of South Brevard County a cluster? Data gathered on 1979 melanoma cases from other hospitals in Brevard County (Table 1), suggested a north-south gradient of occurrence for melanoma. Environmental factors exhibiting a similar pattern were considered, as well as trihalomethane levels in municipal water supplies (Bridges 1978). Field studies were then performed and 36 water samples were taken throughout the county. Three blood samples to verify exposure were obtained.

METHODS

The cluster analyses of the data (1975-77) involved two statistical techniques (Pinkel and Nefzger 1959; Mantel 1967). The first approach was a modified chi-square test, "cell occupancy" technique, described by Pinkel and Nefzger (1959). Voter precincts were used as "cells" and the population partitioned accordingly. This method was employed twice, first with expected values based on the Third National Cancer Survey (Cancer Incidence, 1974), and secondly by distributing the observed cases using population proportions. The second technique, "an interval approach", an enhancement of the Knox model by Mantel (1967), involved defining spatial and temporal thresholds and then assessing "closeness" for each attribute for each case. The thresholds selected for the analysis were based on the reported cluster (7 cases); spatial threshold, 1 kilometer-temporal threshold, 1 month. The latter technique Mantel (1967) is somewhat more sensitive due to its uniform regard for cases beyond a certain threshold and

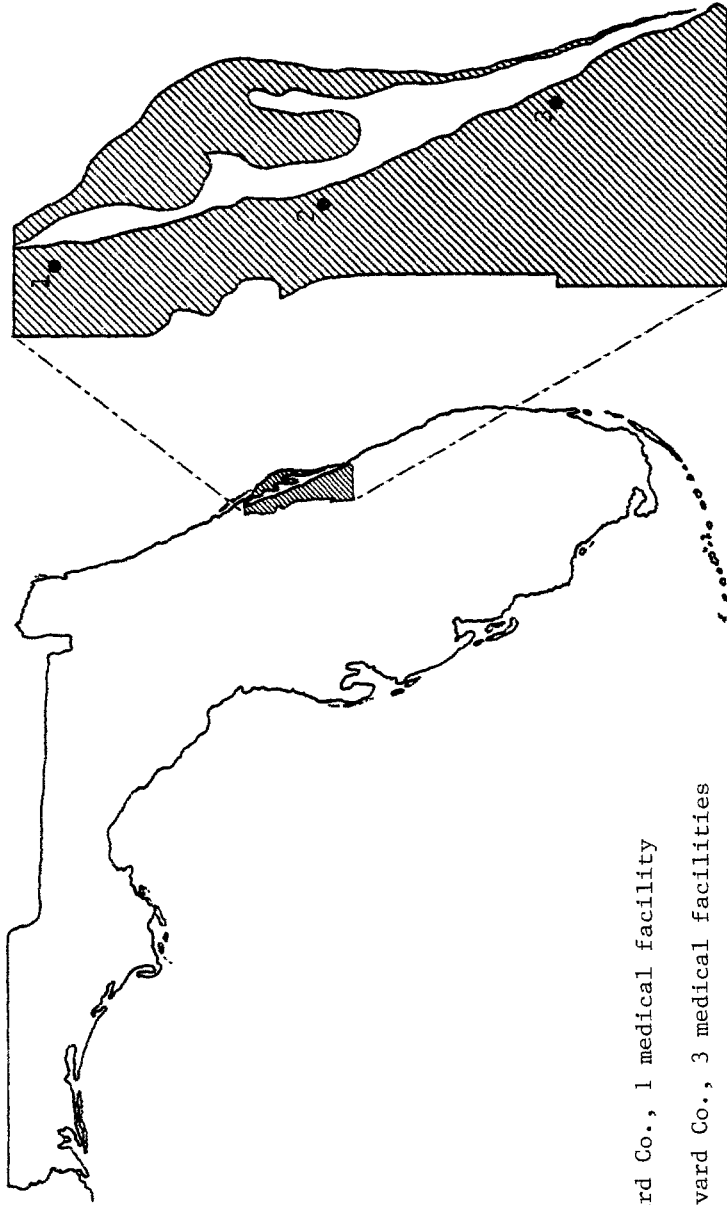


Fig. 1.

- 1 - North Brevard Co., 1 medical facility
- 2 - Central Brevard Co., 3 medical facilities
- 3 - South Brevard Co., 1 medical facility

its use of case specific determinations. However both techniques were devised for infectious disease models and this somewhat limits their applicability to chronic disease clusters. The subsequent field studies involved personal interviews of four of the seven "cluster" cases. Interviews were held with those cases who were living and willing to participate. These interviews included medical, familial and occupational histories.

The additional information concerning 1979 melanoma experience was obtained from the pathology departments of the other hospitals in the county. Water samples were taken in sterilized, sealed containers and refrigerated (as were the blood specimens) during transportation to the Miami laboratories. Both water and blood samples were from locations selected to represent the north-south gradient suggested by the melanoma data. The water and blood samples were analyzed using published gas chromatographic methods (Peoples et al. 1979). A total of 36 samples were taken on three different dates to eliminate possible sampling bias by normal fluxuations in water constituents. The independent analyses of the water department concerned were also compared with our results.

RESULTS

The melanoma experience in South Brevard County was extremely dissimilar from expected values calculated using the Third National Cancer Survey data (Cancer Incidence 1974), ($\chi^2 = 153.732$, $p < 0.001$). However the community experience (when distributed according to population density) did not demonstrate clustering ($\chi^2 = 36.242$; $0.25 < p < 0.10$). The results of the interval approach (Mantel, 1967), was also not demonstrative of clustering ($\chi^2 = 0.287$; $0.6 > p > 0.5$). Despite this outcome, the technique did classify 19 of 26 cases as "close" with respect to time and 9 cases as "close" in space (7 of these 9 comprised the suspected cluster). The case interviews were not remarkable for occupation or host risk factors (e.g. family history, complexion).

The results of the water analyses (Table 2) provided a dramatic north-south gradient of trihalomethane (THM) levels. These data suggest increased formation of THM in south Brevard County is primarily a function of normal water treatment (evidenced by chloroform levels), yet the levels of other THM's (chlorodibromomethane, bromodichloromethane) is noteworthy. These studies are exclusive and should not be interpreted as indicative of absence of other chemical contamination. The few (3) blood samples taken were supportive of the north-south pattern of exposure, viz., high serum chloroform levels in areas wherein high THM levels were present in water.

DISCUSSION

There is much information to suggest the etiologic relationship between sunlight exposure and melanoma (Editorial, 1972). The age specific increase of melanoma is also well documented (Cancer Incidence, 1974). These two factors can not be ignored for the entire population of Brevard County. This population is older (retirees) and inclined to outdoor activities. However, there has been a report of a possible chemical risk related to melanoma (Bahn et al. 1976). There are also suggestions of cancer risk being influenced by THM exposure (Cantar et al. 1978, Carlo and Mettlin

1980). If the data presented in Table I accurately represents complete melanoma experience, a relative risk of 2.4 exists for living in the community or high THM exposure. These data, and the experience reported here suggest further study of the possibility of trihalomethanes being a determinant of melanoma.

Table I - 1979 Melanoma Experience, Brevard County, Fla.

Region	Population	Observed New Melanoma Cases - 1979	Expected Cases of Melanoma*	Chi-squared Value (1 df)
North Brevard Co.	92,754	4	10.73	4.72
Central Brevard Co.	108,561	13	12.56	0.02
South Brevard Co.	63,011	19	7.29	18.81

*calculated using Third National Cancer Survey Data, with adjustment for South Florida age and sunlight considerations (rate = 11.57/100,000).

Table 2 - Results of Water Samples (Ranges in ppb)

Region	Chloroform	<u>BDCM</u> [±]	<u>DBCM</u> [±]	Bromoform
North Brevard Co.	6-55	0-60	0-80	0-4
Central Brevard Co.	11-20	2-6	1-4	NF
South Brevard Co.	200-off scale	75-250	50-100	2-20

+ - Chlorodibromomethane, bromodichloromethane

NF - not found

These data represent 28 water samples collected on three different dates. Three samples were taken from North Brevard County, five from Central Brevard County and twenty from South Brevard County. In all cases, the same locations were visited.

REFERENCES

- Bahn, A.K., I. Posenwaik, N. Herrmona, P. Grover, J. Stellman and K. O'Leary: New England Journal of Medicine **295**, 450 (1976).
 Bridges, H.R.: The City of Melbourne - Caught in the Middle, Presented at the Second Annual Brevard Water Resource Conference, Florida Institute of Technology (1978).
 Cancer Incidence, 1969-71, HEW Pub. No. 74-637 (1974).
 Cantar, K.P., R. Hoover, T.J. Mason and L.J. McCabe: Journal National Cancer Institute **61**, 979 (1978).
 Carlo, G.L., and C.J. Mettlin: American Journal of Public Health **70**, 523 (1980).

Editorial: Epidemiological Approach to Malignant Melanoma, British Medical Journal 1, 130 (1972).
Mantel, N.: Cancer Research 27, 209 (1967).
Peoples, A.J., C.D. Pfaffenberger, T.M. Shafik, H.F. Enos: Bull. Environm. Contam. Toxicol. 23, 244 (1979).
Pinkel, D., and D. Nefzger: Cancer, 351 (1959).