Classics in Oncology

Cancer Studies in Massachusetts. 2. Habits, Characteristics and Environment of Individuals with and without Cancer

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At the inception of the Massachusetts program for cancer control Dr. Frederick Hoffman was consulted for suggestions. He advised that the Massachusetts study should include a collection of questionnaires similar to those that he was collecting in his San Francisco Survey.[1] As Dr. Hoffman is probably the greatest collector of figures of our time, any advice from him should be most seriously considered. A few of these questionnaires were obtained in the 1925 study[2] but as the number was too small for tabulation they were given to Dr. Hoffman to incorporate with his other records.

During 1927 a somewhat similar study was made by this Department, with the assistance of several of the visiting nurses' organizations throughout the State. Our method of approach was somewhat different from that of Dr. Hoffman. We feel that any study of the habits of individuals with cancer is of little value without a similar study of individuals without cancer. To know that a large percentage of patients with cancer have certain habits is of little value for inference unless we know what percentage of the community at large has the same habits.

In the laboratory it may be fairly easy to obtain animals which may be used as controls, but in dealing with the human species this is an entirely different problem.

Methods: Our controls were obtained by having the same investigator who collected the record of the patients with cancer fill out a similar record for an individual without cancer, of the same sex and approximately the same age. In a few cases it was necessary for a different investigator to obtain a control.

The following information was obtained:

Name, Address
Sex, Age, Race, Conjugal state
Birthplace of individuals, Of father, Of mother
No. of children, Height, Weight
Average amount of exercise before illness
Length of intimate association with cancer patients
Foods eaten prior to illness:
Meat, Sugar, Starches, Canned goods, Green vegetables, Other vegetables, Milk products, Coffee, Tea, Salt
Use of tobacco
Use of alcohol
Use of laxatives
Housing conditions
Economic status
Chronic past illness
Type of cancer

These items are intended to cover most of the present hypotheses regarding the causation of cancer.

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We obtained records from 217 cancer patients and a similar number of controls. While the number is small, it is felt to be sufficiently large to make a preliminary statement of our findings. Sometimes large differences will show up in small samples, and only such differences are of value in a program of cancer control.

Evaluation of Sample: The groups contain 55 males and 162 females. The sex ratio of 34 males to 100 females is less than that found in the cancer mortality records, 65 males to 100 females, and the clinic attendance of 80 males to 100 females. This difference probably means that many men with cancer are cared for by their wives, but when the women are affected the visiting nursing associations are employed. The average age of the cancer patient is 59.2± .9 years, and the standard deviation is 12.9. The controls have an average age of 59.4± .8 years, and the standard deviation is 12.2. The slight difference in ages is due to the difficulty of getting controls of exactly the same age as the cancer cases, but these differences are insignificant.

"... cancer was more prevalent among the foreign born and children of foreign born than among the children of native parents."

The two groups are practically identical regarding the economic status of the individual, although there are fewer cancer cases among the well to do.

In respect to race, there is little difference between the cancerous and the controls.

When the two groups are compared by country of birth of individuals, the native born are in excess of the foreign born, but the difference is within the limit of chance fluctuation. When we consider the country of birth of the father and mother we find the differences are greater. In a previous paper[3] we found that cancer was more prevalent among the foreign born and children of foreign born than among the children of native parents. In selecting the controls it is most difficult to get individuals whose parents are born in the same countries as those of the cancer patients. Our cancer group, therefore, has more individuals with foreign parents than the control group.

A comparison of the two groups relative to the conjugal state shows that there are more single females among the control group than among the cancer group. In order to determine if this difference was due to our sample, the female deaths from cancer in the State were compared by conjugal state with our sample, with the resulting figure of 16.2 percent for the State and 13.6 percent for the sample. The cancer group evidently has too few single females, and the control group has too many, as several of the nurses used themselves as controls.

In order to determine how representative our sample of cancer cases was in respect to type, comparison has been made on a percentage basis with the types found in the Massachusetts Hospitals, in the death returns, and in the State-aided cancer clinics. It is impossible to arrive at a precise figure. The death returns do not include the cures. The hospital admissions do not account for the many patients remaining at home. The volume of the clinic cases is too small on which to base judgment.

The above discussion of comparisons of the cancer and control groups emphasizes the difficulties of getting satisfactory controls. We believe, however, they are as good as can be obtained, but as we realize their inadequacy, we have arrived at conclusions only after due consideration of the known differences between the groups.

Comparison of Cancer and Control Groups: The contagion theory was studied by comparing the two groups in respect to the previous association with cancer patients. There is no relationship.

The work of several laboratory investigators shows convincing evidence in favor of the hereditable predisposition to develop cancer. There is also a slight amount of evidence from human material.[4] We have attempted to measure the difference between the cancer and the control groups regarding heredity, but we realize that social as well as genetic differences may be thus depicted. Forty-one percent of those with negative heredity history of cancer in more distant relatives fall in the cancer group, while we should expect 50 percent. Also it is noticeable that 61 percent of the "unknowns" fall in the cancer group. Both these differences are highly significant statistically. The difference between the two groups with respect to positive heredity history is not significant. No inference can be made unless we know how the unknowns would be distributed if they were known. We found that there was a considerably larger percentage of foreign born among the unknowns of the cancer group, and assuming that the foreign born person in the cancer age cannot well remember or perhaps never knew the causes of death of his more distant relatives, it is reasonable to expect that some of the unknowns at least would have a positive history. Therefore, we feel that there may have been a relationship shown if we had all of the information. This applies almost equally well to the heredity history in the immediate family.

Housing conditions were used to measure the parasitic theory. It is believed that cockroaches and other vermin, possible carriers of parasites, would be more prevalent where the housing conditions were poor, than where they were good. [There was] no connection between cancer and housing.

Constipation has been considered a possible cause of cancer.[5] The users of laxatives have been studied to measure any possible connection between constipation and cancer. [We found] no significant difference between the two groups.

The female cancers for all types by the number of children [were] compared with cancers of the female genitals and cancers of the breast. The findings are not statistically significant, probably because of the small figures, but the results are consistent with those of the Health Section of the League of Nations.[6] They found that cancer of the uterus is more prevalent and cancer of the breast less prevalent among women who have borne children than among those who had not. Seventy-five percent of our total group have borne children while 77 percent of those with cancer of the female genitals and 72 percent of those with cancer of the breast had children.

"... cancer of the uterus is more prevalent and cancer of the breast less prevalent among women who have borne children."

The possible relationship between exercise and cancer is found to be significant.

Height and weight are both studied and while height shows no significance there was a tendency among the cancer group to be underweight. This difference may be due to the probability that the nurses classified their patients by the present weight rather than the normal weight before illness.

Chronic past illnesses were studied to determine if any relationship existed between them and cancer. The only significant difference between the cancer cases and the controls appears in the chronic diseases of the teeth in males. This disease is over three times as prevalent among the cancer group as among the control group and is statistically significant, as 40 percent of the male patients with cancer had bad teeth and only 11 percent of the controls. Among the females 13 percent of the cancerous pa-

tients and 20 percent of the controls had bad teeth. A check was made of this sample by getting similar figures from the clinic cases.[12] The cancer group was here compared with a control group so selected from those attending the clinics with no evidence of cancer as to make the two groups similar in respect to age and sex. We found 9.2 percent of the males with cancer, 3.6 percent of the male controls, 4.6 percent of the females with cancer and 1.7 percent of the female controls had bad teeth. There are a smaller number of individuals with bad teeth among the clinic cases than in the nurses' study. This difference is believed to be due to the better economic status of the individuals attending the State-aided Cancer Clinics.

It might be thought that the excess of bad teeth in males might have some relation to the excess of cancer of the buccal cavity in males, but the subdivision of cancer by type among males showed no relationship and therefore the bad teeth may be regarded as a source of toxicity affecting total cancer rather than a source of chronic irritation affecting the cancers of the mouth.

Various foods have been studied to determine if there was any relationship between their ingestion and cancer. With the exception of dry vegetables and tea and coffee, the cancer cases ate less of the various articles of food than the controls. This probably is accounted for by the presence of the disease itself. In the continuation of this study we are seeking information on the foods eaten prior to illness, as in many cases the diet has changed after the inception of the disease.

The ingestion of salt has been considered by several as predisposing to cancer.[7,8] [The data] point to no relationship between salt and cancer.

The use of alcohol shows no relation with cancer. The unknowns however, are so many that they might alter the conclusions.

The use of tobacco has long been considered a factor in the incidence of cancer of the buccal cavity. Dr. Hoffman gives the smoking habits of cancer patients by the site of the disease in his San Francisco Survey. We have realigned Dr. Hoffman's figures in preparing Table 19.[9]

If we postulate that only cancers of certain sites should be affected by heavy smoking, and that those of other sites should not be so affected, and that sarcoma also should not be influenced by tobacco smoking, we can then compare the sites supposed to be affected by smoking with the other two groups which now can be regarded somewhat as controls. These figures, however, give no light upon the relation of smoking to cancer in general. Including under "sites supposed to be affected by smoking" cancers of the lip, jaw, cheek and tongue, and under "sites not supposed to be affected by smoking" all other cancers, we show the results in Table 20.

Of all males who have cancer in the above sample 78.8 percent are heavy smokers. Dr. Hoffman found in his larger sample of 834 male patients[10] that 44.1 percent were heavy smokers. In our sample, 47.3 percent were found to be heavy smokers. What is the true percentage of heavy smokers among males with cancer? Evidently the sample quoted in Table 19 is not representative of the cancer population. What is the percentage of heavy smokers in the general population? We do not know. Dublin, Fiske and Kopf,[11] among 16,662 male policy holders in the Metropolitan Life Insurance Company, found 33.1 percent to be heavy smokers. In our control sample we found 20 percent heavy smokers and in our total group, including both cancers and controls, we found 33.7 percent.

The difference between our control group and the cancer group in respect to heavy smoking is 27 percent. This is highly significant, which suggests that heavy smoking has some relation to cancer in general. Of the heavy smoking group, pipe smoking seems to be the most important, as 73.1 percent of the heavy smokers in the cancer group are pipe smokers and 72.6 percent of the heavy smokers in the control group are pipe smokers.

TABLE 19
PERCENT OF EXCESSIVE SMOKERS BY TYPE OF CANCER

	Percent	No. of Cases
Cancer of the throat	54	13
Cancer of the intestines	100	5
Cancer of the pancreas	33	3
Cancer of the rectum	88	8
Cancer of the lung	100	5
Cancer of the bladder	60	10
Cancer of the lip	92	12
Cancer of the jaw	100	5
Cancer of the neck	83	6
Cancer of the cheek	100	12
Cancer of the oesophagus	77	13
Cancer of the prostate	100	9
Cancer of the tongue	100	7
Cancer of the stomach	82	39
Cancer of the leg	50	2
Sarcoma	73	15
Miscellaneous	60	20

TABLE 20
CANCER SITES BY SMOKING

	Sites supposed to be affected by smoking	Sites not supposed to be affected by smoking	Sarcoma	Total
Heavy smokers	34	100	11	145
Not heavy smokers	1	34	4	39
Total	35	134	15	184
Percent of heavy smokers	97.2	74.6	73.3	78.8

TABLE 21
CANCER SITES BY SMOKING

	Sites supposed to be affected by smoking	Sites not supposed to be affected by smoking	Total
Heavy smokers	9	17	26
Not heavy smokers	8	21	29
Total	17	38	55
Percent of heavy smokers	52.8	44.8	47.3

TABLE 22
TOBACCO

CANCER GROUP

	Users			Non-users			Unknown		
	M.	F.	T.	M.	F.	T.	M.	F.	T.
Pipe	38	1	39	11	124	135	6	37	43
Cigarette	11	1	12	21	126	147	23	35	58
Cigar	23	1	24	16	125	141	16	36	52
Chewing	13	0	13	22	126	148	19	37	56

CONTROL GROUP

	Users			Non-users			Unknown		
	M.	F.	T.	M.	F.	T.	M.	F.	T.
Pipe	27	1	28	25	137	162	3	24	27
Cigarette	9	4	13	38	134	172	8	24	32
Cigar	29	0	29	22	136	158	4	26	30
Chewing	12	1	13	35	134	169	8	27	35

TABLE 23 BUCCAL CAVITY CANCERS BY USE OF TOBACCO			
	Users	Non-users	Unknown
Pipe	16	9	5
Cigarette	5	12	13
Cigar	10	12	8
Chewing	6	14	10

In Table 20 there is a difference of 18 percent between the heavy smokers who had cancer of the buccal cavity and the total percent of heavy smokers. This is statistically significant and indicates that a small part of the buccal cavity cancers may be due to smoking. Table 21 prepared from our figures is consistent with Table 20, but it is not significant, due probably to the small size.

Table 22 compares the cancer and control groups from the nurses' questionnaires by smoking habits and Table 23 shows the smoking habits of those individuals who had cancer of the buccal cavity. The relationship between cancer of the buccal cavity and smoking appears from our figures to be due to pipe smoking alone.

The study is being continued, narrowing the field of inquiry to the amount of salt eaten, the amount of condiments, canned goods, foods ordinarily eaten prior to illness, constipation and tobacco. In the 1928 study, the classification of foods is broader than in the present one.

Discussion

Throughout the study the "Unknown" item has been the most unsatisfactory. Such conclusions as we have drawn are made on the assumption that the unknowns are distributed in the same ratio as the known items. This is the most probable inference but it is by no means assured. In those tables in which the unknowns differ markedly from the controls they could easily alter the findings.

It should also be noted that when any two groups are compared with respect to a large number of variables, the differences themselves will form a frequency distribution and some of the variables with statistical significance may thus be entirely due to chance. In order to determine whether or not there is real significance in a given instance it is necessary that additional samples be obtained.

Conclusions

Variations in the habits of cancer patients cannot be studied without the use of good controls, which are most difficult to obtain. We believe our sample to be as nearly satisfactory as is reasonably possible to get on a large scale.

As only large differences between controls and cancers need be considered the size of the sample is adequate.

The collection of data on cancer patients without similar data on controls is

valueless in the determination of factors influencing the causation of cancer.

Bad teeth in males are more common among the cancer group than among the controls. This applies to cancer in general and is not limited to buccal cavity cancer.

Heavy smoking is more common in the cancer group than among the controls. In our sample heavy smoking was largely pipe smoking and was particularly more common in those individuals with cancer of the buccal cavity.

The figures gave a suggestion of a hereditary predisposition to cancer but the volume of unknowns made definite conclusions impossible.

The cancer group ate less than the controls but this probably is wholly due to the presence of the disease.

Although we realize that the figures in this study are too small and incomplete for significant conclusions to be drawn, they are presented to show the methods used in order that others may conduct similar studies. We feel that other independent samples collected in a like manner would do much to either prove or disprove our findings.

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