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Familial polyposis, a rare intestinal condition which may develop into cancer, is present in a group of related persons in Guilford County, North Carolina.

The composition of the diet influences the proper functioning of the gastro-intestinal tract. For this reason, an evaluation of a three-day food intake of members of the family predisposed to this condition was made in relation to a three-day food intake of a matched group of controls without any known intestinal disorders.

A food questionnaire was developed and used in recording the frequency, the kind, and the amount of food eaten by both groups. The nutrient intake of each experimental subject was compared with his matched group of controls. The recommended dietary allowances were determined for all subjects and these were compared with the actual intakes.

The frequency of use of various food groups revealed that the experimental group consumed more of the following: seafood, medium fiber vegetables, coffee, and milk. The comparison of nutrient intakes showed that the male experimentals were lower in all nutrients as compared to their matched controls. The female group was lower in all of the nutrients except riboflavin and niacin. The comparison of the recommended dietary allowance revealed the intakes of calcium, iron, ascorbic acid, and calories to be very low for the experimentals.

A STUDY OF THE FOOD INTAKES OF A GROUP WITH FAMILIAL POLYPOSIS

by

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CHAPTER I

INTRODUCTION

Persons suffering with familial polyposis, a rare type of intestinal disorder, are predisposed to the development of cancer in the intestinal area. Three identifying features of this condition are (a) the hereditary aspect, (b) the appearance, at puberty, of polyps in the colon and accompanying gastro-intestinal distress, and (c) the tendency for the patient to develop the malignant disease at an early age.

Although the first comprehensive review and analysis of familial polyposis was made by C. E. Dukes (1) in 1930, isolated cases of the disorder were reported as early as 1882.

This disease is present in a group of related persons living in Guilford County, North Carolina. Its beginning can be traced back to one man who lived six generations ago. Of the current living individuals of this family, one-fourth are likely to develop the characteristic polyps. This disease has been reported to exist also in Australia, Africa, and England; however, little is known about the precise etiology of it. The incidence of those developing

polyps in the affected family fall either on a bimodal or modal curve in other areas where this disease is present. The members of the family residing in North Carolina do not fall on either type curve (2).

Familial polyposis is a consequence of gene mutation, and is transmitted by both sexes. In most of the affected families, one-half of the children are likely to inherit the abnormality while the remainder do not develop the polyps. The survival of the polyposis gene is dependent on environmental and genetic factors (3).

Environmental factors are of interest in relation to the appearance of the disease. Food is one of the environmental factors which has an effect on health. The composition of the diet, including natural components and those added in processing, influence the proper functioning of the gastro-intestinal tract. For this reason, a study of the food intakes of those persons with the predisposition to develop familial polyposis could provide information useful to those studying the disease in depth.

The purpose of this work was to study and evaluate the food intakes of the members of the polyposis family in relation to that of a group of matched controls without any known intestinal disorders.

Another purpose was to develop a questionnaire which would be clear and easy to follow and which would allow the

person receiving it to check the actual amounts of foods eaten on three consecutive days during the middle of the week.

A dietary study was made from these questionnaires to obtain information on food intakes for a three-day period. The frequency of the use of certain foods and food groups was recorded for the experimental and control groups, and these were compared for outstanding differences. The nutritive values of the diets of both groups were evaluated and compared with the Recommended Dietary Allowances for normal individuals in the United States (4).

CHAPTER II

REVIEW OF LITERATURE

Background of Condition

Familial polyposis is defined as a condition marked first by numerous polyps in the lower part of the small intestine and colon, second by a tendency to occur in members of the same family, and third by the occurrence of gastro-intestinal distress. The intestinal polyps may give rise to abdominal symptoms and often become malignant (3).

This disease is present in a group of related persons in Guilford County, North Carolina. Four generations of the family involved are now living and approximately one-fourth of these will develop the polyps. It has been reported to exist in other areas of the world; but the disorder is a rare condition, and little is known about its precise etiology (2).

This condition is a consequence of gene mutation and can be transmitted by both sexes. The gene which produces familial polyposis is dominant so that marriage between an unaffected and an affected person would produce children of whom half might be affected. It is transmitted as an autosomal dominant trait (1).

The survival of the freely inherited polyposis gene will depend on environmental and genetic factors. The affected family members who survive to reproduce are endowed with either a genetic background or environment which, in some way, modifies and delays the lethal effects of the polyposis gene, making it possible for the members of the family to pass any group of favorable genes on to the next generation. Thus it is expected that the effects of the polyposis gene will become less harmful as it is passed from one generation to the next (3).

The crypts of Lieberkühn are located at the base of the villi in the large intestines and it is in this area of mitotic activity where the epithelial cells of the intestinal mucosa are formed. The cells formed in the crypts migrate up the length of the villus and usually are extruded from the tip into the intestinal lumen (5). In familial polyposis the cells are not extruded, but multiply and result in the formation of polyps. These are the cells believed to be transformed into malignant or cancer cells (2).

Polyps vary in size and usually have a broad base of attachment. Although the polyps carpet the colon and rectum throughout, they may be scattered with large areas of visible mucosa between them (1).

In 1945 Wilensky (6) stated that there were two factors which determine the transformation of a benign polyp into a malignant one. The first factor is the degree of undeterminable individual tendency, either inherited or acquired, toward such a development; and the second is the degree, intensity, and duration of repeated chemical and mechanical irritation especially prone to occur in the large intestine.

According to Bacon (7), investigators who have studied familial polyposis believe that the diffuse adenomatosis is due to a hereditary inferiority of the intestinal mucosa which predisposes it to overgrowth. The disorder usually manifests itself during adolescence or early adult life. The symptoms of this condition include diarrhea, abdominal cramps, blood loss, weakness, electrolyte changes, and other symptoms relating to carcinoma (1). These symptoms of familial polyposis begin around age twenty with cancer developing some fifteen years later (7).

In a review of intestinal polyposis by Lockhart-Mummery (8), he stated that the best method for treatment of this condition is total colectomy and ileorectal anastomosis. In previous years, operations which removed only a part of the colon were not adequate. A carcinoma developed sooner or later in the large intestine and by the time it was detected there was no hope of cure.

There are many factors which need consideration in the preoperative preparation and postoperative care of a patient undergoing a colectomy. A thorough cleaning of the large bowel and building up of the general condition of the patient to the highest level possible are essential. This includes rectification of any cellular and hemoglobin deficiency of the blood to at least 85 per cent of the normal; rectification of any protein deficiency in both blood or tissue not only to the normal but, if possible, to an excess; and rectification of any abnormal hepatic function (6).

Immediately after the operation parenteral methods of nutrition include the use of plasma in sufficient amounts combined with transfusions of whole blood. As soon as possible, oral feeding is instituted and the dietary protein intake is increased to 150 to 180 grams per day. The amount of protein may not be sufficient due to impaired digestion or other disability. When this is the case the discrepancy should be made good by adding a sufficient quantity of amino acids dissolved in, or mixed with the food. After the patient leaves the hospital, excess and enriched protein nutrition should be continued for reason that a patient with an ileostomy continues to discharge abundantly and much is lost before complete utilization (6).

Environmental Factors Related to Carcinogenesis

Nutrition may be related to cancer as one of the environmental factors exerting a possible etiological or conditioning influence on tumor initiation and development (9). There is the possibility that food may contain some carcinogens which are the cancer producing substances in humans. More than 450 compounds have been found to be carcinogenic and almost half of these are polycyclic aromatic hydrocarbons or their derivatives or analogs (10).

Although many substances in food have been studied for carcinogenic activity, most of these studies have involved rats. These studies may not be readily adaptable to humans because of species differences in reaction to carcinogens (10).

Hueper has reviewed various studies on the role of non-nutritive food additives and contaminants. The results of these epidemiological studies have indicated that prolonged dietary intakes of drinking water, wine, and other foodstuffs contaminated with arsenicals from industrial sources or as insecticides have caused cancer of the skin in some people. These potential carcinogenic contaminants may be introduced into foodstuffs if vegetables, fruits, fish, oysters, and livestock are grown on soil or in water polluted with known carcinogens, such

as radioactive matter, arsenicals, selenium, and polycyclic hydrocarbons contained in ship fuel oil (11).

In the same review the effects of some of the estrogens used as fattening agents for poultry and livestock by the food industry were considered. Some have shown carcinogenic activity when given to experimental animals.

There is the possibility that a carcinogenic chemical may be formed from a non-carcinogenic agent under the influence of heat. This may occur when bread or biscuits are excessively toasted or when meats are excessively grilled or roasted. This conversion could occur during the formation of charred or tarry carbonaceous matter (11). A list of non-nutritive food additives and contaminants which are classified as potential environmental carcinogens (11) and a list of some of the naturally occurring carcinogens (12) appear in Appendix I.

According to Sugai et al. (13), there are also the possibilities that heated fats either contain carcinogens or act as cancer-promoting agents. Fresh or heated vegetable oils from various sources have been fed to rats with specific levels of the carcinogen, 2-acetylaminofluorene, for periods of nine to thirty months. The results of this feeding experiment showed the formation of tumors in various tissues. The indications are that the lipase-undigestible or the nonurea adduct-forming fraction isolated from heated

oil acted in synergism with the 2-acetylaminofluorene and enhanced its carcinogenic activity.

There have been other studies in which malignant tumors occurred in rats that had been injected subcutaneously with heated fats (14). Still other studies have shown that rats when fed a basal diet of pure lard, cottonseed oil, or a mixed cooking fat, each heated from 200° to 220°C, developed papillomas of the forestomach (15).

Tea is known to contain many phenols which accumulate in the plant during the natural processes of oxidation and reduction. These phenols have been shown by Kaiser (16) to have a cancer promoting action. Skin cancer was produced by applying 3,4 benzpyrene and brewed tea to the surface of the skin.

In the sediments and deposits of the middle Rhine and its tributaries in Germany, twenty-five polycyclic aromatic compounds were found with at least six showing carcinogenic activity. Some of these carcinogens probably originate in seaweed and in the earth, but a larger majority of them come from rubbed-off debris from asphalt and blacktop highways (17).

The products of incomplete combustion of fat are known to contain a large number of polynuclear hydrocarbons. Two such compounds which have been detected in

some foods are benzpyrene and benzanthracene. These compounds have been detected on the surface of charcoal-broiled meat, and apparently arise from the pyrolysis of fat which occurs when drippings hit live coals (18).

Lijinsky and Shubik (19) have reported that another means of introducing carcinogens into food is by methods of preservation such as smoking carried out by exposing food to wood smoke in a smoke oven. Benzpyrene has been found in smoked mutton and trout. Although the quantities of benzpyrene are small, they might be sufficient to start a carcinomatous growth (20).

Phenothiazine and several of its derivatives have been found to protect animals from the carcinogenic effects of benzpyrene. This compound increases benzpyrene hydroxylase, an enzyme which converts the carcinogen benzpyrene to a weak or completely inactive form. It is interesting to note that some dietary constituents such as flavones have been found to increase this enzyme activity (21).

Diet as an Etiological Factor in Gastro-Intestinal Cancer

Although the cause of cancer is unknown, results of several investigations suggest a relationship between diet and cancer. Regardless of whether actual components in

foods cause cancer or the presence of certain dietary components influence the development of intestinal cancer in an organism, studies involving the effects of diet on cancer in humans are deemed appropriate.

Higginson (22) carried out a retrospective survey on 93 patients with carcinoma of the stomach, 340 patients with carcinoma of the colon and rectum, and 1020 controls in 7 hospitals in Kansas in 1959. The socioeconomic and dietary backgrounds of the patients with carcinoma were investigated. The patients were questioned as to the frequency of the use of foodstuffs. They were asked to rank the foodstuffs according to frequency of use and to describe the meal pattern of a typical day. The results indicated that those with gastric carcinoma consumed more pork-related foods, lard, and collected fats than did the other groups tested. This group also consumed more fried foods during the course of the survey. There were no significant differences in the use of coffee with or without milk, tea, hot or cold, or carbonated beverages. Alcoholic habits were similar in all groups. The patients with colon and rectum cancer did not show an increase in the frequency of the use of any foodstuffs.

In 1961 Hueper (23) compiled a list of carcinogens which also contained the type of cancer either known or suspected from each, the compounds of economic importance

containing the carcinogen, and the persons likely to come in contact with the carcinogen. Intestinal cancer was suspected from two of the carcinogens. The carcinogens came from thermic and oxidation products of oils and fats of vegetable and animal derivation and from aromatic amines some of which are food dyes.

Wilheim and Ivy (24) suggested as possible causative factors in the development of intestinal cancer the food or its residues of food, the action of digestive secretions, or by-products of bacterial action. It seemed possible to him that exogenous carcinogens present in the ingesta might be absorbed into or onto the cells of the gastric mucosa, irritating them so that gastric cancer would result without prior ulceration. This possibility would apply to the mucosa of the colon and small intestine, as well as to the stomach.

The formation of polyps in the large intestine or the transformation of benign polyps to malignant ones have never been specifically related to dietary factors. However, a few decades ago Hoelzel and DaCosta (25) were able to produce polyposis of the colon in rats by feeding a diet containing a large amount of roughage, a relatively high proportion of protein, and practically no fat. This diet was composed of a mixture of 200 parts by weight

pulverized cellulose, 43 parts casein, 43 parts cornstarch, 5 parts dry yeast powder, 5 parts alfafa meal, and 4 parts salt mixture.

Nutrition of the Cancer Cell

In the beginning familial polyposis is primarily a disease of the individual cell. If the polyps become malignant and cells multiply at a rapid rate, the condition becomes a disease of the whole animal as a result of this uncontrolled growth (26). In order to relate nutrition and this type of cancer one must think in terms of the nutrition of the individual cell.

The growth of a cancer cell requires the same nutrients as that of a normal cell. The cancer derives its nourishment directly from the body fluids of the host and only indirectly from the diet. Although the diet may be totally lacking in something as essential as protein or thiamin, the body fluids still contain measurable amounts of these essential materials which have been derived, if necessary, from the breakdown of normal tissues. Under these conditions the tumor is able to extract nutrients from the body fluids for its maintenance (27).

There has been much work done on the protein and amino acid needs of the tumor cells and the marked effect

of changes in the nitrogen content of the host affected by the cancerous state. Henderson (28) reported that cancer cells are able to take up amino acids from the blood and concentrate them to a greater extent than do some normal tissues. Because these amino acids are constantly released and recombined by normal cells, the neoplastic cell can gain them from the normal cells merely by seizing upon them with greater avidity without direct attack upon the normal tissue.

Costa (29) discussed various nutritional alterations occurring in patients with cancer. He reported on the state of cachexia experienced by cancer patients. Fat and protein depletion are the most apparent metabolic alterations followed by retention of water and salt. Patients exhibit weakness, anemia, and a characteristic fading of vital functions. The cancerous growth present in the gastro-intestinal tract causes an impaired food intake (30). With any type of cancer of the large intestine there are alterations in the absorption of water, salts, and vitamins (31). The carcinoma causes a change in the consistency and the frequency of stools. Instead of the remaining food matter changing from a liquid to a semisolid state, it is eliminated in very loose, watery bowel movements. The number of bowel movements increase from eight to fourteen per day (32).

Diet and the Treatment of Cancer

Although opinions are conflicting regarding the cause of cancer, there are several diets which have been used in the treatment of various types of cancer.

In 1945 Gerson (33) published a diet regime which he thought would help control or arrest the course and symptoms of malignant neoplastic disease. The diet was rich in potassium (vegetables, fruits, salads, fruit and vegetable juices) and low in sodium (saltless, unsmoked foodstuffs). It consisted entirely of fresh foods and contained no fats. For the first six weeks the diet was free of animal proteins. After six weeks, fat free proteins of milk products such as buttermilk, skim milk, yoghurt, and pot cheese were added along with fat soluble vitamins A and D. After the diet was used in the treatment of cancer of the breast and thigh several changes took place. The inflammatory process surrounding malignant disease was altered markedly. The diet caused a very noticeable relief of pain and in a number of instances there was a disappearance of metastatic involvement.

In the 1940's and 1950's the use of low calorie diets for the treatment of cancer was introduced. A reduction of approximately one-third in caloric intake was reported by Tannenbaum and Silverstone (34) to reduce markedly the genesis of tumors in mice. Since the mitosis

of all cells is inhibited by caloric restriction Peliner (35) assumed that the mitosis of the latent cancer cell is also inhibited. The restriction in the amount of carbohydrate and carbohydrate intermediate products could limit mitosis and thus cancer growth. Before a tumor is well established the tumor cells must compete with adjacent normal cells for food. When excess food is eaten much energy is still available for tumor cells after ordinary cells are satisfied. If the food intake is restricted then the neoplam does not fare so well.

Herberger (36) in his book on the treatment of inoperable cancer stated that it was not known whether diet could prevent cancer. He recommended that the cancer patients receive no more than 2000 calories. A daily intake of sixty to eighty grams of protein was recommended, with the protein sources being milk, cream, and cheeses. All fats should be derived from unsaturated fatty acids and cold pressed oils. An amount of 200 grams of carbohydrate was deemed essential and could be provided by fruit, vegetables, and wholemeal bread.

In the last few years a diet low in phenylalanine has been used in treating some types of cancer (37). By restricting the intake of this essential amino acid, a variety of advanced human malignant diseases were prohibited. A deficient phenylalanine diet (400 milligrams

per day) was tried from four to eighteen months in the management of five patients with advanced metastasizing neoplasms. Of these original cases, three were surviving and had been followed between six and eighteen months at the time of this report. All patients showed surprising improvement and resumed useful functional activities without continuous analgesia. The careful restriction of this amino acid resulted in an inhibition of tumor growth without deleterious effects on body mass, serum proteins, and hemogram. It permitted healthy tissue to compete for the limited amino acid more efficiently than malignant tissue.

Demopoulos (38) reported that a deficiency of phenylalanine and tyrosine in the diet inhibits tyronsinase which results in a 50 per cent reduction in the cellular oxidation of dihydroxyphenylalanine to melanin. This resulting condition cripples the respiration and reproduction of the melanocyte. In a Los Angeles study eight patients were placed on a diet based on a powdered commercial dietary preparation deficient in tyrosine and phenylalanine. The diet also included small amounts of fruits, vegetables, and low-phenylalanine bread for a total daily phenylalanine and tyrosine intake of 1000 milligrams rather than the approximately 6000 milligrams in a normal diet. It was found that adults disliked the unpleasant taste and odor of the mixture, and others had difficulty

remaining on the diet. Another amino acid mixture, prepared similar to the first preparation with regard to tyrosine and phenylalanine content, was mixed with lemonade or soup and made much more palatable. The mixture was supplemented with capsules of methionine, other essential amino acids, appropriate amounts of vitamins, minerals, and other vital nutrients.

Although low calorie and low protein diets have been regarded as the basic principles of cancer feeding for a long time, the therapeutic essentiality of such diets has not been confirmed by clinical and experimental data. Bernard (39) believed that only an increase in protein intake enables the cancer patient to meet the needs which grow with the disease and the treatments.

The proper feeding of a patient suffering with advanced malignant disease of the colon or rectum is a major problem. A diet highly satisfactory for a normal individual cannot be adapted to a patient with a malignant disease of the digestive tract by merely varying its contents according to the whims of the patient concerned. A daily intake of 3000 to 3500 calories has been recommended by Drueck (40). All feedings should be with easily digested foods of high caloric value, easily assimilated and low in residue. The diet should include moderately liberal proteins, slightly low carbohydrate, fairly liberal fats, eight to ten glasses of fluids, liberal vegetables,

minerals, salts and vitamins, especially A and D in fish oils, C in fruits, and B in wheat germ and cereals.

CHAPTER III

PROCEDURE

This was a comparative study of a three-day food intake of several related persons predisposed to familial polyposis (the experimental group) with a three-day food intake of persons with no polyposis (the control group). The experimental group was composed of high risk individuals, individuals with familial polyposis, and individuals who had been treated for this condition by an operation which removed the large intestine. Both groups were from the low to middle income bracket and resided in Guilford County, North Carolina. Three to five subjects were matched to each experimental subject according to age, sex, and occupation.

A check-type questionnaire which was easy to understand and use in recording the specific amounts and kinds of food eaten during a three-day period was developed. It allowed for checking the foods eaten on three consecutive days during the middle of the week. At the end of the questionnaire, questions relating to other food habits and one concerning smoking habits were included for future use at the request of the Biology Department of the University. Personal data on height, weight, occupation, age, and sex was also collected. (See questionnaire, Appendix II).

The selection of the polyposis family members was done by Dr. William McLendon, a pathologist at Moses H. Cone Memorial Hospital in Greensboro, North Carolina, and Dr. Laura G. Anderton, an Associate Professor of Biology at the University of North Carolina at Greensboro. Since some of these people live in constant fear of the disease and are very sensitive about their condition, it was desired that the family members remain anonymous. For this reason, they were not interviewed, but sent questionnaires. A letter from Dr. McLendon asking for their cooperation and explaining the project accompanied each of the thirty-four questionnaires (See letter, Appendix II). The questionnaires were mailed back to the doctor at the hospital and then returned to the University for analysis. Members of the investigating team made every possible effort to reduce anxiety in the experimental subjects; however, maximum attempts were made to encourage the family members to return the questionnaires. The identity of individuals within the experimental group remained unknown until after the analysis of the data was completed so that an objective evaluation could be made.

The selection of the controls was made from a group of volunteers from various civic organizations in Guilford County. These included several home demonstration clubs, a group of jaycees, and a men's Bible class. Visits were

made to these organizations in August. The purpose of the study and the need for normal controls were explained to each civic group prior to the time the individuals volunteered to serve as controls. Their cooperation was requested again in October.

The frequency of the use of the foods was recorded for both groups on the basis of either daily, less than daily, or not within the time period of the study. Foods were tabulated according to meats and seafood, vegetables, fruits, beverages, and milk and dairy products. The vegetables and fruits were divided into groups according to low, medium, and high fiber content. The values ranged from 0.0 to 0.5 gram of fiber per 100 grams for the low fiber group, from 0.51 to 1.0 gram for the medium fiber group and from 1.1 grams on up for the high fiber group (See Table 1, Appendix III). The number eating a certain food or a certain group of foods, as in the case of vegetables and fruits, was divided into the total number in the experimental group and control group, and compared for any outstanding difference in frequency of consumption.

The United States Department of Agriculture Handbooks Number 8 and Number 72 and Church's Food Values of Portions Commonly Used were used to determine the nutrient content of each food consumed (41, 42, 43). When the values of some home-prepared foods were not available the nutritive values

of recipes common to this area were determined. The food intakes were calculated for calories, protein, fat, carbohydrate, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid.

The caloric requirement for each individual in the study was calculated on the basis of his desirable weight according to height rather than on the subject's actual weight. The other recommended allowances of nutrients were determined according to the procedure given in the National Research Council's publication on recommended dietary allowances (4). Table 2 in Appendix III shows this information.

The nutrient intakes of the experimental group were compared with the average nutrient intake of their matched controls. It was determined whether the experimental's intake of nutrients was lower, higher, or the same as that of his matched controls.

The average nutrient intake was obtained for the three-day period on each individual (Table 3, Appendix III). These averages were compared to the recommended dietary allowances. The number of subjects meeting these allowances, two-thirds of these allowances, and less than two-thirds of these allowances were determined. A comparison was also

made between the experimental and control group in relation to meeting these recommended dietary allowances.

Preliminary information on a three-day food intake of some of the members of the experimental family was obtained by Dr. Anderton in the spring of 1967. This data was evaluated using the basic four (44).

On January 31, 1968, an interview was held with the co-ordinator of the family to get additional information regarding food patterns which was not included on the questionnaire.

CHAPTER IV

DISCUSSION AND RESULTS

Only ten members of the experimental group returned their food questionnaires. Of these, eight had not developed the characteristic polyps at the time of this study, even though they were considered high risks. In this group one had polyps and had been advised to have an operation for the removal of them. Another had undergone an operation for the removal of the polyps in 1964. A total number of fifty controls were selected from those returning the questionnaires. Thirty-eight of these were matched with the experimental subjects and twelve additional controls were used to give a more representative picture of the kinds of foods eaten in Guilford County. A detailed description of all subjects studied is given in Table 4 of Appendix III according to age, sex, height, weight, and time of participation in the study.

Data was compiled on the frequency of foods eaten daily and less than daily for certain foods, groups of foods, and beverages consumed. In this tabulation of frequency data, one questionnaire received too late for matching with controls was included. Ratios of the total number of subjects participating and the number consuming a certain food in both groups have been determined.

Table 1 shows that there appeared to be no outstanding difference between groups in the distribution of the use of pork, beef, or chicken; however, a greater percentage of the experimental group consumed seafood.

TABLE 1

RATIO OF THE TOTAL NUMBER OF SUBJECTS PARTICIPATING AND THE NUMBER CONSUMING MEATS AND SEAFOOD IN BOTH GROUPS

Type of Meat	Frequency of Intake		
	Daily	Less than Daily[a]	Not within Period
	Experimentals		
Pork	.36[b] (4)[c]	.64 (7)	.00
Beef	.00	.82	.18 (2)
Chicken	.00	.45 (5)	.55 (6)
Seafood	.00	.73 (8)	.27 (3)
Organ meats	.00	.00	.00
	Controls		
Pork	.30 (15)	.62 (31)	.08 (4)
Beef	.10 (5)	.80 (40)	.10 (5)
Chicken	.00	.66 (33)	.34 (17)
Seafood	.00	.42 (21)	.58 (29)
Organ meats	.00	.18 (9)	.82 (41)

[a]Designates a food eaten either once or twice within a three-day period

[b]Number of subjects consuming the food divided into total number in group

[c]Number of subjects consuming the food

The vegetables and fruits were divided into groups according to low, medium, and high fiber content. (See Table 1, Appendix III). The number of these foods eaten within each group may exceed the number of subjects if more than one vegetable or fruit was consumed during the period. This could happen since each group contains more than one vegetable or fruit. Ratios were calculated to determine differences in consumption of vegetables and fruits between the experimental and control groups.

In comparing the consumption of vegetables (See Table 2) the experimentals appeared to eat more of the vegetables daily in the medium fiber content group and more in the less than daily column in both the low and high fiber group. The controls consumed considerably more of the medium fiber vegetables less than daily than did the experimentals. The experimental group showed a lower intake of the medium and high fiber fruits than did the controls (See Table 3). Percentage of differences have been calculated to show the variations between the two groups in frequency of consumption.

A study of the use of milk and dairy products by both groups of subjects was made. The experimentals showed a lower consumption of cheese. This group had a daily intake of eggs lower than the control group, but a higher intake of eggs less than daily. There was no outstanding difference in the consumption of ice milk. It appeared that the experimental group had a lower intake of ice cream than their

TABLE 2

RATIO OF THE TOTAL NUMBER OF SUBJECTS PARTICIPATING AND THE NUMBER CONSUMING VEGETABLES ACCORDING TO FIBER CONTENT IN BOTH GROUPS

Type of Vegetable	Frequency of Intake	
	Daily	Less than daily
Low Fiber Vegetables		
Experimentals	.18 (2)[a]	1.4 (15)
Controls	.30 (15)	1.0 (50)
Difference	.12	.40
Medium Fiber Vegetables		
Experimentals	.27 (3)	3.8 (42)
Controls	.10 (5)	5.3 (263)
Difference	.17	1.5
High Fiber Vegetables		
Experimentals	.00	1.7 (19)
Controls	.00	1.4 (71)
Difference	.00	.30

[a]Total number of vegetables consumed by either experimental or control group

TABLE 3

RATIO OF THE TOTAL NUMBER OF SUBJECTS PARTICIPATING AND THE NUMBER CONSUMING FRUITS ACCORDING TO FIBER CONTENT IN BOTH GROUPS

Type of Fruit	Frequency of Intake	
	Daily	Less than daily
Low Fiber Fruits		
Experimentals	.00	1.4 (15)[a]
Controls	.06 (3)	1.3 (63)
Difference	.06	.10
Medium Fiber Fruits		
Experimentals	.00	.36 (4)
Controls	.02 (1)	.60 (30)
Difference	.02	.24
High Fiber Fruits		
Experimentals	.00	.45 (5)
Controls	.06 (3)	.54 (27)
Difference	.06	.09

[a]Total number of fruits consumed by either experimental or control group

controls. The experimental group showed a greater percentage consuming milk daily than did the controls. These findings are given below in Table 4.

TABLE 4

RATIO OF THE TOTAL NUMBER OF SUBJECTS PARTICIPATING AND THE NUMBER CONSUMING MILK AND DAIRY PRODUCTS IN BOTH GROUPS

Milk and Dairy Products	Frequency of Intake		
	Daily	Less than Daily	Not within Period
	Experimentals		
Cheese	.00	.09 (1)	.91 (10)
Eggs	.18 (2)	.73 (8)	.09 (1)
Ice milk	.00	.18 (2)	.82 (9)
Ice cream	.00	.18 (2)	.82 (9)
Milk	.45 (5)	.36 (4)	.18 (2)
	Controls		
Cheese	.04 (2)	.62 (31)	.34 (17)
Eggs	.40 (20)	.38 (19)	.22 (11)
Ice milk	.02 (1)	.22 (11)	.76 (38)
Ice cream	.04 (2)	.36 (18)	.60 (30)
Milk	.34 (17)	.44 (22)	.22 (11)

A comparison of beverage intake between the experimental and control group was made. The controls showed a higher ratio of one to two cups of coffee consumed daily whereas the ratio of two or more cups consumed daily was

higher in the experimental group. There appeared to be no outstanding difference in the consumption of tea and carbonated beverages (Table 5).

Information on consumption of alcoholic beverages showed that 9 per cent of the experimentals drank alcoholic beverages as opposed to 18 per cent of the controls.

To evaluate the food intakes a comparison of the nutrient intake was made between the two groups. The nutrients studied were protein, carbohydrate, fat, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid, and the results are shown in Table 6. The table has shown whether the experimental subject's intake was higher (H), lower (L), or the same (S) as that of his matched controls for each nutrient.

All of the male experimentals were lower in their caloric intake than their matched controls; whereas, five out of the nine questionnaires returned by the females showed a lower caloric intake. Five males and five females were lower than their controls in their protein intake. The fat intake was lower in five out of six for the males and six out of nine for the females. All of the males had lower carbohydrate intakes while only five of the females showed lower intakes. The mineral intake followed a similar pattern. For calcium, both sexes showed that five had lower intakes than their controls and four males and five females were lower in iron. Vitamins showed the following pattern:

TABLE 5

RATIO OF THE TOTAL NUMBER OF SUBJECTS PARTICIPATING AND THE NUMBER CONSUMING BEVERAGES IN BOTH GROUPS

Beverage	Frequency of Intake				
	Daily			Less Than Daily	Not Within Period
	Less than 1 cup	1 to 2 cups	2 or more		
			Experimentals		
Coffee	.00	.36 (4)[a]	.36 (4)	.09 (1)	.18 (2)
Tea	.00	.36 (4)	.09 (1)	.18 (2)	.36 (4)
Carbonated beverages	.00	.27 (3)	.00	.27 (3)	.46 (5)
			Controls		
Coffee	.00	.48 (24)	.22 (11)	.10 (5)	.20 (10)
Tea	.02 (1)	.36 (18)	.06 (3)	.32 (16)	.26 (12)
Carbonated beverages	.00	.22 (11)	.02 (1)	.18 (9)	.58 (29)

[a]Number of subjects consuming the beverage

TABLE 6

COMPARISON OF AVERAGE NUTRIENT INTAKES OF EXPERIMENTALS WITH THEIR MATCHED CONTROLS

Male Group	Subject Number	Cal.	Pro.	Fat	CHO	Ca.	Fe.	Vit. A	Thia.	Ribo.	Nia.	Asc. Acid
	42E	L[a]	L	L	L	L	L	L	L	L	L	L
	17E	L	L	L	L	L	H	L	L	L	L	H
	20E	L	L	L	L	L	L	L	L	L	H	L
	29E	L	H	L	L	L	H	H	H	S	H	H
	16E	L	L	H	L	H	L	L	H	L	L	L
	16E	L	L	L	L	L	L	L	L	L	L	L

TABLE 6--Continued

Female Group	Subject Number	Cal.	Pro.	Fat	CHO	Ca.	Fe.	Vit. A	Thia.	Ribo.	Nia.	Asc. Acid
	55E	L	L	L	L	L	L	L	S	L	L	L
	29E	H	H	L	H	L	H	L	H	L	H	H
	24E	L	L	L	L	L	L	L	L	L	H	H
	9E	L	L	L	H	L	L	H	L	S	L	L
	9E	L	L	L	L	H	H	L	L	H	L	L
	6E	H	L	L	H	L	H	L	H	L	H	L
	6E	L	H	H	L	H	L	H	L	H	S	L
	36E	H	H	H	H	H	H	H	H	S	H	L
	36E	H	H	H	L	H	L	H	L	H	S	L

five were lower in both groups for vitamin A; four males and five females were lower in thiamin and one female had the same intake; five males and four females were lower in riboflavin with one male and two females having the same intake as their matched controls. Four males and three females had lower niacin intakes and two females had the same intake as their matched controls. In ascorbic acid intake four males and seven females were lower than their matched controls.

In general, the male experimental group showed a nutrient intake lower than that of their matched controls. With the exception of riboflavin and niacin, a majority of the female group was lower in each nutrient as compared to their controls.

Another type of evaluation of food intakes was made by comparing the actual nutrient intakes of each subject with their recommended dietary allowances as established by the Food and Nutrition Board of the National Research Council (Tables 2 and 3, Appendix III). Table 7 shows the percentage of subjects meeting the recommended allowances, two-thirds of the recommended allowances, and less than two-thirds of these allowances.

As a whole a high percentage of the experimental group met the recommended allowances for protein, vitamin A, thiamin, riboflavin, and niacin. The nutrients most deficient in their diets were calories, calcium, iron, and ascorbic acid. Over half of the experimental subjects did not meet two-thirds of the recommended allowances for calories and

TABLE 7

PERCENTAGE OF THE EXPERIMENTAL AND CONTROL SUBJECTS MEETING THE RECOMMENDED DIETARY ALLOWANCES, TWO-THIRDS OF THE ALLOWANCES, AND LESS THAN TWO-THIRDS OF THE RECOMMENDED DIETARY ALLOWANCES

	No.	Cal.	Pro.	Ca.	Fe.	Vit.A	Thia.	Ribo.	Nia.	Asc. Acid
RDA[a]										
E	14	14.3	50.0	7.1	21.4	57.1	64.3	35.7	42.9	35.7
C	71	23.9	74.6	14.1	42.3	52.1	74.6	57.7	54.9	50.7
2/3 RDA										
E	14	28.6	35.7	28.6	35.7	28.6	14.3	42.9	42.9	14.3
C	71	52.1	23.9	26.8	35.2	23.9	21.1	26.8	36.6	22.5
Less than 2/3 RDA										
E	14	57.1	14.3	64.3	42.9	14.3	21.4	21.4	14.3	50.0
C	71	23.9	1.4	59.2	22.5	23.9	4.2	15.5	8.5	26.8

[a]RDA indicates recommended dietary allowances

calcium. One-half of the subjects in this group fell within the less than two-thirds of the recommended dietary allowance level for ascorbic acid while approximately 43 per cent fell within this level for iron.

The nutrients most deficient in the diets of the controls were calcium, iron, vitamin A, and ascorbic acid. Approximately 60 per cent of the controls had an intake of calcium below two-thirds of the recommended dietary allowances.

A survey carried out by the United States Department of Agriculture of the food consumed by 7,500 households in this nation in the spring of 1965 showed a similar pattern (45). Fifty per cent of these households had diets that met the allowances for all nutrients while the other 50 per cent had diets which failed to meet the allowances for one or more nutrients. The nutrients usually found to be below those allowances were calcium, vitamin A, and ascorbic acid.

The recommended dietary allowances have been developed to allow for a margin of safety above average physiological requirements for the general population.

> They provide a buffer against the increased needs during common stresses and permit full realization of growth and productive potential; but they are not to be considered adequate to meet additional requirements of persons depleted by disease or traumatic stresses (4).

The members of this family live under psychological and possibly biological stress and, for this reason, it is felt that they should have diets which meet at least 100 per cent of the recommended allowances for all nutrients.

Limitations of the Study

In studies in which the subjects are volunteers, sample size cannot be controlled. This is especially true when only a limited number are available and return of questionnaires cannot be insured. One of the most limiting factors was the sample size of the experimental group, since only 32 per cent returned the questionnaires. This limited the number of experimentals to eleven, ten of which were studied in detail. This sample size did not allow for either a determination of seasonal variations in food intakes or the determination of food intakes at various age levels to see if differences exist.

In studying environmental factors such as food intakes, long term epidemiological studies would provide more data for an evaluation of the role of diet in disease. This study of a three-day food intake provides only a beginning for the accumulation of such data required, and is, therefore, limited in its use in determining how diet may influence the development of cancer.

The method of obtaining information from a food questionnaire is not as reliable as a diet history carried out by a trained interviewer. Such a person would be able to

gather more information on the dietary background of both the experimental and control groups. The questionnaire gave only limited information and the investigator had to assume that both groups understood how to record foods eaten and had a reasonable concept of average measurements.

Evaluation of Preliminary Data by the Basic Four

Preliminary information on a three-day intake of some of the members of the experimental family was obtained by Dr. Anderton in the spring of 1967. Her data allowed for an evaluation using the basic four food groups (44). Dietary information was obtained on nine subjects (Note Table 8). Four individuals met the daily recommended number of servings in the milk group while only three met the recommended daily servings of fruits and vegetables. All had an intake of two servings or more of meat and five out of nine met the daily recommended servings in the bread and cereal group. Two subjects drank no milk at all. Three subjects consumed less than the recommended one serving daily of a food rich in vitamin C. Three subjects also consumed less than the recommended one serving of a green or yellow vegetable daily. Using the basic four food guide, nutrient intakes cannot be determined, but it is obvious from the composition of the diets listed that the intake of some nutrients would be low and probably inadequate in this group.

TABLE 8

NUMBER OF EXPERIMENTALS MEETING AND NOT MEETING THE BASIC FOUR

Food Group	Recommended Servings	No. Meeting	No. Not Meeting
Milk	2 cups - Adults 3 cups - Children (age 9 - 12)	4	5
Fruit and Vegetables	4 servings	3	6
Meat or Meat Substitute	2 servings	9	0
Bread and Cereal	2 servings	3	6

A SUBJECTIVE EVALUATION

Since the response from the family was not as good as expected, it was thought that an interview with the co-ordinator of the family might reveal something of value concerning overall dietary practices. The interview was held on January 31, 1968. The co-ordinator (Subject Number 2) had the polyps and had undergone the total colectomy in 1958. Questions were asked concerning her eating habits before and after this operation. Her appetite was described as good both before and after it; however, weight gain had become a problem only after the operation. She had never noticed any foods which she could not eat. She did state that certain vegetables such as dry beans and peas, cabbage, and onions give her a griping sensation and, also, that pork is seldom eaten for reasons explained later. In her immediate family the consumption of alcoholic beverages is not practiced. She stated that meats are cooked by either broiling, baking, or roasting in her household and that frying and deep fat frying are avoided. Her food questionnaire was returned in April of 1967 and in comparing the foods which she recorded with the basic four, it was found that she did not get the daily recommended servings of milk, vegetables and fruits, or bread and cereals.

Her father died from pellagra and familial polyposis. She remembered that her father ate frequently the following:

berry pies, hot biscuits, greens, cornbread, sweet potatoes, and cooked cabbage. He seldom ate raw vegetables. She believed that pork was a factor in the development of his pellagra and possibly in the development of polyps.

Subject Number 55, a female, was operated on for familial polyposis in 1964. The diet instructions given to this individual before and after surgery were obtained from Moses H. Cone Memorial Hospital in Greensboro, North Carolina. Several days before undergoing the operation she was placed on a low residue, high protein diet with supplements of vitamins C, K, and B complex. Two days prior to surgery she was placed on a surgical liquid diet. On the fourth day after surgery tea, sugar, jello, and consommés were allowed. A low residue diet followed with half portions of vegetable juices such as carrot and V-8 which could not be tolerated. She was discharged with the diet prescription of a full low residue diet.

In April of 1967 the questionnaire showed that this subject drank no milk for the three-day period and that her diet was below the daily recommended number of servings of fruits and vegetables and breads and cereals. The questionnaire returned in August of 1967 revealed a very poor diet and the subject was under two-thirds of the recommended dietary allowances in her intake of protein, calcium, iron, vitamin A, riboflavin, and

ascorbic acid. Fifty-two per cent of her calories came from fat. This is high considering that in the usual American diet 30 to 45 per cent of the calories are provided by fat (46). She met the recommended allowance for thiamin only.

Subject Number 16 had the polyps at the time of this study. In August thiamin was the only nutrient which was being consumed at the recommended allowance level. His intake of calories, protein, iron, vitamin A, riboflavin, and niacin met two-thirds of the allowances. The intake of calcium and ascorbic acid was below two-thirds of these allowances which are recommended. His diet became more deficient in October, for he was below two-thirds of the recommended allowances for all nutrients, except thiamin and riboflavin which met two-thirds of these allowances.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

Summary

The first purpose of this work was to study and evaluate the food intakes of the members of the polyposis family in relation to that of a group of matched controls without any known intestinal disorders.

The second purpose was to develop a questionnaire which would allow the person receiving it to check the actual amounts of foods eaten on three consecutive days in the middle of the week.

The frequency of the use of certain groups of foods was tabulated for both groups and compared using ratios. The nutrient intakes and the recommended dietary allowances of both groups were determined and evaluated. From this, those meeting the recommended allowances, two-thirds of these allowances, and less than two-thirds of these allowances were found.

There was no outstanding difference in the use of pork, beef, or chicken between the experimental and control group. A greater percentage of the experimentals consumed seafood.

The experimental group appeared to eat more of the medium fiber vegetables daily than did the control group.

The experimental group consumed approximately twice as much coffee daily as the control group. The intakes of cheese, eggs, and ice cream were lower for the experimental group; however, the daily milk intake was higher.

The male experimental group showed a nutrient intake lower than that of their matched controls. The female group was lower also in each nutrient as compared to their controls with the exception of riboflavin and niacin.

In comparing the nutrient intake with the recommended dietary allowances the experimental group was low in calcium, iron, ascorbic acid, and calories. One-half of the experimentals fell within the less than two-thirds of the recommended dietary allowance level for ascorbic acid and approximately 43 per cent fell within this low range for iron.

As a whole, the experimental group showed poor dietary patterns. A greater number of this group had lower intakes of the nutrients as compared to their matched controls. There were lower percentages in the experimental group meeting the recommended dietary allowances than in the control group. Their diets definitely showed a need for improvement and a need for dietary counseling, especially the subject who has the polyps and those who have undergone the operation.

Recommendations for Further Studies

Food intake studies may prove to be of value in research on the etiology of cancer of the large intestine.

Long range epidemiological studies are needed to give a better picture of dietary habits, fluctuations in nutrient intakes over certain periods, role of health status, and various environmental conditions which may influence the overall nutritional status of individuals. It is hoped that this study will serve as a beginning for an accumulation of data which will be used to establish a norm on the types of foods eaten in this area.

Dietary interviews, however, should be the method used for gathering the data instead of food questionnaires because the information on subjects' responses from the food questionnaires was dubious in some instances. A dietary interview would give more precise information on food intakes. After the data has been collected computers need to be used to tabulate the nutrient content of the foods eaten in order to reduce the possibility of human error and to save time.

More research on substances in foods thought to be carcinogenic needs to be done. Types, concentrations, and sources of carcinogens in foods most likely to carry these substances all need further study. The role of water and air pollution also needs to be clarified. The methods of processing, preservation, cooking, and other treatments of foods should be studied.

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APPENDIX I

POTENTIAL ENVIRONMENTAL CARCINOGENS

NATURALLY OCCURRING CARCINOGENS

NON-NUTRITIVE FOOD ADDITIVES AND CONTAMINANTS AS POTENTIAL ENVIRONMENTAL CARCINOGENS

A. Food Additives
   1. Natural and synthetic dyes
   2. Antioxidants of fats and lipids and vegetable matter
      a. Destroyers of peroxides formed during auto-oxidation
      b. Oxygen acceptors
      c. Hydrogen donators
   3. Natural and synthetic mucilages, thickeners, and gelatinous materials
   4. Synthetic sweeteners
   5. Synthetic flavoring agents
   6. Surfactants (detergents, foaming agents)
   7. Humectants
   8. Preservatives and chemical sterilizing agents
   9. Water conditioners (iodine fluorides)
   10. Antifoaming agents
   11. Salt substitutes
   12. Shortenings
   13. Antistaling agents and softeners
   14. Bleaches
   15. Food modifiers and improvers (meat tenderizers, etc.)
   16. Oil and fat substitutes of petroleum derivation
   17. Organic solvents used as vehicles or some additives
   18. Hydrogenated oils and fats (containing saturated, instead of the biologically important unsaturated fatty acids and possibly nickel as a contaminant)
   19. Hygroscopic and anti-hygroscopic agents
   20. Emulsifiers and solidifiers

B. Food Contaminants
   1. Pesticide residues
      a. Bactericides
      b. Insecticides
      c. Rodenticides
      d. Molluscicides
      e. Fungicides
      f. Herbicides
      g. Nematoxides
      h. Defoliants
   2. Antisprouting and antimaturation agents of fruits and vegetables

3. Insect repellents
4. Hormonal fattening agents-estrogens
5. Antibiotics (fed to food animals and added to foodstuffs)
6. Antienzymatics
7. Enzymes
8. Pan glazes (silicones)
9. Pan greases (mineral oils)
10. Water pollutants: coal tars and oils, petroleum tars, asphalts, oils, refinery and coke-oven effluents, chromates, radioactive substances, arsenicals etc.
11. Chemical sterilizing agents
12. Wrapping and coating materials (paraffin, waxes, resins, plastics)
13. Soot adherent to smoked foodstuffs and roasted and toasted products
14. Household detergent and their coloring agents (stilbene derivatives)
15. Non-ionizing radiation (ultraviolet) products
16. Ionizing radiation (radioactive) products
17. Radioactive substances taken up by plants and food animals from contaminated soil or water or adhering to them in form of radioactive fallout

NATURALLY OCCURRING CARCINOGENS--COMPOUNDS OF PLANT AND FUNGAL ORIGIN

A. Plant origin
   1. Safrole in sassafras
   2. Capaicine in chili peppers
   3. Various tannins
   4. Cycasin in cycad groundnut
   5. Pyrrolizidine alkaloids in senecio shrubberry
   6. Parascorbic acid in mountain ash berry

B. Fungal origin--produced by mold
   1. Palutin
   2. Griseofulvin
   3. Penicillin
   4. Aflatoxins
   5. Actinomycins

APPENDIX II

FOOD QUESTIONNAIRE

LETTERS SENT TO EXPERIMENTALS

Subject No._____

FOOD QUESTIONNAIRE (FOOD CHART)

Check ( ) the kinds and amount of foods eaten over a three-day period during the middle of a week.

Meats: 1 serving = usual restaurant serving 2-3 ounces	Date_____ Day I		Date_____ Day II		Date_____ Day III	
	1 or less	2 or more	1 or less	2 or more	1 or less	2 or more
Pork (including sausage, bacon, shoulder, spare ribs, etc.)						
Ham						
Organ meats (liver, kidney, etc.)						
Beef (hamburger, pot roast, stew, etc.)						
Fowl (chicken, turkey, etc.)						
Fish (fresh water)						
Fish (salt water)						
Salmon						

Shrimp and crabs Tuna fish Clams, oysters, scallops Rabbit and squirrel Lamb Soups Pizza Others			
Desserts: 1 slice = 1 serving			
Cake Berry pies Apple pie Peach pie Cherry pie Others			

FOOD QUESTIONNAIRE--Continued

Vegetables c = cup	Date_____ Day I ¼c ½c 1c	Date_____ Day II ¼c ½c 1c	Date_____ Day III ¼c ½c 1c
Asparagus			
Green beans			
Beets			
Broccoli			
Brussels sprouts			
Cabbage (raw)			
Cabbage (cooked)			
Carrots (raw)			
Carrots (cooked)			
Cauliflower			
Celery			
Collards			
Corn			

Cucumbers			
Egg plant			
Turnip greens			
Creesy greens			
Lettuce			
Okra			
Onion (raw)			
Onions (cooked)			
Green peas			
Blackeyed peas			
Peppers			
Pumpkin			
Irish potatoes			
Sweet potatoes			
Rutabagas			
Spinach			
Squash, summer			

FOOD QUESTIONNAIRE--Continued

Vegetables c = cup	Date_____ Day I ¼c ½c 1c	Date_____ Day II ¼c ½c 1c	Date_____ Day III ¼c ½c 1c
Tomatoes (raw) Tomatoes (cooked) Turnips (roots) Others			
Dairy Products c = cup			
Cheese Eggs - Number Ice cream Ice Milk Milk (whole) Milk (skim)			

Others			
Fats			
Butter or oleo Lard, shortening, oils Salad dressings, mayonaise, etc.			
Fruits			
Apples (raw) Apples (cooked) Berries (raw) Berries (cooked) Cantaloupe Figs (raw) Figs (cooked) Bananas Pineapple (raw) Pineapple (cooked)			

FOOD QUESTIONNAIRE--Continued

Fruits c = cup	Date_____ Day I ¼c ½c 1c	Date_____ Day II ¼c ½c 1c	Date_____ Day III ¼c ½c 1c
Plums			
Fruit cocktail			
Grapes			
Grapefruit			
Oranges			
Peaches (raw)			
Peaches (cooked)			
Pears (raw)			
Pears (cooked)			
Persimmons			
Watermelon			
Prunes			
Raisins			

Others				
Breads and Cereals: 1 serving = 1 roll or 1 slice	1 or less / 2 or more		1 or less / 2 or more	1 or less / 2 or more
Biscuits				
Crackers				
Rye Bread				
White Bread				
Whole Wheat				
Dry Cereal				
Grits				
Oatmeal				
Rice				
Corn Bread				
Waffles				
Pancakes				

FOOD QUESTIONNAIRE--Continued

Miscellaneous c = cup	Date_____ Day I ¼c ½c 1c	Date_____ Day II ¼c ½c 1c	Date_____ Day III ¼c ½c 1c
Candy			
Chocolate			
Coconut			
Jelly			
Nuts			
Peanut Butter			
Pickles			
Sugar			
Sirup			
Others			

FOOD QUESTIONNAIRE--Continued

QUESTIONS:

1. What seasonings do you use most often in cooking?
   (a) Fat back (b) Butter or oleo (c) Bacon

2. What method of cooking meats do you use most often?
   (a) Frying (b) Roasting (c) Boiling (d) Broiling

3. I eat canned meats and fish. Often Rarely Never

4. I eat canned vegetables and fruits.
   Often Rarely Never

5. Do you use tobacco? (Yes) (No) If answer is yes, fill in the following:
   a. Number of cigarettes per day_____
   b. Number of cigars per day_____
   c. Pipes - number of times filled per day_____
   d. Chewing tobacco - number of times per day_____
   e. Snuff - number of times per day_____

6. Do you grow any of your food?_____which?
   (a) Fruits (b) Vegetables (c) Ham (d) Chicken
   (e) Others

7. I use the following seasonings:
   a. Mustard
   Often Rarely Never

   b. Horseradish
   Often Rarely Never

   c. Pepper
   Often Rarely Never

   d. Hot Pepper Sauces
   Often Rarely Never

Personal Information

Age_____

Sex_____

Occupation of person who supports family_____

FOOD QUESTIONNAIRE--Continued

QUESTIONS FOR THE CONTROLS:

1. Have you had any surgery on the digestive tract?_____
   If answer is yes - what type of surgery?_____

2. Have you had any X-rays of the gastro-intestinal tract?
   _____
   (Have you ever had a Barium enema or a GI series in which you swallowed a white barium drink and X-rays were taken)_____
   If answer is yes - what did your doctor say the X-rays showed?_____
   Did you have any treatment following the X-rays?_____

3. Have you ever had any prolonged diarrhea lasting more than 2 to 3 days?_____

4. Have you ever had bleeding in stools?_____

5. Has there been any change in your bowel habits in the last six months?_____

THE MOSES H. CONE MEMORIAL HOSPITAL
1200 NORTH ELM STREET
GREENSBORO, NORTH CAROLINA 27402

Dear

As part of the continuing study with which you have previously cooperated, we are trying to find out if certain foods or beverages prevent digestive system diseases from developing and if other foods or beverages irritate the digestive system. In order to discover this we need diet information from many people. We need your help and would appreciate it if you would check the enclosed food chart at the end of each meal for a three day period. This three day period should be during the week and should not include Saturday or Sunday. Please use a separate chart for each family member over 10 years old. Also, please answer the other questions at the end of the food chart for each person.

After the food chart is completed please return it to me in the self-addressed, stamped envelope. This information as with the other information we have obtained with your cooperation, is confidential and your identity will not be revealed in any use of this data in medical publications or presentations of our findings.

We plan to repeat this study in October and will send you another chart then.

Thank you again for your continuing assistance with this study. If you have any questions about this, please feel free to call me at 275-8292, extension 302.

Sincerely yours,

William W. McLendon, M. D.

WWM:jc

THE MOSES H. CONE MEMORIAL HOSPITAL
1200 NORTH ELM STREET
GREENSBORO, NORTH CAROLINA 27402

Dear

As part of the continuing study with which you have previously cooperated, we would like to ask your help again. We would appreciate if you would check the enclosed food chart at the end of each meal for a three day period. The three day period should be during the week and should not include Saturday or Sunday. Please use a separate chart for each family member over 10 years old. Also, please answer the other questions at the end of the food chart for each person.

After the food chart is completed, please return it to me in the self-addressed, stamped envelope. This information, as with the other information we have obtained with your cooperation, is confidential and your identity will not be revealed in any use of this data in medical publications or presentations of our findings.

We plan to repeat this study again during the winter and spring and will send you other charts then.

Thank you again for your continuing assistance with this study. If you have any questions about this, please feel free to call me at 275-8292, extension 302.

Sincerely yours,

William W. McLendon, M.D.

WWM:jmc

APPENDIX III

FIBER CONTENT OF VEGETABLES AND FRUITS

NUTRIENT INTAKES, RECOMMENDED DIETARY ALLOWANCES, AND BIOLOGICAL DESCRIPTIONS OF ALL SUBJECTS

TABLE 1

FIBER CONTENT OF VEGETABLES AND FRUITS PER 100 GRAMS

Fiber Content		
Low 0.0 - 0.5 gm.	Medium 0.51 - 1.0 gm.	High 1.1 gm---
Beets	Asparagus	Baked beans
Cucumbers	Cabbage	Blackeyed peas
Tomatoes	Carrots	Field peas
	Cauliflower	Green peas
Apples (cooked)	Celery	Lima beans
Bananas	Collards	Mustard greens
Cantaloupe	Corn	Pumpkin
Figs	Green beans	Rutabagas
Fruit cocktail	Kraut	
Grapefruit	Lettuce	Apples (raw)
Nectarines	Mushrooms	Blackberries (raw)
Oranges	Okra	Blackberries (cooked)
Peaches (cooked)	Onions	Blueberries (raw)
Plums	Peppers	Pears (raw)
Watermelon	Potatoes	Persimmons
	Spinach	Strawberries
	Squash	
	Sweet potatoes	
	Turnip greens	
	Turnip roots	
	Blueberries (cooked)	
	Grapes	
	Peaches (raw)	
	Pears (cooked)	
	Prunes	
	Raisins	

TABLE 2

AVERAGE OF THREE-DAY NUTRIENT INTAKES OF EXPERIMENTALS, THEIR MATCHED CONTROLS, AND THE AVERAGES OF THE GROUP OF CONTROLS

Subject Number	Cal.	Pro. Gm.	Fat Gm.	CHO Gm.	Ca. Mg.
42E	1201	52	55	132	440
7C	2409	80	92	323	929
50C	2534	107	141	217	903
54C	1960	83	81	236	785
65C	2648	97	136	253	610
105C	1792	63	85	200	821
Average	2269	86	107	246	809
55E	1069	38	79	125	179
55C	1765	45	105	163	167
58C	2421	78	130	244	783
69C	1547	55	117	218	308
Average	1911	60	117	208	420
17E	1438	71	67	145	412
41C	1167	60	103	77	269
52C	2010	85	91	251	832
85C	1960	89	87	214	875
94C	1119	59	73	62	170
99C	2832	106	200	281	860
Average	1818	80	111	177	601
20aE	1557	53	52	155	320
26C	2021	91	112	168	1446
79C	2649	104	141	211	673
104C	1867	89	104	189	358
149C	1078	38	57	119	249
Average	1904	80	103	172	682

TABLE 2--Continued

Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
5	898	.6	.8	8	18
12	1995	1.4	2.0	11	58
14	4140	1.8	2.1	18	58
11	7886	1.1	1.8	16	188
14	5685	1.6	1.6	21	57
7	3705	.8	1.4	9	29
12	4682	1.3	1.8	15	78
7	1839	.9	.6	6	39
9	3375	.7	.6	12	38
12	4822	1.0	1.6	16	53
12	19602	.9	1.9	15	232
11	9267	.9	1.4	14	108
13	6510	1.1	1.2	16	83
12	3120	1.3	.9	19	32
12	8889	1.1	2.1	18	70
13	20738	1.3	3.4	18	54
10	4120	.7	.8	15	25
11	5423	2.0	2.0	15	34
12	8458	1.3	1.8	17	43
7	5363	.7	1.0	21	36
10	3208	1.3	2.9	12	35
19	20033	1.3	2.9	14	35
12	4616	1.5	1.2	16	82
7	5964	.5	.7	9	42
12	8455	1.2	1.9	13	48

TABLE 2--Continued

Subject Number	Cal.	Pro. Gm.	Fat Gm.	CHO Gm.	Ca. Mg.
24E	1850	72	80	219	664
29C	1729	52	94	176	449
38C	2298	61	124	270	665
74C	2651	117	111	312	959
Average	2226	77	110	253	691
29aE	2005	106	99	181	733
40C	2733	103	144	313	590
43C	2258	80	127	242	873
118C	2131	74	112	235	920
Average	2374	86	127	263	794
16E	1505	61	82	132	526
97C	1428	68	71	133	471
98C	1561	79	66	68	388
100C	1722	56	62	251	420
Average	1570	68	66	151	426
16E	1265	42	71	119	393
97C	1932	87	122	191	686
98C	2182	94	108	215	463
100C	1241	55	49	145	223
Average	1785	79	93	184	457

TABLE 2--Continued

Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
12	10465	1.2	1.5	21	155
11	7795	1.0	1.1	12	112
13	24036	3.9	2.4	17	116
17	1296	1.6	2.2	22	133
14	14929	2.2	1.9	17	121
17	5378	1.7	1.7	22	132
14	3305	1.5	1.5	20	53
14	7383	1.4	1.9	12	92
10	2591	1.0	1.7	14	82
12	4426	1.3	1.7	15	75
8	4264	1.2	1.3	12	39
10	3526	.9	3.5	15	69
10	17656	1.2	2.3	17	82
9	5063	1.2	1.2	15	103
10	8748	1.1	2.3	16	85
7	2633	1.0	1.0	8	35
14	9219	1.4	1.6	22	81
15	20724	1.3	2.5	19	91
9	5434	.6	.8	13	62
13	11792	1.1	1.6	18	78

TABLE 2--Continued

Subject Number	Cal.	Pro. Gm.	Fat Gm.	CHO Gm.	Ca. Mg.
9E	1169	48	50	133	384
111C	1720	73	116	138	404
112C	1151	44	52	122	338
114C	1608	63	84	126	503
Average	1493	60	84	128	415
9E	918	50	35	106	1113
111C	1836	72	69	236	608
112C	1221	44	53	127	324
114C	1988	85	137	159	432
Average	1682	67	86	174	455
36E	1857	72	106	195	604
9C	1624	44	72	204	384
103C	2114	92	123	227	668
150C	1665	46	86	186	473
152C	1648	75	91	136	865
Average	1763	64	93	188	597
36E	1746	80	88	174	625
9C	1998	85	95	212	407
103C	2159	92	130	202	439
150C	1372	38	57	185	255
152C	1317	80	65	117	782
Average	1712	74	87	179	471

TABLE 2--Continued

Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
6	3834	.4	.9	10	14
8	2202	.9	1.0	17	24
6	1195	.7	.8	8	48
9	2855	.8	.9	9	57
8	2084	.8	.9	11	43
10	26020	1.3	1.8	10	60
9	6025	.8	1.2	14	78
6	2651	.6	.8	12	104
13	6829	.7	1.6	17	102
9	5169	.7	1.2	14	95
10	3532	1.6	1.4	12	84
10	1507	.9	.9	10	104
13	5629	1.7	1.8	14	48
8	4105	.7	1.0	9	110
8	2881	1.1	1.8	11	108
10	3520	1.1	1.4	11	93
10	4550	1.1	1.5	13	33
12	2051	1.6	1.0	15	68
12	4729	1.5	1.3	15	65
8	7552	.8	.8	9	163
9	3807	1.3	1.7	11	116
10	4535	1.3	1.2	13	103

TABLE 2--Continued

Subject Number	Cal.	Pro. Gm.	Fat Gm.	CHO Gm.	Ca. Mg.
6E	1888	63	72	251	362
13C	2208	86	139	202	636
33C	1337	49	57	147	357
39C	1655	87	77	164	474
63C	1586	60	81	157	264
67C	1859	89	90	179	396
Average	1729	74	89	170	426
6E	1640	59	76	198	320
13C	1574	81	101	140	326
33C	1214	53	48	148	391
39C	2162	98	118	183	443
63C	1529	65	71	165	428
67C	2140	86	108	208	539
Average	1723	77	89	169	425

TABLE 2--Continued

Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
14	5697	1.2	1.0	17	67
14	4166	1.8	1.7	14	78
38	16810	.6	2.0	16	35
13	9346	1.5	1.3	19	96
10	3567	1.0	1.2	15	40
15	20689	1.6	2.4	22	168
12	10915	1.3	1.7	17	82
12	24471	.9	2.0	15	82
12	6207	1.4	1.3	14	40
8	5547	.6	.9	13	60
14	3790	1.7	1.4	19	32
10	4997	.9	1.4	13	122
15	24082	1.3	2.4	21	135
12	8924	1.2	1.5	16	78

TABLE 3

CALCULATED RECOMMENDED DIETARY ALLOWANCES ON THE BASIS OF HEIGHT, WEIGHT, AND AGE OF ALL SUBJECTS

Subject Number	Cal.	Pro. Gm.	Ca. Mg.	Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
42E	2500	46	1100	15	4500	1.0	1.5	17	70
7C	2350	60	1100	15	4500	.9	1.4	16	70
54C	2900	74	1100	15	4500	1.2	1.7	19	70
50C	2700	66	1400	15	5000	1.1	1.6	18	80
65C	3100	82	1100	15	4500	1.2	1.9	20	70
105C	2850	70	1400	15	5000	1.1	1.7	19	80
55E	1950	52	800	15	5000	.8	1.2	9	70
55C	2000	55	800	15	5000	.8	1.2	13	70
58C	2200	62	800	15	5000	.9	1.3	15	70
69C	2100	59	800	15	5000	.8	1.3	14	70
17E	2900	80	800	10	5000	1.2	1.7	19	70
41C	2450	65	800	10	5000	1.0	1.5	16	70
52C	2950	72	800	10	5000	1.2	1.8	19	70
85C	2850	69	800	10	5000	1.1	1.7	19	70
94C	2800	76	800	10	5000	1.1	1.7	19	70
99C	2450	65	800	10	5000	1.0	1.5	16	70
29aE	3100	76	800	10	5000	1.2	1.9	20	70
40C	2650	72	800	10	5000	1.1	1.6	18	70
43C	3100	76	800	10	5000	1.2	1.9	20	70
118C	2600	69	800	10	5000	1.0	1.6	17	70

TABLE 3--Continued

Subject Number	Cal.	Pro. Gm.	Ca. Mg.	Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
20aE	3200	80	800	10	5000	1.3	1.9	21	70
26C	3100	76	800	10	5000	1.2	1.9	20	70
79C	3100	76	800	10	5000	1.2	1.9	20	70
104C	3100	76	800	10	5000	1.2	1.9	20	70
149C	2850	69	800	10	5000	1.1	1.2	19	70
24E	1550	55	800	10	5000	.8	.9	9	70
29C	1550	55	800	10	5000	.8	.9	9	70
38C	1550	55	800	10	5000	.8	.9	9	70
74C	1900	59	800	10	5000	.8	1.1	9	70
16E	2150	69	800	10	5000	.9	1.3	14	70
97C	2600	69	800	10	5000	1.0	1.6	17	70
98C	2800	76	800	10	5000	1.1	1.7	19	70
100C	2800	76	800	10	5000	1.1	1.7	19	70
9E	1900	50	800	15	5000	.8	1.1	9	70
111C	2100	59	800	15	5000	.8	1.3	14	70
112C	1950	52	800	15	5000	.8	1.2	9	70
114C	2000	55	800	15	5000	.8	1.2	13	70
36E	2100	59	800	15	5000	.8	1.3	14	70
9C	2100	59	800	15	5000	.8	1.3	14	70
103C	2100	59	800	15	5000	.8	1.3	14	70
150C	1950	52	800	15	5000	.8	1.2	9	70
152C	2000	55	800	15	5000	.8	1.2	13	70

TABLE 3--Continued

Subject Number	Cal.	Pro. Gm.	Ca. Mg.	Fe. Mg.	Vit. A I.U.	Thia. Mg.	Ribo. Mg.	Nia. Mg.	Asc. acid Mg.
6E	1700	50	800	15	5000	.8	1.0	9	70
13C	2000	62	800	15	5000	.8	1.2	13	70
33C	1950	52	800	15	5000	.8	1.2	9	70
39C	2100	59	800	15	5000	.8	1.3	14	70
63C	1950	52	800	15	5000	.8	1.2	9	70
67C	2000	62	800	15	5000	.8	1.2	13	70

TABLE 4

BIOLOGICAL DESCRIPTION OF SUBJECTS AND TIME OF PARTICIPATION

Month	Subject Number	Age	Sex	Height ft.	Weight lb.
August	42E-Risk	11	M	4'8"	95
	7C	10	M	4'6½"	69
	54C	10	M	5'½"	77
	50C	12	M	4'10"	91
	65C	11	M	5'2"	125
	105C	12	M	5'	84
	55E-Colectomy	23	F	5'2"	155
	55C	19	F	5'4"	138
	58C	32	F	5'8"	176
	69C	18	F	5'5½"	130
	17E-Risk	55	M	6'2"	190
	41C	53	M	5'6"	165
	52C	43	M	5'10"	155
	85C	52	M	5'8"	175
	94C	49	M	6'	168
	99C	54	M	5'5"	184
October	20aE-Risk	25	M	6'2"	190
	26C	28	M	5'11"	150
	79C	34	M	6'	185
	149C	32	M	5'9"	155
	104C	32	M	6'	188
	24E-Risk	74	F	5'3"	170
	29C	73	F	5'4"	140
	38C	72	F	5'3"	125
	74C	64	F	5'5½"	115
	29aE-Risk	42	M	5'11½"	221
	40C	47	M	5'10"	165
	43C	36	M	5'11"	168
	118C	55	M	5'8"	138

TABLE 4--Continued

Month	Subject Number	Age	Sex	Height ft.	Weight lb.
August and October	16E-Polyps	67	M	5'7"	161
	97C	56	M	5'7"	157
	98C	58	M	6'	180
	100C	56	M	6'	185
	9E-Risk	27	F	5'3"	110
	111C	26	F	5'6"	125
	112C	25	F	5'2½"	112
	114C	22	F	5'4½"	113
	36E-Risk	27	F	5'6"	135
	9C	32	F	5'5½"	135
	103C	25	F	5'7"	123
	149C	22	F	5'1"	115
	152C	23	F	5'4"	120
	6E-Risk	47	F	5'	160
	13C	49	F	5'7"	136
	33C	44	F	5'2"	150
	39C	43	F	5'5½"	132
	63C	41	F	5'2"	146
	67C	53	F	5'7"	200
Additional Controls					
	29bC	40	F	5'5"	117
	31C	37	F	5'3"	145
	51C	37	F	5'4"	115
	53C	36	F	5'2½"	137
	57C	39	F	5'	185
	61C	38	F	5'2"	104
	6XC	47	M	6'	190
	32C	37	M	5'8"	195
	60C	38	M	5'9"	175
	65C	40	M	5'11"	192
	93C	53	M	6'1"	245
	115C	37	M	5'11"	160