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A Comprehensive Effect of Diet Upon Chronic Degenerative Diseases



*T.C. Campbell, Ph.D., Jacob Gould Schurman, Professor of Nutritional Biochemistry,
Division of Nutritional Sciences, Cornell University, Ithaca, New York*

Abstract

Data available from the first phase (1983) of the Nina-Cornell-Oxford project on diet and disease in China has resulted in numerous analyses of various nutritional and health outcomes. The findings and results of these various studies indicate consistent support for a hypothesis that postulates that the chronic degenerative diseases share a common nutritional etiology and that a diet enriched in a variety of plant foods minimizes the development of these diseases. A general overview of the study design, survey features and analytical methods reveal the comprehensive and unique nature of this diet-disease relationship. The evidence supporting this hypothesis for various site-specific (stomach, liver, breast, colon) cancers is remarkably consistent. An analysis of antioxidant status and cancer mortality also lends support to this general hypothesis. Mean dietary fiber intake was 33 grams/day for a reference man (highest county mean is 77 grams/day), and although there has been speculation that mineral status may be compromised, there is no evidence thus far produced in this study to suggest that this is a problem. (Chiefly funded by U.S. National Institutes of Health and Chinese Academy of Preventive Medicine.)

For many decades, even centuries, the food people ate was known to be associated with the diseases people got. Then, in the first half of this century, modern methods of nutrition research were used to show that certain diseases, mostly of the young and the poor, could be prevented by consuming very small amounts of essential micronutrients, or vitamins. By mid century, much of this work was well in hand and recommended intakes of these vitamins, along with various minerals, were proposed.

A nutritional link to these degenerative diseases was indicated by two especially interesting observations. First, the prevalence of these diseases among various populations was strongly correlated with diets lacking in dietary fiber(1) and rich in fat and foods of animal origin(2, 3, 4); and second, and perhaps most significantly, people who migrated to new societies, and who accordingly changed their diets but not their genes, assumed the risk of disease of the society to which they moved (5, 6). This latter observation pointed toward a major role for dietary and lifestyle factors in disease causation. Researchers drew inferences and established hypotheses, consumer interest grew, and government institutions began to take note. New dietary recommendations on the prevention of these diseases were formulated, first for heart disease, then for cancer (reviewed in(7, 8)). Particular emphasis was given to the need to increase consumption of fruits, vegetables and cereal products in order to increase the intake of complex carbohydrates, dietary fiber and micronutrients thought to prevent these diseases. One recommendation was particularly note worthy, namely to decrease total fat intake from 38-40% of calories to

30% of calories. This was considered to be a practical target(8, 9, 10), fairly easily achieved by decreasing the use of added fats and oils and replacing high fat meats and dairy products with low fat counterparts. In this way, the types of food usually consumed could be retained as long as their low fat, low cholesterol varieties were chosen.

As this phase of research drew to a close, nutrition researchers then turned their attention to the possible involvement of nutritional factors in the chronic degenerative diseases, the cancers and the cardiovascular diseases, and certain other diseases which occur mostly in mid and older ages.

However, some of these reports (9, 10) cautioned that a decrease in fat intake only to 30% of calories might not be enough, that diets richer in plant foods and still lower in fat might be necessary. How much lower was not an easy question to answer. In richer societies, the number of people consuming low fat, plant rich diets have been too few for study. In poorer societies, although most diets contain a large amount - but a minimal variety - of plant foods, there have been too few data to make a comprehensive evaluation of diet and disease. Fortunately, a unique opportunity then arose in The People's Republic of China to undertake a study to fill this void. Chinese scientists had published in 1981 an atlas of cancer mortality which showed that, for about a dozen different sites, cancers were localized to specified geographic regions(11). This presented an unusually promising opportunity to investigate possible risk factors within these regions, an opportunity made particularly valuable by the facts that the vast majority of people lived in these regions all of their lives, that they consumed only the locally produced food, and that diets were stable over time because of the uniquely regional climatic and geographic conditions of food production.

A study thus was organized in rural China in 1983-84 to survey 65 counties, 2 villages per county (to assess data consistency) and 100 adult subjects per county, for multiple dietary and lifestyle characteristics. Questionnaires were completed, food intakes over 3 days were carefully recorded, and blood, urine and food samples were collected for later analyses. Eventually 367 items of information were judged to be reliable and were published in monograph form(12). Of particular interest was the large number of dietary and nutritional variables which encouraged a comprehensive evaluation of nutritional effects upon disease occurrence.

One of the features of this study, its experimental design, requires comment. This investigation used a cross-sectional, ecologic study design which means that it produced correlations (associations) between various dietary and lifestyle factors with various disease mortality rates. Studies of this type generally are considered somewhat limited in that they only suggest but do not confirm possible causal relationships. Thus, these studies mostly are limited to the generation of new hypotheses. The reasoning for this concern (at least for previous studies) is that too many factors remain unmeasured, data on different populations are collected by different procedures, and the populations under comparison usually are of different genetic backgrounds(13). These are legitimate concerns when single factors or single foods are sought as causes of disease. However, in this study in China, these limitations are of much less concern since the same experimental procedures were used for all regions being compared, genetic backgrounds were very similar and, most importantly, a comprehensive collection of dietary and lifestyle variables were

recorded(12). This latter advantage is particularly important because comprehensive causes, as represented by major dietary trends, can be investigated by examining the associations of many different but related factors included within this 'comprehensive' cause. For example, to test the comprehensive hypothesis that a diet rich in foods of plant origin but sparing in foods of animal origin minimizes risk for the so-called 'diseases of affluence,' it was possible in this study to obtain evidence on causality by simultaneously examining many different variables which describe this comprehensive effect.

There are several thousands of statistically significant associations in this data set, and the task is to sort out those which are biologically plausible from those which are there by chance alone. The following represents a selection of a few of the interpreted and/or published associations which are concerned with the effects of nutrition on chronic degenerative disease etiology.

First, it was found that the average dietary and nutritional characteristics of people in rural China(12) are very different from the average characteristics of Western diets (Table 1) (although diet compositions in both societies vary considerably). Particularly significant indicators of the Chinese diet are the very low intakes of fat (6-24% of calories), the relatively high intake of carbohydrate (almost all starch-like), the very high intakes of dietary fiber, the relatively low intake of total protein; and the especially low intake of animal protein. Cereal grains (corn, wheat, millet), certain tubers, and vegetables are the main fiber sources. In essence, diets in rural China are mostly comprised of foods of plant origin. Interestingly, total calorie intake in rural China is considerably higher than the U.S., yet excess body weight is considerably lower. The combination of consuming an energy dilute diet, along with regular physical activity, is thought to be responsible for this effect. Thus, these dietary characteristics in rural China offer opportunities not heretofore possible for evaluation of the hypothesis that diets rich in foods of plant origin (with little or no added fat) prevent the development of chronic degenerative diseases. Moreover, lifelong use of these diets implies a high degree of nutritional adaptation, a point rarely considered in most intervention trials and metabolic studies of Western subjects.

The nutritional consequences of such a diet may be illustrated by considering the case of plasma cholesterol, a particularly good biomarker of the nutritional richness of these diets. Plasma cholesterol is markedly lower in rural China; Chinese high levels approximate U.S. low levels. Within the higher cholesterol range of Westerners, meat, total fat, animal protein, and lack of fiber in the diet increase this biomarker. These same factors also seem to operate within the lower Chinese cholesterol levels, but in this case, only small additions of meat and fat and modest decreases in their usually high fiber intakes appear to significantly elevate cholesterol ($p < .01$ to $p < .05$).

Even though the range of plasma cholesterol was relatively low in China, nonetheless within this range, elevated cholesterol was associated with increased mortality rates for these diseases. This can be seen in several ways. First, plasma total cholesterol and LDL cholesterol were significantly and positively correlated with most of the cancer mortality rates ($p < .05$ to $p < .01$)(16). Second, plasma Blipoprotein levels, an indicator of the so-called 'bad' cholesterol, was positively correlated with coronary heart diseases ($p < .01$)(17). Third, an aggregate group of these diseases (cancers, heart disease and diabetes) was found to have rather similar regional distributions, while the most significant biochemical

marker of disease prevalence within these geographic regions was plasma cholesterol ($p < .001$)(18). And fourth, the major correlates of liver cancer, commonly found in poor countries, were plasma cholesterol ($p < .001$) and persistent infection with hepatitis B virus ($p < .001$)(19). This latter finding was particularly interesting in that aflatoxin, a well known chemical carcinogen for experimental animals, was not correlated with liver cancer. Thus, the occurrence of this cancer may be explained by a combined effect of nutrition and persistent viral infection (high in China) without including an effect of a chemical carcinogen.

Overall, these associations of plasma cholesterol suggest that the lower the cholesterol, the lower the prevalence of these diseases. Furthermore, a diet containing even quite small amounts of added fat and animal foods increase cholesterol levels, among many other effects, all of which point to increased disease susceptibility.

And there is other evidence from this study which further supports this view. Breast cancer, after controlling for the usual risk factors, is positively correlated ($p < .05$) with dietary fat, which ranges from 6% to 24% of calories(20). Animal protein intake for men, ranging from 0 to 20% of total protein, is positively correlated with plasma total cholesterol ($p < .01$) and LDL cholesterol ($p < .001$) whereas plant protein intake, consumed at much higher levels, is inversely correlated with these cholesterol fractions ($p < .01$)(16). Again, the positive association with animal protein is especially remarkable in view of its already very low intake.

These and other findings from this project support the hypothesis that diets must be largely, if not entirely, based on a variety of foods of plant origin, with little or no added fat, in order for chronic degenerative disease risks to be minimized. Such diets would be high in complex carbohydrate and very low in fat and foods of animal origin. This conclusion, although provocative, must be taken seriously both because of the comprehensive nature of these findings and because of the fact that the individuals included in this study were adapted to these diets, a feature almost always missing from studies on Western subjects. Perhaps the most provocative finding in this study is the observation that diets very rich in foods of plant origin are more beneficial than diets merely rich in such foods. These findings also suggest that the current U.S. dietary guidelines, which generally are targeted to 30% total fat and which still permit a relatively rich supply of presumably low-fat foods of animal origin, are not likely to achieve comprehensive prevention of chronic degenerative diseases. More emphasis must be given to an increased consumption of fruits, vegetables, and cereals. Much more information will be added to this study when the results of a second, larger and more recent survey in mainland China and Taiwan become available.