DOCUMENT RESUME

ED 321 997 SE 051 505

AUTHOR Roehrig, Karla L.
TITLE Risk Factors and Disease Prevention. Nutrition in Health Promotion Series, Number 19.
INSTITUTION Ohio State Univ., Columbus. Dept. of Family Medicine.
SPONS AGENCY Health Resources and Services Administration (DHHS/PHS), Rockville, MD. Bureau of Health Professions.
PUB DATE 85
CONTRACT 240-83-0094
NOTE 40p.; See SE 051 486 for "Comprehensive Guide and Topical Index" to Modules 1-26. See SE 051 487-502 for Modules 1-16, "Primary Care Series" and SE 051 503-512 for "Nutrition in Health Promotion" series.
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Cancer; Cardiovascular System; *Dietetics; Disease Control; Health Education; Higher Education; *Independent Study; *Medical Education; Medicine; Nutrition; *Nutrition Instruction; Physiology; *Preventive Medicine; *Risk; Science Education; Special Health Problems; Teaching Methods

ABSTRACT

Nutrition is well-recognized as a necessary component of educational programs for physicians. This is to be valued in that of all factors affecting health in the United States, none is more important than nutrition. This can be argued from various perspectives, including health promotion, disease prevention, and therapeutic management. In all cases, serious consideration of nutrition related issues in the practice is seen to be one means to achieve cost-effective medical care. These modules were developed to provide more practical knowledge for health care providers, and in particular primary care physicians. This module is designed to aquaint the primary care physician with the role risk factors play in the disease process and to identify how risk factors (such as diet) may be modified in order to lessen the threat of chronic disease. Cardiovascular disease and cancer are used as models for the application of risk factor analysis in disease prevention. Included are learning goals and objectives, a self-check of achievement with regard to goals, and references. (CW)

The Nutrition in Primary Care Series Contains These Modules:

1. Nutrient Content of Foods, Nutritional Supplements, and Food Fallacies
2. Appraisal of Nutritional Status
3. Nutrient and Drug Interactions
4. Normal Diet: Age of Dependency
5. Normal Diet: Age of Parental Control
6. Normal Diet: Adolescence
7. Normal Diet: Pregnancy and Lactation
8. Normal Diet: Geriatrics
9. Dietary Management in Obesity
10. Dietary Management in Diabetes Mellitus
11. Dietary Management in Hypertension
12. Dietary Management in Hyperlipidemia
13. Dietary Management in Gastrointestinal Diseases
14. Dietary Management for Alcoholic Patients
15. Nutritional Care of Deteriorating Patients
16. An Office Strategy for Nutrition-Related Patient Education and Compliance

The Nutrition in Health Promotion Series Contains These Modules:

17. Individual and Social Factors
18. Metabolic Principles
19. Risk Factors and Disease Prevention
20. Decoding Fad Diets
21. Protecting Bone and Teeth
22. Exercise and Physical Activity
23. Vitamins and Trace Minerals
24. Behaviorial and Neurological Disorders
25. Preventing Hospital and Home Malnutrition
26. Questions About Common Ailments

Faculty Guide (includes comprehensive index for Modules 1-26)

Department of Family Medicine
College of Medicine - The Ohio State University
456 Clinic Drive - Columbus, Ohio 43210

19 Nutrition in Health Promotion: Risk Factors and Disease Prevention

Karla L. Roehrig, Ph.D.
Associate Professor
Department of Food Science and Nutrition
The Ohio State University
Columbus, Ohio

Project Editor
Lawrence L. Gabel, Ph.D.

Nutrition Content Editor
Charlette R. Gallagher-Allred, Ph.D., R.D.

Family Medicine Content Editor
Patrick J. Fahey, M.D.

Contract Number: 240-83-0094

U.S. Department of Health and Human Services
Public Health Service
Health Resources and Services Administration
Bureau of Health Professions
Division of Medicine

Project Officer: Margaret A. Wilson, Ph.D.

Acknowledgments

Project Staff

Lawrence L. Gabel, Ph.D.-Project Director, Associate Professor and Director, Graduate Education and Research Section, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Joan S. Rehner-Project Assistant, Secretary, Graduate Education and Research Section, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Patrick J. Fahey, M.D.-Family Medicine Coordinator, Assistant Professor and Director, Predoctoral Education Section, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Charlette R. Gallagher-Allred, Ph.D., R.D.-Nutrition Coordinator, Nutritionist, Riverside Methodist Hospital, Columbus, Ohio

John S. Monk, Ph.D.-Evaluation Coordinator, Assistant Professor and Coordinator, Research and Evaluation, Graduate Education and Research Section, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Independent Study Package Consultant

Tennyson Williams, M.D., Professor and Chairman, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Nutrition Consultant

Jil Feldhausen, M.S., R.D., Nutritionist, Department of Family & Community Medicine, University of Arizona, Tucson, Arizona

Editorial Consultant

Chester E. Ball, M.A., Assistant Professor Emeritus, The Ohio State University

Technical Assistants

Annette M. Battafarano, M.A., Graduate Research Associate, Graduate Education and Research Section, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Richard E. Doty, M.S., Graduate Research Associate, Graduate Education and Research Section, Department of Family Medicine, The Ohio State University, Columbus, Ohio

Criteria/Assessment Committee

Mark T. Winders, M.D., Resident, Department of Family Medicine, The Ohio State University, Columbus, Ohio

David R. Rudy, M.D., Director, Monsour Family Practice Residency Program, Monsour Medical Center, Jeannette, Pennsylvania.

Maria Steinbaugh, Ph.D., Associate Director, Nutrition Services, Ross Laboratories, Inc., Columbus, Ohio

Wilburn H. Weddington, M.D., Family Physician, Columbus, Ohio

A special note of appreciation is extended to persons in family practice residency programs and universities throughout Ohio for reviewing the materials and to the faculty and residents of the Central Ohio Affiliated Family Practice Residency Programs where the materials were piloted:

Grant Hospital, Columbus, Ohio
Riverside Methodist Hospital, Columbus, Ohio
University Hospital, Columbus, Ohio
Mt. Carmel Hospital, Columbus, Ohio

Composition. Camera Work, Reproduction and Binding: Lesher Printers, Fremont, Ohio

Library of Congress Catalog Card Number: 85-62199

Contents

Tables

Figure

Index

Introduction

Some of our habits, occupations, or even personality traits seem to be associated with increased risks for developing certain diseases. Some of the risks are obvious. Other risks are not nearly so apparent. They may also not be immediate; for example, it may take years of exposure to a particular chemical to develop a problem. On the other hand, the exposure to a chemical may be for a limited period, but it may take years for an associated disease to become apparent.

In order to (1) better monitor patients' long-term health; (2) make educated judgments about which disease to watch for in particular cases; and (3) counsel patients about modifications in lifestyle to reduce their risks for various diseases, one needs to know about risk factor analysis. Since it is difficult for most of us to change lifelong patterns, the primary care physician must make rational decisions about recommending various changes with which the patient may have difficulty complying. It is also easier, and perhaps more useful, to instill habits in younger patients than it is to change the habits of older patients.

Unfortunately, many people, including physicians, would like assurances that following a certain regimen will absolutely protect a person from disease. This module stresses that risk factor analysis is only a statistical tool; guarantees from this approach for lessening chances for acquiring a disease cannot be given or even implied. Further, in considering risk factors, the physician should always keep in mind the underlying biochemistry and physiology of the disease state. This will provide additional insight into the relevance and importance of a risk factor. For example, chemical X is detoxified by the liver and is associated with increased risk for some type of cancer. "Normal" patients and those with liver disease or a deficiency of certain detoxifying enzymes will clearly not have the same risk. Factors which may be of risk to some patients may not be of risk to all patients. It is the physician's responsibility to determine who is at risk. Then it is necessary to determine whether alteration of some factor in a patient's lifestyle is of sufficient benefit to outweigh the difficulties in complying with the change.

Goal

The goal of this module is to acquaint the primary care physician with the role risk factors play in the disease process and to identify how risk factors (such as diet) may be modified in order to lessen the threat of chronic disease. Cardiovascular disease and cancer are used as models for the application of risk factor analysis in disease prevention.

Objectives

Upon completion of this module, you will be able to:

1. *Discuss how risk factors are determined.*
2. *Determine how much confidence can be placed in risk factor analysis.*
3. *Detail the risk factors for:*
   a. Cardiovascular disease, and
   b. cancer.
4. *Identify what steps may be taken to reduce the risks of cardiovascular disease and cancer, with special emphasis on dietary considerations.*
5. *Assess appropriate modifications of lifestyle and diet for the reduction of disease-related risks.*

Determination of Risk Factors

Risk factors are characteristics believed to be associated with susceptibility to various diseases and are determined largely from epidemiological studies.

Certain lifestyles or physical traits seem to be associated with susceptibility to certain disease states. A risk factor is a characteristic which has a high degree of correlation with contracting a particular disease or syndrome. The study of the association of selected variables with particular diseases is known as risk factor analysis and in human populations draws largely from epidemiological studies.

Retrospective studies make use of patient records or interviews with patients with and without a disease. Prospective studies follow a population group exhibiting a particular characteristic in order to determine how many develop a disease as compared to a group without the characteristic.

Human studies can be divided into two types: observational and experimental.[1] Observational studies can be further divided into retrospective or prospective studies. Retrospective studies make comparisons between those individuals who have a disease and those who do not; they are conducted using patient interviews or reviews of records. The frequencies of a particular factor, occurring within a sample having a disease and in a control sample, are determined to establish whether a statistically significant difference exists. If a statistical difference exists, it is taken as an indication of association between the factor and the disease. Such an association should never be construed as indicative of causation.

Several sources of error are routinely associated with retrospective studies: (1) a disease may influence a patient's environment causing sampling errors; (2) interviews may rely on patients' fallible long-term memories; and (3) records may indicate data and observations consistent with past but not current beliefs and reporting practices. Sample selection for retrospective studies can be difficult. It is assumed that selected disease cases are representative of all disease cases, that the control sample is representative of the healthy population (free of the disease in question), and that both samples can be clearly identified. Biases may be introduced in selection based on age, sex, or race. If hospital records are used, the sample is not usually random because of the skew represented by hospital admissions.

Prospective studies are also observational. In these studies, a sample of persons is determined to have or not to have a certain characteristic and then is followed over time to ascertain whether the persons develop a particular disease. Such studies may be concurrent; i.e., people with and without a characteristic are selected at the same time and followed for a given period. In non-concurrent studies, groups are selected historically and traced to the present. In both types of prospective studies, there may be difficulty in maintaining follow-up records because patients may enter and leave the study at various times for a variety of reasons, leading to differences in the observational period. There may be changes in the overall population demographics which could confound the original objectives. There might also be insufficient numbers of the disease cases which appeared in the observational period to validate the results statistically.

In clinical trials, people are randomly assigned to treatment groups, and in double-blind clinical trials neither the subjects nor the researchers know who is in which group.

Human studies may be experimental rather than observational, taking the form of clinical or community trials. In a clinical trial, the population sample is randomized for allotment into groups. These trials may be therapeutic, intervention, or preventive trials. Control groups for these studies may consist of actual persons; or when there are strong reasons for believing a treatment should not be withheld, the control population may consist of historical cases treated in some different manner. To ensure integrity of the data, especially when the determined effect may be highly subjective, studies should be conducted at least as double-blind experiments; neither the patient nor the observers know whether a person is receiving a treatment or a placebo. Triple-blind experiments carry this further to include those evaluating the data. The studies are performed only on volunteers, which may in itself introduce a bias since they may possess characteristics not typical of the usual patient.

In community trials, the entire population is subjected to some treatment or program (such as fluoridation of water or nutrition education) and compared to some other demographically similar group. These studies do not usually have randomized treatment groups and any given individual has relatively less importance to a particular study than for the ordinary smaller clinical trial.

Risk factor analysis cannot determine cause and effect, but if a dose response between a risk factor and a disease can be established, then the possibility of a causal link is strengthened.

Under no circumstances can data collected from observational types of studies be used to determine direct cause and effect. Too often the presence of an elevated relative risk is interpreted to imply causality. It is difficult to determine whether a characteristic is directly linked to a disease (primary risk factor) or whether the characteristic is linked to a second factor which is itself linked to the disease (secondary risk factor). Further, associations may be relevant or irrelevant, depending upon the soundness of the original hypothesis and controls. For example, all people who eat pickles die. That does not mean, however, that pickles kill people. If a dose response related to a particular risk factor and an associated disease can be established, then the possibility of causality is strengthened. Data from epidemiological studies, although they can never determine cause and effect, do provide a valuable base on which to design and execute experiments to determine the potential mechanism of action of a particular risk factor.

The implied importance of risk factors to disease must be supported by experimental data in order to have any validity. In turn, intervention is not justified unless there is (1) no possibility for harm, and (2) substantial evidence for benefits.

The dangers and fallacies of using epidemiological data alone have been examined. Hulley *et al.*[2] pointed out that evidence from many types of studies should be examined in order to support or refute the association of a risk factor with disease. They suggested using observational studies in combination with experimental studies (1) over time, (2) by country, (3) by dose response, (4) by chronology, and (5) with multivariate analyses to detect interacting parameters to establish links at the molecular level. They strongly suggested that intervention is not justified unless there is no possibility for harm and, also, there is substantial evidence of benefit. Bailar[3] emphasized the need for standardization in the collection of epidemiological data to avoid problems of biased, missing, or incomplete data. A second major problem, as Bailar sees it, is that analysis of epidemiological data relies to a great extent on interpretation, and, therefore, epidemiological studies must be supported by experimental studies where this is much less of a problem. The use of these sorts of data to influence broad public policy has been discussed by Holland and Wainwright[4] who point out some of the problems in applying the data obtained to practical health care policy. These are: (1) the problem under study should be significant in the population; (2) cost-effective methods for screening the population must exist; (3) there must be an effective treatment for the disease; (4) availability of the treatment must be widespread; (5) the overall process should not cost more than treating diagnosed cases without intervention; and (6) there should be an advantage (increased lifespan, economics, etc.) to detection and/or prevention of the disease. You, the physician, however, will be treating individuals; this individuality must be kept in mind as certain patients may require or request care that may differ from national policy. Oliver[5] has delineated some of the dangers of treating population groups with elevated risks for a certain disease when most of the individuals in the group will never actually have the disease. He suggests limiting intervention with drugs for prophylactic reasons to those cases where there is a clear and substantial increase in benefit when compared to the associated risks of using a drug.

Cardiovascular Disease

Four primary risk factors for cardiovascular disease are lipid transport defects, hypertension, diabetes mellitus, and smoking.

Cardiovascular disease (CVD) is the leading cause of death in the U.S. A number of risk factors have been determined to be associated with what is really a set of

problems known collectively as cardiovascular disease. These problems include coronary heart disease, cerebral vascular disease, and peripheral vascular disease.

Lesions in the cardiovascular system can be found even at a very early age, but the rates at which the disease progresses are highly individual. Grundy[6] has cited four primary risk factors (lipid transport defects, hypertension, smoking, and diabetes) and five secondary risk factors (excessive intake of saturated fat and cholesterol, obesity, excessive salt intake, stress, and a sedentary lifestyle) in his review of the etiology of atherosclerosis. Other experts stress family history as a major risk factor; this concept is important in screening in the office. A number of other factors (such as family support) may impinge upon either primary or secondary risk factors to enhance or diminish the risk or to affect the treatment in a given situation. The risk factors for CVD and their implications are given in Table 19-1.

Table 19-1. Risk Factors and Their Implications

Disease	Risk Factor	Modifiable	Management Goals and Physician Responsibility
CVD	*Primary*		
	Lipid transport defects	Partially	Monitor serum lipids. Counsel maintenance of body weight. Institute diet or drug therapy as required.
	Hypertension	Yes	Monitor blood pressure. Achieve and maintain reasonable body weight. Reduce stress. Institute exercise program. Monitor electrolyte balance. Discuss effects of medication and dietary salt restriction.
	Diabetes mellitus	Partially	Stress tight glycemic control. Encourage patient self-monitoring. Achieve and maintain reasonable body weight. Monitor blood pressure.
	Smoking	Yes	Stress cessation of habit. Encourage participation in a stop-smoking program. Provide diet counseling to avoid weight gain.
	Secondary		
	Exercise	Yes	Stress routine program to give aerobic, flexible, and strengthening exercise.
	Obesity	Yes, with difficulty	Provide counseling about reducing diets and behavior modification. Inform about links with diabetes and hypertension. Encourage exercise program.

Table 19-1.	Risk Factors and Their Implications (continued)		
Cancer	Sun	Yes	Stress use of maximum-protection sun screen.
	X-rays	Partially	Discuss medical necessity.
	Genetics	No	Closely monitor patients with family histories of cancer, particularly women having mothers or sisters with breast cancer.
	Occupational	Partially	Closely monitor patients working with solvents, asbestos, or hydrocarbons. Discuss work-place safety.
	Smoking	Yes	See smoking above.
	Alcohol	Yes	Stress moderate use or abstinence.
	Dietary fat	Yes	Suggest a diet with 30% of calories as fat, evenly divided between saturated, monounsaturated, and polyunsaturated fats.
	Obesity	Yes, with difficulty	See obesity above.
	Vitamins A & C	Yes	Stress adequate intake from dietary sources. Discourage the use of supplements. Explain hazards of overdose.
	Fiber	Yes	Counsel selection of high-fiber foods with up to 20 gm/day. Ensure adequate calcium and other mineral intakes.
	Estrogen	Partially	Limit use to lowest dose and minimum time consistent with treatment goals.
	Sexual proclivities	Yes	Discuss risks of homosexual or promiscuous behavior.

Lipid Transport Defects

Lipoproteins serve diverse functions in the body, including transport of both dietary and endogenously synthesized triglycerides and cholesterol to the tissues.

The lipoproteins and their broad functions are delineated in Table 19-2. Roughly speaking, the various fractions are interrelated and partially interconvertible. Clearly, lipoprotein metabolism is a very complex process involving protein synthesis, posttranslational protein modification, endogenous synthesis of lipids and cholesterol, serum transport of dietary lipids, receptor recognition at various tissues, processing of internalized

lipoproteins, and transport of delipidated lipoproteins back to their sites of origin. With so many processes involved, there could well be a number of different sites of errors, any of which would lead to the observation of elevated lipoproteins in the serum.

The tests for hyperlipidemia are sensitive to a number of factors, such as dietary state, medication, and recent illnesses.

Usually, hyperlipidemia (elevated serum triglycerides and/or cholesterol) is the first clinical sign noted. For this observation to be clinically significant, however, the test must have been conducted

1. after a 12-14 hour fast,
2. during a time when the patient has been consuming a habitual rather than an atypical diet,
3. when the patient has not had any serum-lipid-altering medication, and
4. when the patient has not experienced a recent acute illness.

Before ordering more extensive tests or instituting therapy, an additional serum lipid determination should be made 2-4 weeks later to evaluate the possibility of an aberrant initial test. After diagnosing hyperlipdemia, it may then be useful to know which lipoproteins are affected. The lipoprotein phenotypes, and their characteristics and defects (where known), are provided in Table 19-3.

Table 19-2 Major Lipoprotein Classes and Their Functions

Classes	*Function*
Chylomicrons	Transport of dietary fat to tissues
VLDL	Transport of endogenously synthesized fat to tissues
LDL	Transport of cholesterol to tissues
HDL	Transport of cholesterol back from tissues to liver for excretion

Table 19-3 Lipoprotein Phenotypes

Phenotype	Description	Clinical Signs	Defects
I	Hyperchylomicronemia	Cholesterol ↑ TG > 1000 plasma clear	Lipoprotein lipase deficiency
IIA	LDL ↑	Cholesterol ↑ TG Normal	Defective LDL
IIB	LDL + VLDL ↑	LDL > 190	Defective LDL receptor
III	Remnant accumulation		Disorder of ApoE
IV	VLDL ↑	LDL < 190 TG > 200-400, less severe Cholesterol ↑ TG > 400-1000, more severe Plasma turbid	
V	VLDL + Chylomicrons	Cholesterol high TG > 1000 Plasma turbid	ApoC II deficiency

For the cholesterol proportion of the risk for cardiovascular disease, increased risk involves only those people with cholesterol levels in the upper two quintiles of the population.

Serum cholesterol levels at various ages have been compared with incidence of coronary events in several studies, and age-dependent correlations between serum cholesterol and coronary attacks have been found. The risk, however, has not been found to be linear over a broad range of cholesterol levels (U.S. Pooling Project) and involves essentially only those people in the upper two quintiles of cholesterol levels.[6] Further, serum cholesterol is a better predictor of risk for CVD for men less than 50 years old than it is for those greater than 50.[7] The mean plasma cholesterol concentration in the U.S. is 210 mg%. The distribution of cholesterol levels for men and women is shown in Table 19-4. It has been suggested[8] that serum cholesterol levels up to 225 mg% are acceptable for a 45-year-old male. Levels up to 250 mg% should be mildly worrisome, up to 300 mg% moderately worrisome, and more than 300 mg% very worrisome. In order to place any confidence in an absolute value for serum cholesterol for a given patient, it is necessary to know whether the laboratory norm is the same as the population norm. An important report, the N.I.H. Concensus Development Conference on lowering blood cholesterol, is Physician Reference #11 in this module; aggressive screening for all persons and treatment of those above the 75th percentile for serum cholesterol are two of the many recommendations.

It is not surprising that serum cholesterol values are not highly correlated with risk when one considers that serum cholesterol is associated with several lipoprotein fractions each having different functions. Persons with extremely high levels of LDL cholesterol (i.e., those with familial hypercholesterolemia — 1 in 500 people) have a deficiency of LDL receptors in their tissues prohibiting cholesterol uptake. On the other hand, elevated serum cholesterol associated with certain HDL fractions is thought to have a beneficial or protective effect against atherosclerosis.[9] The lipoprotein situation is further

Table 19-4 Distribution of Serum Cholesterol Levels by Age and Sex*

	Male			Female		
Age (yr)	25th	50th	95th	25th	50th	95th
8	158	172	220	167	189	237
12	161	180	232	161	176	219
18-24	162	183	256	163	188	264
25-34	181	205	288	175	199	275
35-44	199	228	322	188	212	295
45-54	209	235	320	206	235	336
55-64	207	234	324	222	254	340
65-74	202	232	321	228	258	348

Source: (For ages 18-74) Vital and health statistics, Series 11, No. 205, 1978; (For ages 8 and 12) Advanced data. July 11, 1977.

*Values given in percentiles.

From Podell, R. and Stewart, M. (eds.): *Primary Prevention of Coronary Disease: A Practical Guide for the Clinician.* Menlo Park, California: Addison Wesley, 1983, p. 94. Used with permission of the publisher.

complicated by the finding that many people have elevated levels of more than one class of lipoprotein and that excesses of particular combinations of fractions may increase risk for a subset of CVD, such as peripheral vascular disease. There is little evidence at present to suggest that elevated triglyceride levels alone predispose one to atherosclerosis. Yet, in diabetics, a group having greatly elevated risk for CVD, there are more likely to be anomalities in lipoproteins associated with triglycerides rather than with cholesterol.

Dietary Fat and Cholesterol in CVD

In well-controlled, broadly based, long-term human studies, it is difficult to demonstrate a relationship between dietary cholesterol and increased risk for cardiovascular disease. This is not surprising since healthy people possess an elaborate feedback mechanism linking dietary intake and endogenous synthesis of cholesterol.

Consumption of excess dietary fat and cholesterol may be considered secondary risk factors for CVD. It is difficult to separate the two in population studies because foods high in one also tend to be high in the other. Most of the data on cholesterol consumption have come from animal models, particularly the rabbit. Use of the rabbit as an experimental model may not be appropriate because, under normal circumstances, cholesterol would never be a dietary constituent of rabbit food. Therefore, regulatory mechanisms linking dietary and endogenous production of cholesterol may not have developed. In man and in animals for which cholesterol is a normal dietary constituent, there is an elaborate feedback control system which inhibits endogenous cholesterol synthesis when there is an adequate dietary supply. In normal humans, 1 to 1.5 gm/day of cholesterol is synthesized endogenously. The typical dietary intake of cholesterol is from 0.3 to 0.8 gm/day. Under ordinary circumstances, increases in dietary cholesterol intake result in decreases in endogenous cholesterol synthesis. For a more complete discussion, see Module 1, Nutrient Content of Foods, Nutritional Supplements, and Food Fallacies.

Unfortunately, many of the studies on effects of feeding or withholding dietary cholesterol regarding endogenous cholesterol synthesis have been done on a short-time basis. During the period directly after a fast or a change in dietary pattern, a period of adjustment (3 to 7 days) is required before balance between consumption and synthesis is restored. Studies conducted during this period may lead to an erroneous conclusion about the interrelationship between dietary intake and endogenous synthesis of cholesterol and the effects on serum cholesterol levels.

Not all lipoprotein classes are equally atherogenic.

In support of a role for cholesterol in atherosclerotic plaque formation, there is evidence suggesting that most of the cholesterol in atheromatous plaque is derived from plasma lipoproteins. However, all classes of lipoproteins do not seem to contribute equally to this cholesterol. Chylomicrons are not atherogenic, but chylomicron remnants in the presence of dysbetalipoproteinemia (absence of apoE required for conversion of VLDL and chylomicron remnants to LDLs) seem to be. Normal remnants may or may not be atherogenic. Although considerable controversy surrounds the role of VLDL in atherosclerosis, VLDL remnants probably do play a significant role. Apparently, the most atherogenic lipoproteins are the LDLs, of which there are several subclasses, not necessarily of equal atherogenic capacity. Not only do the HDL classes seem not to be atherogenic, but high serum levels of this group are associated with a lower risk for CVD. Subclasses of this type, which may have different physiological functions, also may be associated with different levels of risk.

One must take into account the time progression of the development of atherosclerosis. According to Virchow's hypothesis,[10] there is an initial injury to the endothelial lining of the vessel walls followed by platelet adherence and aggregation; release of intracellular triggering factors such as platelet-derived growth factor; smooth muscle cell proliferation; and accumulation of extracellular matrix material (collagen and glycosaminoglycans). It is not until this point that lipids and lipoproteins begin to accumulate, followed by calcification of the plaque material. The initial injury may be due to chemical or viral toxins[11]; autoimmune reactions (such as those resulting from protein glycosylation, as discussed in the following diabetes mellitus section); carbon monoxide; or hydrodynamic stresses created by

local or generalized hypertension, especially at arterial branching points. Once a lesion is formed, it disturbs normal blood flow in the region, enhancing further platelet aggregation and deposition of more material from the serum as the result of the eddy currents formed.

The correlation between triglyceride levels and CVD is not sufficiently strong to consider elevated triglycerides to be a risk factor for CVD, but diabetics, who have an elevated risk for CVD, often have abnormal triglyceride levels.

Whether hypertriglyceridemia is a risk factor for CVD is still controversial. Although there is considerable epidemiological evidence linking high triglyceride levels to CVD, it is not clear that having high triglyceride levels is a primary risk factor or whether it may be a secondary or even tertiary risk factor. Chylomicrons, which carry dietary fat, and VLDLs, which carry endogenously synthesized fat, do not seem to be atherogenic. It is possible that the partial delipidation of these carriers may, however, produce atherogenic lipoproteins. Further, since the lipoproteins are all interrelated, binding a substantial amount of apoprotein as chylomicron or VLDL presumably should reduce the amount available for other types of lipoproteins, thereby reducing their ability to mediate their usual functions. One observation that supports a role of hypertriglyceridemia in CVD is that diabetics have evidence more often of hypertriglyceridemia and less often of hypercholesterolemia. Diabetics, of course, have a considerably increased risk for CVD compared to non-diabetics. Thus it makes sense for the primary care physician to treat patients at about the 95th percentile for their age and sex with an appropriate diet, with calorie or alcohol restriction, if necessary. If the level remains markedly elevated, drug therapy may be considered, especially in the presence of other proven risk factors.

National Diet Recommendations

Major national groups are now recommending significant reduction in fat intake for all Americans; the benefits of this for your individual patient remain to be proven.

There is little evidence to suggest that major dietary changes for the general population will have significant impact on the incidence of CVD; nevertheless, the American Heart Association has recommended the "prudent diet" for all Americans to attempt to achieve a lowered risk for CVD. The recommendations include reducing cholesterol intake to 300 mg daily, decreasing fat in the diet to 30-35% of total calories, and consuming equal amounts of saturated, monounsaturated, and polyunsaturated fatty acids. The National Institutes of Health Consensus Conference also endorses this concept for everyone over age two.

There is certainly not a unanimous opinion that modification of dietary habits for the general public is necessary, wise, or useful.[12] Much of the impetus for lowering saturated fat came from the Seven-Country Study of Keys,[13] a prospective study involving 12,000 men from 40-59 years of age. Other studies have examined incidence of CVD in populations who had traditionally low levels of CVD until they migrated to the West and began consuming "Western diets." It should be pointed out that many other factors in their lifestyles changed as well when they migrated.

Intervention trials have been conducted to determine whether lowering serum cholesterol by dietary means is possible, or beneficial. In seven trials, plasma cholesterol was reduced anywhere from 7 to 16%, but there was no statistical effect on CVD.[12] In only one study, where serum cholesterol levels were elevated in men at risk for CVD, was there a reduction in myocardial infarction associated with reduced serum cholesterol levels. Results from recent studies on drug-induced lowering of serum cholesterol in populations at risk[14,15] have been extended without sound scientific rationale[16] to suggest dietary intervention as a reasonable approach to preventing CVD. In point of fact, the drug studies cited did not include any controls for dietary factors.

Shifting from dietary fat to dietary carbohydrate stimulates endogenous synthesis of fats and cholesterol.

One must examine the consequences of lowering dietary fat. When dietary carbohydrate is substituted for dietary fat and when dietary intake of cholesterol is low,[12] there is a rise in plasma triglycerides, cholesterol, and LDL, and a fall in HDL levels. Feeding simple

carbohydrates results in a larger rise than feeding complex carbohydrates. The type of dietary fat is also important. Polyunsaturated fats seem to lower plasma cholesterol levels independent of dietary cholesterol intake, but the mechanisms of the action are still disputed. Several mechanisms have been suggested: polyunsaturates (1) cause a redistribution of cholesterol from the plasma to the tissues, (2) increase cholesterol excretion in the form of bile acids, or (3) contain compounds in the oil source which inhibit cholesterol synthesis. The effect of dietary polyunsaturates on plasma cholesterol lowering is highly variable, with some patients exhibiting dramatic serum cholesterol drops and with others showing minimal effects.[17] This raises the question of how many people would be influenced by radical changes in the dietary fat pattern intake.

There is some evidence, based on animal studies, that polyunsaturates enhance the carcinogenic potential of some known carcinogens.[12] While there is no strong evidence that this is true in humans, current dietary recommendations reflect the new concern about polyunsaturates and suggest that 30% of calories come from fat, with 10% each from saturated, monounsaturated, and polyunsaturated fats. Diets high in polyunsaturates have also been reported in some cases to be associated with increased risk of gallstones, particularly in obese patients.[18]

Not all dietary fibers are equally effective in lowering serum lipid levels.

Increases in dietary fiber have been deemed desirable because of their lipid-lowering effects. Not all fiber, however, has an equivalent effect due perhaps to differences in the polarity of their side chains. Guar, a food additive from the seeds of the *Cyamopsis tetragonolobis* plant, has been reported to be among the most effective but, unfortunately, also has poor palatability. Pectin is also capable of lowering serum lipids. The effect of fiber may be due to the decreased transit time of material through the GI tract so that there is not as much reabsorption of bile acids. There may be less fat absorbed, or there may be some factor, yet to be discovered, in fiber which lowers serum lipid levels. The fiber in cereals comes largely from the outer, protective coats of the grain. Whether the final product (for example, oatmeal) has a high fiber content depends on how completely the outer coat is removed during processing. The composition of the fiber may vary from food to food, and so the proportion of cellulose, hemicellulose, pectin, etc., can be considerably different, even though the total fiber content may be similar. The dietary fiber content of some foods is shown in Table 19-5. The pectin content of a few of the foods is also given. Guar, of course, is found only as a food additive.

Hypertension

Hypertension seems to be associated with occlusive vascular disease.

The second primary risk factor for CVD is hypertension. A number of studies have shown that sustained hypertension (blood pressure greater than 140/90 mm Hg) leads to a three- to five-fold increased risk for CVD. The major type of CVD associated with hypertension is occlusive vascular disease. Systolic pressure is a better predictor of CVD than is diastolic pressure or the combined systolic and diastolic pressures.[6] Approximately 18% of the U.S. population is afflicted with hypertension,[19] with 90% of the cases being essential (primary) hypertension where no cause has been identified. In the diabetic population, the prevalence figure rises to estimates of from 40-80%.[20] Borderline hypertension may also increase risk, however, not evenly over all age, sex, and racial groups. In some studies, values as low as 110/75 mm Hg have shown increased risk for some groups. For example, at a given blood pressure, men seem to be at greater risk than women. Secondly, as age increases, blood pressure tends to rise. Finally, the prevalence of hypertension in blacks is twice that for whites.

The mechanism whereby hypertension increases risk for CVD is not clear, but hypertension and other risk factors seem to be interactive.

Like lipoprotein metabolism, the regulation of blood pressure is a complicated process. The major components of the regulation are listed in Table 19-6. Impairments in the function of any of the tissues involved will upset the delicate regulatory mechanisms. In some populations there is significant hypertension without concomitantly

Table 19-5 Dietary Fiber Content of Selected Foods* (A reasonable daily intake is 20 gm/day)

Food	*Serving Size*	*Dietary Fiber (gm)*	*Pectin %***
Baked beans	1 cup	18.6	
Dried figs	2	18.5	
Peas	1 cup	11.3	1.6
All bran cereal	½ cup	9.9	
Dried dates	10	7.0	
Brussels sprouts	1 cup	6.5	
Banana	1 medium	5.9	1.2
Peanuts	½ cup	5.7	
Broccoli tops	1 cup	5.6	
Orange	1 medium	4.5	2.8
Apple	1 medium	3.2	1.6
Tomato	1 medium	3.0	4.6
White bread	1 slice	0.8	

*Adapted from Glavin, J. (1983): Dietary Fiber, Ross Timesaver: Dietetic Currents, 10, #6 from original data by A. Paul and D. Southgate in McCance and Widdowson's Composition of Foods. London: Medical Research Council, 1978.

**Data from Chenoweth, W., and Leveille, G.: "Metabolism and Physiological Effects of Pectins," in *Physiological Effects of Carbohydrates*, A. Jeanes and J. Hodge, (eds.). Washington, D.C.: American Chemical Society, 1975.

Table 19-6 Factors Involved in Regulation of Blood Pressure

Hormone	*Site of Action*
Antidiuretic Hormone (ADH) (Vasopressin)	Kidney
Norepinephrine	Heart, vessels
Angiotensin II	Vessels, hypothalamus
Aldosterone	Kidney

high rates of CVD, implying that interactions of risk factors may well be important.[6] The most widely accepted mechanism relating hypertension to CVD is that damage to the arterial wall occurs because of high internal pressures and leads to subsequent plaque formation in response to the damage.

Several unwanted side effects are associated with drug therapy for hypertension.

Treatment of idiopathic hypertension can be problematic in the absence of knowledge about the root causes of the problem. The first line of treatment should be to encourage weight loss if the patient is overweight, reduce stress, promote regular exercise, maintain careful blood pressure monitoring, eliminate smoking, and provide education about good dietary habits. Drug therapy may still be necessary, but many antihypertensive agents have unwanted and even severe side effects, some of which may be exacerbated in the elderly or in diabetics. Categories of antihypertensive agents are listed

Table 19-7 Dietary Considerations During Antihypertensive Therapy

*Pharmaceutical Agent**	*Dietary Cautions*
Diuretics	
Ethacrynic acid	Monitor electrolytes; may need potassium supplements.
Furosemide	Monitor electrolytes; may need potassium supplements.
Potassium-sparing agents	Do not give high-potassium diets or potassium supplements.
Thiazides	Monitor potassium and niacin.
Adrenergic neuronal blockers	
Guanethidine	Alcohol intake may exacerbate postural hypotension.
Direct vasodilators	
Hydralazine	May depress appetite.
Diazoxide	Hyperglycemia is frequent; there may be sodium retention.
Minoxidil	Salt and water retention; monitor electrolytes.
Alpha blockers	
Prazosin	--
Central depressants	
Clonidine	Avoid alcohol.
Methyldopa	--
Reserpine	May depress appetite.
Beta adrenergic blockers	
Propranolol	May prevent signs of acute hypoglycemia; advise diabetics accordingly.
Monoamine oxidase inhibitors	
Paraglyline	Avoid tyramine-containing foods (aged and processed cheese, beer, wine, yeast, chocolate, avocados, broad beans, pickled herring, bananas, papaya, meat tenderizer, and chicken liver)
Angiotensin I Converting Enzyme Inhibitor	
Catopril	Maintain fluid volume; monitor potassium

*List is representative

in Table 19-7. Some of the side effects of these drugs are postural hypotension, depression, loss of appetite, drowsiness, electrolyte and fluid imbalances, prevention of signs of acute hypoglycemia, and hypertensive crises precipitated by certain foods. Analysis of data from the Multiple Risk Factor Intervention Trial suggests that use of hydrocholorothiazide or chlorothalidone at high levels may actually have increased the risk of death from cardiovascular disease in certain patient groups.[21]

Patients with family histories of hypertension or who have diabetes or heart disease may need to be maintained on drug therapy in spite of the possible risks and side effects. O'Malley and O'Brien[22] have suggested a therapeutic approach which includes avoiding central nervous

Table 19-8 Foods High in Potassium

FOOD	AMOUNT-DESCRIPTION	mEq
JUICES		
Prune	4 oz	8.0
Tomato	4 oz	7.0
V-8	4 oz	7.0
Orange	4 oz	6.5
Grapefruit	4 oz	5.5
Pineapple	4 oz	5.0
FRUITS		
Avocado	1 cup	27.0
Prunes	5 whole	15.0
Raisins	½ cup	14.0
Banana	1 large	13.0
Canteloupe	1 cup	13.0
Dates	10	12.5
Apricots	5 whole dried	12.0
Honeydew	1 cup	11.0
Nectarine	2½"	10.5
Peach	2½"	8.0
Apricots	3 fresh	8.0
Orange	1 medium	7.0
Strawberries	1 cup	6.5
Cherries	¾ cup	6.0
Pear	1 medium	5.5
Watermelon	1 cup	5.0
VEGETABLES		
Acorn squash	½ cup	21.5
Yams	½ cup	19.0
Winter squash	½ cup	14.0
Potatoes	1 medium	14.0
	10 fries	13.0
	½ cup baked/mash	10.0
Spinach	½ cup	9.0
Sweet potatoes	½ cup	8.0
Parsnips	½ cup	8.0
Pumpkin	½ cup	7.5
Tomatoes	½ cup	7.0
Dill pickle	1 large	7.0
Brussels sprouts	½ cup	5.5
Succotash	½ cup	5.5
Turnips	½ cup	5.5

FOOD	AMOUNT-DESCRIPTION	mEq
VEGETABLES		
Broccoli	½ cup	5.0
Cauliflower	½ cup	5.0
Carrots	½ cup	4.0
Corn	½ cup	4.0
Peas	⅔ cup	3.5
BREAD-CEREAL		
Bran, 100%	1 cup	12.0
Bran muffin	1 medium	4.5
Bran flakes, 40%	1 cup	3.5
Whole wheat bread	1 slice	2.0
DAIRY PRODUCTS		
Eggnog	1 cup	15.0
Milkshake	1 cup	10.0
Milk	1 cup	9.0
Yogurt, plain	1 cup	8.5
Custard	½ cup	5.0
Pudding	½ cup	5.0
Ice cream	½ cup	3.0
Cottage cheese	½ cup	3.0
Cheese, American	1 oz	1.0
MEAT-MEAT SUBSTITUTES		
Lasagne	3 inch square	12.0
Navy beans	½ cup	10.0
Lima beans	½ cup	9.0
Kidney beans	½ cup	8.0
Almonds	¼ cup	6.5
Peanuts	¼ cup	6.5
Walnuts	10 large	6.0
Macaroni & cheese	1 cup	6.0
Peanut butter	2 Tbsp	5.0
Fish	1 oz	5.0
Pecans	¼ cup	4.5
Beef	1 oz	3.0
Egg	1	2.5
Tuna	1 oz	2.0
Ham	1 oz	2.0
Chicken	1 oz	2.0
OTHERS		
Cream soup	⅔ cup	5.0
Chocolate	6 kisses	3.0

From Gallagher-Allred, C.: *Potassium Content of Foods.* Columbus, Ohio: Riverside Methodist Hospital, 1985. Used with permission of the author.

system depressants in the elderly. Some adrenergic blocking agents may not be suitable either for those susceptible to postural hypotension. The American, British, and Canadian Diabetes Associations have recommended that diabetics follow diets with modest restriction of salt, which includes a reduction of table salt use and avoidance of processed foods with high salt contents.[20] Achievement and maintenance of reasonable body weight and exercise should also be stressed, particularly for diabetics.

Use of antihypertensive drugs often necessitates special dietary precautions.

In a number of cases, drug therapy for hypertension necessitates special dietary considerations or precautions (Table 19-7). Use of diuretics may upset fluid and electrolyte levels, thus requiring monitoring of sodium and potassium levels. Potassium supplementation may even be desirable. Patients suffering from potassium depletion may complain of nausea, weakness, and rapid heart beat. Since potassium supplements are often unpalatable, it is wise to increase potassium levels as much as possible by dietary means. A list of foods which are high in potassium is shown in Table 19-8. It should be pointed out that administration of potassium-sparing diuretics (for example Aldactazide, Dyazide, or Moduretic) will not often require concomitant potassium supplementation; indeed the addition of potassium could be a hazardous course to follow unless hypokalemia is demonstrated. Careful monitoring of potassium during any diuretic and/or potassium therapy remains the best clinical course.

When using diuretics that enhance sodium excretion, it is wise to reduce dietary sodium intake. The sodium content of selected foods is shown in Table 19-9. There are about 2000 mg in a teaspoon of table salt. Other condiments with high sodium content are (mg/tsp): onion salt, 1620; garlic salt, 1850; monosodium glutamate (MSG), 492; soy sauce, 343; and meat tenderizer, 1750. Sodium may also be present in considerable quantities in some antacid preparations and other over-the-counter medications. The patient should be encouraged to tell the physician about any patent medicines being taken so that sodium content may be discussed.

Monoamine oxidase inhibitors require a different kind of dietary vigilance. These drugs inhibit the enzyme which catalyzes the oxidative deamination of a variety of primary and secondary amines resulting in a build-up of compounds such as norepinephrine, dopamine, and serotonin. A problem arises when a patient ingests tyramine found in many fermented foods (see Table 19-7). Because monoamine oxidase is inhibited by the antihypertensive drug, tyramine is not degraded and consequently causes rapid release of norepinephrine stores which can lead to a hypertensive crisis. Fortunately, these agents are seldom needed today as antihypertensive drugs.

For the general population, there is little concrete evidence that high dietary salt intake causes hypertension, a primary risk factor for CVD.

A high salt intake may be a secondary risk factor in association with hypertension for some people, but again the evidence is highly variable. In some populations there is a correlation between salt intake and hypertension. One example is from northern Japan where salt intake has been reported to be 20-25 gm/day.[23] However, there has been a failure to find a correlation between salt and hypertension in most population studies. Even within the same population [e.g., U.S. Health and Nutrition Examination Survey (1971-1975) (Hanes I)], such a correlation was not demonstrated.[24]

It is difficult to determine the amount of sodium intake required in persons because the needs may vary drastically, depending upon such factors as environmental temperature and humidity, exercise, and age. The estimated "safe and adequate intake" by the Food and Nutrition Board of the National Research Council is 1000 to 3300 mg sodium/day, which translates to between 2.8 to 8.4 gm salt/day. At present, the usual range of salt intake in the U.S. is considered to be between 6 and 18 gm/day.

The body can cope with a considerable variation in dietary salt intake as the result of a number of regulatory mechanisms. These mechanisms include alterations in fluid volume and fluid output, and hormonal control of sodium resorption from the kidney. Because of these compensatory mechanisms, it is likely that most individuals are able to maintain blood pressure over a wide range of salt intakes. It has been estimated that 82% of the U.S. population is sodium resistant; i.e., that blood

Table 19-9 Sodium Content of Selected Foods

FRESH/MINIMALLY PROCESSED FOODS		PREPARED FOODS		"FAST FOODS"	
1 cup orange juice	2 mg	1 cup tomato juice	640 mg	1 Arby's Turkey Sandwich	1060 mg
1 cup apple juice	2 mg	1 cup Puffed Rice	1 mg	3 pcs. Arthur Treacher's Fish	675 mg
1 cup long-cooking oatmeal	10 mg	1 cup Corn Flakes	305 mg	1 Burger King Whopper	990 mg
3 ounces ground beef	60 mg	3 ounces corned beef	1500 mg	1 Dairy Queen Hot Dog	830 mg
3 ounces pork	65 mg	1 cup canned green beans	320 mg	Kentucky Fried Chicken:	
1 cup fresh green beans	5 mg	1 cup chicken noodle soup	1050 mg	3 pieces chicken,	
1 cup frozen green beans	2 mg	3 ounces bacon	1400 mg	mashed potatoes,	
1 cup whole milk	120 mg	1 dill pickle	1930 mg	gravy, cole slaw	2285 mg
1 large egg	70 mg	1 slice white bread	100 mg	1 McDonald's Big Mac	1010 mg
1 lemon	1 mg	cooking oil	0 mg	1 Taco Bell Enchirito	1175 mg
1 head Boston lettuce	15 mg	1 cinnamon roll	630 mg		
1 peach	1 mg	1 tablespoon ketchup	155 mg		
8 ounces bluefish	170 mg	1 cup all-purpose flour	2 mg		
3 apricots	1 mg	1 cup self-rising flour	1565 mg		
1 banana	1 mg	1 beef frankfurter	425 mg		
1 carrot	35 mg	1 tablespoon Italian dressing	250 mg		
		1 cup instant pudding	335 mg		
		1 TV chicken dinner	1400 mg		
		1 olive	165 mg		
		1 cup baked beans	1000 mg		

From Kaplan, N. and Punzi, H.: "Patients Page: How Much Salt." *Clinical Diabetes* 2 (Mar/Apr.):45,1984. Used with permission of the American Diabetes Association.

pressure is little influenced by salt consumption.[24] Even diets drastically limited in sodium (less than 1 gm/day) are beneficial in only 30-50% of the cases.[25] Nevertheless, for individual patients, we do not know who are in the large minority of the salt-sensitive; thus, it makes sense to at least try this approach in your new hypertensive patients, especially if the family history suggests salt-dependent hypertension.

Calcium has been suggested as having a protective effect against hypertension.

It has been suggested that low dietary calcium intake might be linked to hypertension.[26,27] This hypothesis is based on several lines of evidence: (1) young black women who consumed more calcium had lower mean systolic blood pressures than those receiving less calcium[28]; (2) data from the HANES I population survey revealed lower calcium intakes in untreated hypertensives[29]; (3) in a small study with age-matched hypertensives and healthy volunteers, it was reported that hypertensives had lower calcium intakes[28]; (4) dietary calcium lowered blood pressure in a hypertensive rat model[30]; and (5) calcium intake falls while blood pressure rises with age.[31,32] Although the preliminary evidence certainly is not conclusive, it would seem to warrant further study before any clinical care recommendations are made. In addition, a determination of all patients' dietary calcium status is warranted throughout life. The U.S. population, particularly the older segment, often has low dietary calcium intake. Apart from any potential influence on blood pressure, the patient should be encouraged to obtain adequate dietary calcium as a preventive measure for osteoporosis.

Diabetes Mellitus

The chronic hyperglycemia of diabetes leads to glycosylation of serum and tissue proteins which can impair their function, leading to intimal injury and thus precipitating development of CVD.

Diabetes mellitus leads to a dramatic rise in CVD, with peripheral vascular disease being an important component. Unlike the case for the general population, female diabetics have a greater risk for CVD than do males. There are several possible reasons for the increased risk in diabetics: (1) platelets in diabetics are "stickier" than normal and show an increased tendency to aggregate, forming thromboemboli; (2) because insulin mimics some of the growth factors that stimulate smooth muscle cell proliferation, it is possible that the hyperinsulinemic states of some Type II diabetics and the high circulating levels of exogenous insulin of some Type I diabetics could promote proliferation of cells in the vessel walls; (3) diabetics also have abnormal serum lipid profiles, although the VLDL fractions usually are the most altered; and (4) chronic hyperglycemia leads to enzymatic and non-enzymatic glycosylation of proteins, a process which often alters protein function. For example, glycosylated hemoglobin is not as efficient in delivering oxygen to the tissues, and glycosylated lipoproteins do not interact normally with their tissue receptors. There may be increased autoimmune clearance of glycosylated proteins because the immune system recognizes the altered proteins as foreign. When the altered protein is an integral part of a vessel wall, its removal could cause injury to the endothelial lining of the vessel, thus initiating the chain of events leading to atherosclerosis. The appropriate treatment goal for the various types of diabetes is to control blood glucose with appropriate means to achieve a maximum level not in excess of 180 mg/dl.

In order to avoid or ameliorate the complications of diabetes, it is recommended that the diabetic maintain body weight as near ideal as possible. Blood glucose levels should be reduced to less than 180 mg% with diet, exercise, insulin, or oral agents as appropriate for the individual patient. Wide swings in blood glucose levels can be avoided by instituting multiple-dose or continuous-dose insulin regimens if necessary. The patient should be encouraged to take an active part in the treatment and monitoring of the disease. In some elderly people, particularly those with visual difficulties or other impairments of faculties, this may not be practical. When it is appropriate, however, the patient should be shown how to make regular (daily) blood glucose determinations using capillary blood from a finger stick and chemically treated test strips. Urine glucose and ketone levels may also be tested but provide less reliable estimates of the degree of blood glucose control. Periodically, samples of blood can be drawn for laboratory analysis of hemoglobin A1c levels. In most normal individuals, 5.5-6.0% of the total hemoglobin is A1c; a value in the diabetic of 9% is believed to be a reasonable goal. To attain these goals, it is recommended that diabetics (without severe complications such as renal disease) increase their intake of complex carbohydrate including fiber, limit simple sugars, and reduce fats. Regular exercise is important not only as an aid to weight control but also as a method for improving cellular insulin sensitivity.

Obesity is not a primary risk factor for CVD but does contribute to diabetes mellitus and hypertension, both of which are risk factors for CVD.

Obesity is a secondary risk factor for CVD. There appears to be little direct link at this time between being overweight and becoming atherosclerotic. Obesity does, however, increase one's risk of becoming diabetic and/or hypertensive, both of which are primary risk factors for CVD. Obesity can lead to hyperinsulinemia, glucose intolerance, and sometimes to frank diabetes. This is believed to come about in part because hypertrophy of the adipocytes leads to decreased sensitivity of this cell to insulin. Since insulin sensitivity is decreased, the adipocyte takes up and/or metabolizes less glucose per unit of time, leading to higher serum glucose levels. The relative hyperglycemia stimulates the pancreas to secrete more insulin. The high insulin levels "down regulate" the insulin receptors on muscle cells causing the receptors to be removed from the cell surface, a process called "swallowing." This, in turn, renders the muscle cell less able to use glucose, leading to still more profound hyperglycemia. If this circular process continues long enough, glucose levels climb high enough to consider the individual diabetic.

A reduction in weight often has the advantage of bringing about a reduction in blood pressure. This may occur without consciously lowering sodium intake. Sodium intake may actually be lower as a consequence of a period of caloric reduction because foods with high energy density which are avoided during dieting often have relatively high levels of salt. Since hypertension is usually a problem in the diabetic, these patients should be particularly encouraged to maintain their ideal body weight to lessen the direct and indirect consequences of obesity.

It is easier for most people to lose weight than it is for them to maintain the weight loss.

Weight loss is extremely difficult for most people to maintain. Successful maintenance of weight loss is almost always a consequence of not only a safe, practical diet but also of behavior modification and improvement of self image. Diabetic patients should be counseled to follow a dietary plan which

1. provides a weight loss of not more than 2 lb/week;
2. reduces consumption of simple sugars;
3. increases complex carbohydrates;
4. increases dietary fiber;
5. reduces total dietary fats and provides an equal distribution of calories from saturated, monounsaturated, and polyunsaturated fats;
6. distributes calories over several smaller meals and snacks as opposed to one large meal; and
7. utilizes ordinary, easily obtainable food that is consistent with the patient's lifestyle and ethnic background.

At the same time, patients may benefit from counseling about their eating habits and perceptions of self-worth. A program of regular exercise should be instituted. The patient's spouse or other significant relatives may need counseling and encouragement as well. Particularly in those cases where someone other than the patient is responsible for food preparation, nutrition counseling is valuable to demonstrate that a diet suitable for a diabetic can be adapted readily to meet the needs of the entire family while providing nutritious, palatable, attractive, and even exciting food.

Smoking

Although nicotine itself is not atherogenic, smoking increases risk for CVD two-fold by as yet an undetermined mechanism(s).

Smoking increases the risk of CVD about two-fold and is correlated both with increased infarction and increased peripheral vascular disease. The mechanism of the effect is unknown but several possibilities have been explored. In animal models, pure nicotine does not accelerate atherosclerosis. It may be possible, however, that nicotine could be a secondary risk factor because in some smokers nicotine produces transient hypertension which is a primary risk factor. Nicotine is believed to exert its actions in the body by stimulating nicotinic receptors, mimicking acetylcholine. Other by-products of smoking, such as carbon monoxide, cadmium, pesticide residues, or combustion products, could also be involved in hypertension or in CVD. Smoking lowers HDL levels slightly,[6] but it is not clear that there is any causal relationship between this observation and the mechanism of the effect of smoking and CVD.

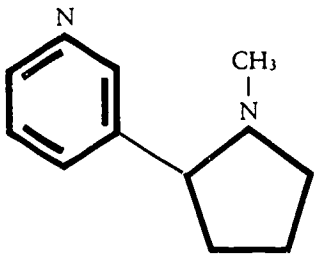
Nicotine and nicotinic acid are different.

Some patients may confuse nicotine and nicotinic acid. It should be pointed out that nicotine is not the same thing as nicotinic acid (niacin) (Figure 19-1). Commercial nicotine comes entirely from tobacco where it is 2-8% of the plant weight, is highly toxic, and is used as an insecticide. Nicotinic acid, also called niacin, is a vitamin found in meat, poultry, fish, grains, legumes, and yeast. Both nicotine and excess niacin intake can increase blood pressure.

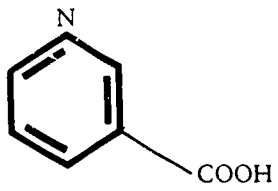
People who quit smoking lower their risk for CVD.

People who quit smoking appear to have a lowered risk for CVD compared to those who continue to smoke. Since the risk factors seem to be interactive, eliminating one risk factor lessens the overall risk. Patients should be

Figure 19-1 Structures of Nicotine and Nicotinic Acid (Niacin)



Nicotine



Nicotinic Acid
(Niacin)

encouraged to quit, or failing that, to cut down on smoking. Of course, to set an effective example, clearly the physician must also be a non-smoker. Patients who need assistance to quit smoking should be referred to the American Lung Association, the American Cancer Society, or hospital based programs for group support. To counteract patients' fears of weight gain and withdrawal symptoms, the physician should suggest the substitution of a low-calorie snack which provides a great deal of oral stimulation (finger foods such as carrot and celery sticks, green peppers, etc., or sugarless mints or other hard candies). To counteract the other withdrawal symptoms, exercise breaks and relaxation breaks should be instituted. See Module 18, Metabolic Principles, for additional discussion of metabolic effects of nicotine.

Other Factors in the Control of Risk for CVD

The role of alcohol in CVD is still controversial.

In some studies,[12] moderate alcohol consumption has led to a rise in HDL levels, which is thought to be beneficial. Other studies have not confirmed this. Alcohol might lessen stress and promote vasodilation. Excessive alcohol intake would be clearly contraindicated because of liver and kidney damage and the likelihood that poor nutritional status would be a consequence. Thus, it is somewhat difficult to determine where the crossover point might be between benefit and harm for any given individual. Further, there is evidence that people who consume moderate to heavy amounts of alcohol also show evidence of hyperlipidemia. In addition to any considerations of the physiological effects of alcohol intake, there are the clear consequences of drinking and driving. There is insufficient evidence to promote the prescribing of alcohol as a preventive measure for CVD. The level of a patient's alcohol intake should be ascertained to determine whether an excessive amount is being consumed and to clarify any potential problems that might arise as the result of consuming alcohol while taking certain medications.

In carefully controlled studies, treatments such as supplements of vitamin E have not been proven to be useful in preventing CVD.

Occasionally, certain vitamins or other preparations or "tonics" are promoted in the popular press or by "health-food" stores as having beneficial properties in the prevention or cure of certain diseases. Vitamin E has been promoted as useful in the prevention and treatment of CVD. In controlled studies,[33] however, such claims have not been verified.

Aerobic exercise three times a week seems to have a beneficial effect in lowering risk for CVD.

Exercise must be included as a factor in the risk for CVD. Epidemiological analysis has indicated that active

individuals are at lower risk, but there is little evidence that exercise after infarction increases survival. It may, however, lessen the side effects of a heart attack.[34] Maximum benefit is believed to be conferred by aerobic exercise performed for at least 20 minutes three times a week. Effects of exercise could be at several levels: improved circulation, maintenance of near ideal body weight, lowering of blood pressure, lowering of stress, or heightened awareness of lifestyles leading to good health. Regardless of the mechanism, a moderate exercise program in conjunction with other types of treatment does seem to have a positive effect.

One must be careful to stress moderate and routine exercise because some types of exercise can have disasterous consequences. A confirmed sedentary individual who suddenly decides to atone for 40 years of inactivity in a single day is a prime candidate for a heart attack. Other forms of exercise may damage joints or expose an individual to other risks. Younger patients should be encouraged to maintain a good exercise program, including aerobic, flexibility, and strengthening exercise. Older individuals who have not exercised need to institute an exercise program gradually. Walking is appropriate for all ages and is an inexpensive form of exercise to pursue.

Some personality types may have a higher risk for CVD than others.

One of the risk factors for CVD has been termed a Type A behavior pattern which is characterized by

1. enhanced competitiveness,
2. striving for achievement,
3. impatience,
4. repressed aggressiveness,
5. restlessness,
6. hyperalertness,
7. tense facial muscles,
8. explosive speech patterns, and/or
9. sense of time urgency.

These individuals tend to deny illness and to experience job conflicts and job dissatisfaction. The syndrome is best diagnosed by a trained interviewer using the Structured Interview which requires 10-15 minutes.[35] It is extremely difficult to make major changes in a patient's personality, partly because society views Type A behavior as a strength and rewards it accordingly. The physician can, however, emphasize making schedule changes to reduce time urgency and suggest stress management and relaxation training. Although many physicians feel that stress is a risk factor for coronary heart disease, one recent well-done study of 548 patients suggested otherwise. Case et al. showed that behavior Type A versus Type B made no difference in survival up to three years after acute myocardial infarction.[36] Poor outcome was completely accounted for by physiological factors such as functional class, ventricular ectopy, and low ejection fraction.

Cancer

Risk Factors for Cancer

A large number of factors may play a role in the development of cancer. The importance of a particular factor is dependent upon the type of cancer in question.

In the United States, cancer accounts for approximately 20% of all deaths. The incidence and mortality for many cancers, however, has remained stable for the last 30 to 40 years (except for increased respiratory tract cancers and decreased stomach cancers) when adjusted for age of the population. Three types of cancer (lung, colorectal, and breast) are responsible for 50% of all the cancer deaths in the U.S. Cancer death rates for various types of cancer seem to be dependent upon a number of factors, both genetic and environmental, and the weight for a selected factor depends upon the type of cancer in question. Such factors include genetic predisposition, smoking, alcohol consumption, age, radiation exposure, obesity, hypertension, occupational exposure to chemical carcinogens, hormonal abnormalities, sexual proclivities (promiscuity and homosexuality), and geographic location. The risk factors for cancer and their implications are given in Table 19-1. There has been increasing concern that what we eat, how we eat, or how much we eat might contribute to the development of certain cancers. Further, there has been interest in finding foods that might be effective in the prevention or treatment of cancer. Some associations between nutrients and various types of cancer, determined largely from epidemiological studies, are shown in Table 19-10. Changes in the dietary patterns in the U.S. from 1909 to 1976 are shown in Table 19-11.

Table 19-10 Potential Relationships Between Various Nutrients and Certain Cancers

Nutrient	External Agent	Effect*	Site of Cancer
High calories		+	Mammary
"	Benzo(a)pyrene	+	Sarcomas, skin cancer
Alcohol		+	Head, neck
Vitamin A		+	Epithelium
"	Dimethylhydrazine	–	Colon
"	Dimethylbenzanthracene	–	Skin
Fiber (agar)		+	Colon
"	Dimethylhydrazine	–	Colon
Vitamin C		+	Cervix, mouth, esophagus, stomach, larynx
Fat		+	Intestine, mammary, prostate

* (+) indicates a protective effect while (–) indicates that tumor growth was enhanced.

Table 19-11 Daily Per Capita Intake of Nutrients in the United States

	Energy Sources				Minerals			Vitamins							
Year	Calories	Protein (gm)	Fat (gm)	CHO (gm)	Ca (mg)	P (mg)	Fe (mg)	Mg (mg)	B_1 (mg)	B_2 (mg)	Niacin (mg)	B_6 (mg)	B_{12} (μg)	A (μg)	C (mg)
1909	3,480	102	125	492	820	1,560	15.2	408	1.64	1.86	19.2	2.26	8.4	2,280	104
1927	3,460	95	134	476	860	1,510	14.1	388	1.55	1.87	18.0	2.05	8.1	2,400	106
1948	3,230	95	140	403	1,000	1,550	18.6	369	1.91	2.30	21.4	1.99	9.0	2,640	114
1965	3,150	96	144	372	960	1,520	16.7	339	1.81	2.30	21.9	2.02	9.1	2,310	97
1976	3,300	101	157	376	930	1,550	18.6	344	2.04	2.46	25.2	2.26	9.6	2,430	118

From Committee on Diet, Nutrition and Cancer, National Academy of Sciences—National Research Council: *Diet, Nutrition, and Cancer.* Washington, D.C.: National Academy Press, 1982, p.52. Used with permission of the publisher.

Diet and Cancer

A number of dietary recommendations have been made to prevent or cure cancer; there is insufficient evidence to support most of these claims.

Recently, there has been increasing pressure to use dietary means to prevent and/or "cure" cancer as well as to support the patient who already has cancer. Margaret Heckler, as Secretary of Health and Human Services, suggested that changes in diet and smoking habits would diminish cancer deaths 25% by the year 2000 and that improvements in therapy could save another 23%.[37] The National Cancer Institute (NCI) has recommended that individuals drink alcohol only in moderation, if at all; follow safe occupational practices; limit x-ray exposures to those medically necessary; avoid exposure to the sun; and limit estrogen use to the minimum possible time (Table 19-12).[37] The National Research Council (NRC) has recommended[38] a reduction of dietary fat from 40% to 30% of calories; inclusion of whole grains and vegetables high in carotenoids; limitation of cured, pickled, or smoked meats; and limitation of alcohol. Increased consumption of fiber and vitamin C and decreased consumption of nitrates and nitrites have also been deemed wise (Table 19-12). The American Cancer Society has also developed some recommendations that

are "likely to produce some measure of reducing cancer risk." [39] These include: (1) avoid obesity, (2) reduce total fat intake, (3) eat more high-fiber foods, (4) include foods rich in vitamins A and C, (5) include cruciferous vegetables such as cabbage, (6) moderate consumption of alcohol, and (7) moderate consumption of salted, smoked, or nitrate-cured foods. They reviewed but provided no recommendations concerning food additives, vitamin E, selenium, artificial sweeteners, coffee, meat and fish cooked at high temperatures, and cholesterol.

The Council on Agricultural Science and Technology (CAST), on the other hand, has suggested that there is insufficient evidence to warrant specific dietary guidelines or to mandate changes in our patterns of eating.[40] While it might be argued that CAST, being associated with agribusiness, could have a somewhat biased opinion, it should be pointed out that if some foods could be unequivocally shown to have a beneficial effect on cancer prevention, the agricultural community would be the first to benefit. Further, much of the concern about the fairly broad declarations of the NCI and the NRC is based on the lack of established causality between various foodstuffs and particular cancers. In the absence of a mechanistic model at the biochemical level to establish links between foods and cancer, it is extremely difficult to perform definitive experiments designed to produce these unequivocal data. The NRC itself recognized the potential problems of offering guidelines in the absence of firm scientific data and for that reason clearly pointed out in the Executive Summary of its report[38] that:

> "Unfortunately, it is not yet possible to make firm scientific pronouncements about the association between diet and cancer; we are in an interim stage of knowledge similar to that for cigarettes 20 years ago. Therefore, in the judgment of the committee, it is now the time to offer some interim guidelines on diet and cancer."

Lifespan is longer and tumor incidence is lower in animal experiments where the calorie intake is reduced, but the mechanism of the effect is unknown.

It is difficult to study the effect of calorie intake on cancer incidence or mortality. When calories are reduced simply by lowering the overall consumption of a balanced diet, the intake of all the nutrients and other factors in the diet are reduced simultaneously. Two other

Table 17-12 Recommendations of the National Cancer Institute and National Research Council to Limit Cancer Risk

1. Drink alcohol only in moderation, if at all
2. Follow safe occupational practices
3. Limit X-ray exposure
4. Limit exposure to the sun
5. Limit estrogen use to the minimum possible time
6. Reduce dietary fat from 40% to 30% of total calories
7. Include whole grains in the diet
8. Include vegetables high in carotenoids in the diet
9. Limit ingestion of smoked, pickled, and cured meats
10. Increase fiber consumption
11. Increase vitamin C consumption
12. Limit consumption of nitrates and nitrites

The above recommendations, or at least some of them, can reasonably be passed along to patients during the routine health examinations performed in a daily medical practice.

ways can be used to lower the caloric density of a diet: (1) shift the ratio of fat to carbohydrate and/or protein, and (2) substitute non-nutritive fiber for calorie-containing components of the diet. In either case, any observed effects could be due to the lower amount of the removed component or to the greater amount of the replacement component. It is impossible to separate the influences of the two components.

Epidemiological evidence for the level of calorie intake as a risk factor for cancer is not strong[38] because most of the studies have looked at correlations between body weight (or degree of obesity) and cancer, rather than directly between calorie intake and cancer. The animal studies available demonstrate a decline in age-related tumors with lowered calorie intake. These studies suffer, however, from the uniform lowering of all nutrients, leading to problems in interpretation as discussed above.

Dietary fiber is beneficial for treating diverticular disease and constipation, but its role in preventing colon cancer is still mostly a matter of conjecture.

Dietary fiber seems to be efficacious in treating constipation and diverticular disease. People who consume high-fiber diets pass larger, bulkier stools with decreased transit time than those eating diets low in fiber.[41] From these observations, it was postulated that potential carcinogens would not only be diluted by the extra bulk but also would be in contact with the GI tract for a shorter period of time and, therefore, should lower the incidence of cancer.

Graham[42] summarized the actual evidence for a positive effect of fiber; there are few controlled studies providing any strong evidence. He pointed out that because of the time lapse between exposure to a carcinogen and the development of cancer, one needs studies where dietary patterns are known 20-30 years before the onset of cancer. Most of the evidence for an effect of fiber arises from studies of particular population groups; these were done without the proper controls or prospective studies.[32,42,43] The conclusion of the NRC[38] was that there is "no conclusive evidence to indicate that dietary fiber (such as that found in fruits, vegetables, grains, and cereals) exerts a protective effect against colorectal cancer in humans."

The palatability of foods naturally high in fiber is good. In the absence of sound scientific evidence, there appears to be little harm in moderately increasing dietary fiber to at least 20 gm/day. This amount can be achieved by selecting foods high in fiber (Table 19-5). One potential problem which has not been thoroughly studied is the possibility that such diets would lead to increased excretion of micronutrients, thereby promoting some marginal nutrient deficiencies. These effects of fiber may be especially pronounced in patients following macrobiotic diet which are very high in fiber but which may have limited amounts of certain micronutrients such as calcium and zinc.

Vitamin C has not been shown to be effective in preventing or treating cancer, and, in large doses, may actually cause significant harm in the form of kidney stones and increased red blood cell breakdown.

Most of the epidemiological studies on the association of vitamin C and cancer are indirect because comparisons were made on the basis of particular foods rather than on vitamin C levels, *per se*. Animal studies are limited because of all the common laboratory animals, only the guinea pig has a requirement for vitamin C.

If there is a positive effect of vitamin C in the prevention or treatment of cancer, it might be presumed to be due to the antioxidant effects of this vitamin. For example, vitamin C might prevent the conversion of nitrates to nitrites and the further formation of nitrosamines, although this does not actually occur physiologically. By such a mechanism, vitamin C would be postulated to have its greatest protective effect on the various segments of the GI tract. However, there have been only limited reports of positive effects and, for the most part, they remain unduplicated by other investigators.[40] Further, administration of high doses of vitamin C to patients with advanced cancer was not beneficial.[44,45] The NRC has concluded that "limited evidence suggests that vitamin C can inhibit formation of some carcinogens and that consumption of vitamin C-containing foods is associated with a lower risk of cancers of the stomach and esophagus."[38]

Large doses of vitamin C (greater than 1-2 gm/day) can actually cause considerable harm. There are some

relatively benign side effects, such as nausea, abdominal cramps, and diarrhea. More importantly, high levels of vitamin C can cause kidney stones. Increased red blood cell breakdown can also occur, particularly in Orientals, American Blacks, and Mediterranean individuals. After taking high vitamin C levels for some time, the body becomes more efficient at breaking down the vitamin. If ingestion of the high levels abruptly ceases, breakdown still continues at the accelerated rate for a period of time leading to an actual deficiency of the vitamin. Amounts of 5-20 gm/day of vitamin C are often recommended by macrobiotic diet pushers; these levels are highly unsafe.

Reports do not provide conclusive evidence of a causal relationship between nitrates and cancer. Limited amounts of nitrates are used for preserving meats and preventing botulism.

Nitrate can be reduced to nitrite, which in turn can react with amines or amides to form N-nitroso compounds, which have been shown to be potent carcinogens *in vitro*.[38] One might expect that the apparent association between consumption of cured meats and cancer would strongly implicate nitrates as carcinogens. Nitrate and salt are added to the meat to inhibit the growth of potent pathogens, such as botulism, and to enhance the pink color of meat. In countries where there is a high intake of smoked and cured meat products, stomach cancer rates are high. In the U.S., however, stomach cancer rates have steadily declined since 1930 even though during the same period consumption of cured and processed meats has been steadily rising.[40] Nitrate in the diet (75 mg/day) comes mostly from vegetables. Drinking-water and fruit juices contribute lesser amounts. Nitrite (0.8 mg/day) is present from the reduction of nitrate, cured meats, baked goods, and cereals.

The risks of botulism are certain and deadly. The purpose in adding nitrate to meat is to add the lowest amount necessary to provide protection against spoilage. The Committee on Nitrite and Alternative Curing Agents in Foods concluded that "reports do not provide conclusive evidence of a causal relationship (between nitrites and cancer)."[38] There are insufficient data to provide any reason for alarm about this practice.

In general, food additives are used to retard spoilage, improve appearance or texture, extend shelf-life, enhance flavor, or restore nutrients lost in processing. Use of these additives has ensured us of having the most abundant, varied food supply on earth. Many of the additives, among which is water, are "naturally" occurring compounds. Since 1958, when the Food Additive Amendment to the Food, Drug and Cosmetic Act was passed, all new food additives must be tested for safety. Some additives in use at that time were exempted from testing based upon opinions from qualified scientists. These substances are generally recognized as safe (GRAS), but are being reviewed by the FDA in ongoing studies. The Delaney clause of the Food, Drug and Cosmetic Act prohibits the FDA from approving the use of any food additives found to cause cancer in humans or animals.

Vitamin A has been shown both to inhibit and to increase tumor growth in animal studies.

There have been a great number of studies of all types concerning the efficacy of vitamin A (or similar retinoids) in the prevention of cancer. For some types of cancer, there appears to be a positive effect from increased consumption of vitamin A.[38,43] In several prospective studies, the serum retinol levels were lower in individuals who developed cancer than in those who did not. Vitamin A has been shown to inhibit tumor development in animal studies using known carcinogens. Not all of the studies have found beneficial effects of this vitamin. In animal studies chemically induced large bowel tumors were actually enhanced by retinoids, as were skin tumors induced by dimethylbenzanthracene and croton oil.[42] Thus, the effects of vitamin A may be dependent upon the type of tumor-inducing mechanism. Because of the possibility that vitamin A could actually enhance some types of tumor growth, it has been recommended that increased vitamin A consumption not be encouraged until further experiments are conducted.[46]

Excesses of vitamin A are highly toxic. Symptoms of overdose occur on as little as 25,000 IU/day.[47] Carotenoids, provitamin A, are not toxic because they are not converted rapidly enough by the body to vitamin A to cause problems. Their deposition in the layers of the skin can, however, literally turn a person orange. Vitamin A

toxicity symptoms may include fatigue, headache, insomnia, loss of appetite, bone and joint pain, hair loss, constipation, and irregular menstruation in women. Excesses of vitamin A may even mimic a brain tumor because there is an increase in fluid in the skull cavity which elevates intracranial pressure. This condition is reversed when excess vitamin A intake ceases. The NRC has concluded "the toxicity of vitamin A in doses exceeded by those required for optimum nutrition and the difficulty of epidemiological studies to distinguish the effects of carotene from those of vitamin A, argue against increasing vitamin A intake by the use of supplements."[38]

In several epidemiological studies low serum cholesterol levels have been found to be associated with increased cancer risk.

Epidemiological studies have correlated per capita fat consumption with breast cancer, prostate cancer, and cancers of the other reproductive organs and the GI tract.[38] It is often difficult to interpret these data because other dietary constituents, such as protein, rise in concert with increased fat. The putative effect of fats has been postulated to be related to increased levels of bile acids secreted in response to high-fat diets. The bile acids could potentially be converted by gut microflora to carcinogens. In some animal studies correlations between high-fat diets and tumor induction have been shown. In humans, however, there have been few well-controlled studies and the results are equivocal, since they could not be duplicated in subsequent studies.[42] Ironically, using data from large cohort studies performed to determine CVD-cholesterol links, it was found in eight separate studies[48] that total cancer incidence, and in particular colon cancer incidence, rose as serum cholesterol levels fell. At present, a mechanism for this effect would be purely speculative. In animal studies, polyunsaturated fats appeared to increase tumor incidence in the presence of a carcinogen. This might be due to the ability of polyunsaturates to form free radicals.

The NRC has stated[38] that studies in animals suggest that when total fat intake is low, polyunsaturated fats are more effective than unsaturated fats in enhancing tumorigenesis, whereas the data in humans do not permit a clear distinction between the effects of different components of fat. Until more data are available, it would seem premature to advise large-scale alterations for the general population, either in the quantity or the type of fat consumed.

Selenium and vitamin E are both involved in the body's antioxidant systems. Too little data exist as yet, however, to assign a definite role to either in preventing or treating cancer.

A number of other factors have been considered for a role in cancer, such as selenium and vitamin E. There have been even fewer studies for these compounds than for those discussed previously. Similarly, there is conflicting evidence or lack of controlled experiments such that specific recommendations are not warranted. Both selenium and vitamin E are involved in protecting the body against oxidative damage.[49] Selenium is a required component of the enzyme glutathione peroxidase. It was illegal at one time to add selenium to animal feeds because of the fear that it might cause cancer. Now just the opposite is the case, and selenium is being touted as a cancer preventive. The amount of selenium in foods depends on the selenium content of the soil in which the food was grown. Selenium tends to be found in the highest amounts in organ meats and seafood. Safe amounts of selenium have been determined to be from 50-200 μg/day for adults by the Food and Nutrition Board, National Academy of Sciences. The NRC has stated the "firm conclusions (about selenium and cancer) cannot be drawn on the basis of the present limited evidence."[38]

Vitamin E, alpha tocopherol, has had even more spectacular claims associated with it, including enhanced sexual potency, extension of life, prevention of heart attacks, and curing of muscular dystrophy.[33] Biochemically, vitamin E functions as an antioxidant, but whether it is part of any enzyme system is unknown. The RDA for vitamin E for adult females is 8 mg (12 IU) and 10 mg (15 IU) for adult males. One tablespoon of corn oil per day would provide more than 100% of the RDA for both men and women. By eating a normal diet, it would be very difficult indeed to induce a deficiency of vitamin E. The NRC has found the data "not sufficient to permit any firm conclusion to be drawn about the effect of vitamin E on cancer in humans."[38]

Nutritional Support of the Cancer Patient

The cancer patient has very special nutritional needs which require professional attention as part of a team approach to management of the cancer patient.

Although the role of nutrition in cancer prevention is cloudy, rapid strides are being made in the nutritional support of the cancer patient.[43] The dietary problems are complex. There may be anorexia as the result of malignancy or therapy that is the product of complex physiological and pyschological interactions. Tumors themselves alter whole-body metabolism because of their demand for certain nutrients. There may also be lowered absorption of nutrients, making it difficult to obtain adequate nutrition even if the patient can and will eat. The physician should discuss with the patient and his family a number of concerns relating to the nutritional support of the cancer patient. These issues should include effects of chemotherapy and radiation treatments, megavitamin or macrobiotic therapy, rational use of dietary supplements, and when to use such treatments as total parenteral nutrition. A registered dietitian should be an integral part of the team approach to caring for the cancer patient. Nutritional support of such patients is discussed in Module 15, Nutritional Care of Deteriorating Patients.

Summary

A risk factor is a characteristic which has a high degree of correlation with contracting a particular disease. Identification of risk factors is a statistical process based upon data obtained from epidemiological studies. Risk factors should not be interpreted as being direct causal agents for disease but should instead suggest further experiments to elucidate and verify links between risk factors and disease. Four primary risk factors have been identified for cardiovascular diseases: lipid transport defects, hypertension, smoking, and diabetes mellitus. Serum cholesterol levels are correlated with risk for heart disease only for those people having mean serum cholesterol levels in the upper two quintiles of the population. The biochemical mechanisms underlying these risk factors for cardiovascular disease have yet to be thoroughly delineated. The risk factors for cancer pose a more complex problem because the degree of risk is a function of the type of cancer. Although a number of dietary modifications have been suggested in an attempt to prevent cancer, the worth of these suggestions has yet to be demonstrated. Progress, however, has been made in the nutritional support of the cancer patient, and such support should be an integral part of cancer patient care.

Evaluation

The evaluation for this module is intended to raise your awareness as to the prevalence of certain risks among your patients. Below is a "Risk Checklist" based on the risk factors listed in Table 19-1 and discussed throughout this module. As you see patients during the next several weeks (or even months), document the presence or absence of each risk factor on the "Risk Checklist." When you have done so for 100 or more patients, prepare a risk profile for your practice. Discuss this profile with other residents, faculty, and health care professionals. If possible, institute educational measures to promote the reduction of risks among your patients, especially those risks most prevalent in your practice.

Risk Checklist

Directions

As you see each patient, determine the presence or absence of each of the following risks. Keep a copy of this checklist in the patient's record and a second copy in a file for later reference.

Risk Factor	*Present*	*Absent*
Hypertension	_____	_____
Diabetes	_____	_____
Smoking	_____	_____
Lack of exercise	_____	_____
Obesity	_____	_____
Substantial exposure to the sun or tanning lamps	_____	_____
Exposure to X-rays	_____	_____
Exposure to occupational hazards (please list)	_____	_____

_____

_____

_____

Intake of dietary fat	_____	_____
Lack of adequate vitamins and minerals in diet	_____	_____
Use of estrogen	_____	_____
Sexual proclivity	_____	_____
Family history of:		
Cardiovascular disease	_____	_____
Cancer	_____	_____
Diabetes	_____	_____
Other (please list)	_____	_____

_____

_____

References

1. Lilienfeld, A., and Lilienfeld, D.: *Foundations of Epidemiology,* 2nd Ed. New York: Oxford University Press, 1980.
2. Hulley, S., et al.: "Epidemiology as a Guide to Clinical Decisions." *New England Journal of Medicine,* 302: 1383-1389, 1980.
3. Bailer III, J.: "Cause and Effect in Epidemiology." *New England Journal of Medicine,* 302:1417-1418, 1980.
4. Holland, W., and Wainwright, A.: "Epidemiology and Health Policy." *Epidemiologic Reviews,* 1:211-232, 1979.
5. Oliver, M.: "Risks of Correcting the Risks of Coronary Disease and Stroke with Drugs." *New England Journal of Medicine,* 302:297-298, 1982.
6. Grundy, S.: "Atherosclerosis: Pathology, Pathogenesis, and Role of Risk Factors." *Disease-a-Month,* 29:1-58, 1983.
7. Ahrens, R.: "Sucrose, Hypertension and Heart Disease: An Historical Perspective." *American Journal of Clinical Nutrition,* 27:403-422, 1983.
8. Podell, R.: "Lipids, Nutrition and Coronary Heart Disease." *Primary Prevention of Coronary Disease: A Practical Guide for the Physician,* R. Podell and M. Stewart (eds.). Reading, Massachusetts: Addison Wesley Pub. Co., Inc., 1983, pp. 78-119.
9. Gordon, T., et al.: "Lipoproteins, Cardiovascular Disease and Death." *Archives of Internal Medicine,* 141:1128-1131, 1981.
10. Ross, R., and Glomset, J.: "The Pathogenesis of Atherosclerosis. Parts 1 and 2." *New England Journal of Medicine,* 295-369-377 and 420-425, 1976.
11. Kolata, G.: "Virus-Heart Link Studied." *Science,* 227-785, 1985.
12. Samuel, P., et al.: "The Role of Diet in the Etiology and Treatment of Atherosclerosis." *Annual Review of Medicine,* 34:179-194, 1983.
13. Keys, A.: "Coronary Heart Disease in Seven Countries." *Circulation,* 41:Supplement 1, pg. 1-88, 1970.
14. Lipid Research Clinics Program: "The Lipid Research Clinics Primary Prevention Trial Results, I." *Journal of the American Medical Association,* 251:351-364, 1984.
15. Lipid Research Clinics Program: "The Lipid Research Clinics Coronary Primary Prevention Trial Results, II." *Journal of the American Medical Association,* 251:365-374, 1984.
16. Hamilton, J.: "Cholesterol Study." *Science,* 223:1247, 1984.
17. McNamara, D.: "Diet and Hyperlipidemia." *Archives of Internal Medicine,* 142:1121-1124, 1982.
18. Shonfeld, G., and Witzum, J.: "Diet and Drug Therapy for Hyperlipoproteinemia." *Nutrition and Drug Interrelationships,* J. Hathcock and J. Coon (eds.). New York: Academic Press, 1978, pp. 773-819.
19. Van Itallie, T.: "Summary: Symposium on Current Perspectives in HTN." *Hypertension 4* (Supplement III), 1982, p. 177.
20. Arky, R., et al: "Examination of Current Dietary Recommendations for Individuals with Diabetes Mellitus." *Diabetes Care,* 5:59-63, 1982.

21. Kolata, G.: "Heart Study Produces a Surprise Result." *Science,* 218:31-32, 1982.

22. O'Malley, K., and O'Brien, E.: "Management of Hypertension in the Elderly." *New England Journal of Medicine,* 302:1397-1401, 1980.

23. Food and Nutrition Board: *Toward Healthful Diets.* Food and Nutrition Board, National Academy of Sciences, National Research Council, Washington, D.C. 1980.

24. National Dairy Council: "Nutrition Update: Sodium." *Dairy Council Digest,* 55:33-38, 1984.

25. Laragh, J., et al. (eds.): *Frontiers in Hypertension Research.* New York: Springer-Verlag, 1982.

26. McCarron, D., et al.: "Dietary Calcium in Human Hypertension." *Science,* 217:267-269, 1982.

27. Ackley, S., et al.: "Dairy Products, Calcium and Blood Pressure." *American Journal of Clinical Nutrition,* 38:457-461, 1983.

28. Langford, H., and Watson, W.: "Electrolytes, Environment and Blood Pressure." *Clinical Science and Molecular Medicine,* 45:111-113, 1973.

29. McCarron, D., and Morris, C.: "Calcium Consumption and Human Hypertension. Report of a National Survey." *Clinical Research,* 30:338A, 1982.

30. Parrott-Garcia, M., and McCarron, D.: "Calcium and Hypertension." *Nutritional Reviews,* 42:205-213, 1984.

31. National Center for Health Statistics: *Dietary Intake Source Data, United States, 1971-1974.* Hyattsville, Md.: U.S. Dept. Health, Ed. and Welfare, 1979, pp. 1-58.

32. Ayachi, S.: "Increased Dietary Calcium Lowers Blood Pressure in the Spontaneously Hypertensive Rat." *Metabolism,* 28:1234-1238, 1979.

33. Bieri, J., et al.: "Medical Uses of Vitamin E." *New England Journal of Medicine,* 308:1063-1071, 1983.

34. Rigotti, N., et al.: "Exercise and Coronary Heart Disease." *Annual Review of Medicine,* 34:391-412, 1983.

35. Roseman, R.: "The Interview Method of Assessment of the Coronary Behavior Pattern." *Coronary Prone Behavior,* T. Dembroski, et al., (eds.). New York: Springer-Verlag, 1978.

36. Case, R.B., et al.: "Type A Behavior and Survival after Acute Myocardial Infarction." *New England Journal of Medicine,* 312:737-741, 1985.

37. Washington Post: "Anti-Cancer Diet Gets Big Federal Push." *Columbus Dispatch,* March 7, 1984, p. 1.

38. Committee on Diet, Nutrition and Cancer: *Diet, Nutrition and Cancer.* Washington, D.C.: National Research Council, National Academy Press, 1982.

39. Editorial: "Eating the Right Stuff." *Cancer News,* Spring/Summer, 1984, pp. 4-6.

40. Pariza, M.: "A Perspective on Diet, Nutrition and Cancer." *Journal of the Americar Medical Association,* 251:1455-1458, 1984.

41. Burkitt, D.: "Etiology and Prevention of Colorectal Cancer." *Hospital Practice,* 19:67-77, 1984.

42. Graham, S.: "Toward a Dietary Prevention of Cancer." *Epidemiologic Reviews,* 5:38-50, 1983.

43. Van Eys, J.: "Nutrition and Neoplasia." *Nutritional Reviews,* 40:353-359, 1982.

44. Creagen, E., et al.: "Failure of High Dose Vitamin C to Benefit Patients with Advanced Cancer: A Controlled Trial." *New England Journal of Medicine,* 301:687-690, 1979.

45. Moertel, C., et al.: "High Dose Vitamin C Versus Placebo in the Treatment of Patients with Advanced Cancer Who Have Had No Prior Chemotherapy." *New England Journal of Medicine,* 312:137-141, 1985.

46. Kolata, G.: "Does Vitamin A Prevent Cancer?" *Science,* 223:1161, 1984.

47. Yaffe, S., and Filer, L.: "The Use and Abuse of Vitamin A." *Nutritional Reviews,* 32 (supplement): 41-43, 1974.

48. Kolata, G.: "Data Sought on Low Cholesterol and Cancer." *Science,* 211:1410-1411, 1981.

49. Willett, W., and MacMahon, B.: "Diet and Cancer—An Overview." *New England Journal of Medicine,* 310:633-638, 697-703, 1984.

Resources for the Physician

1. Stein, E., et al.: "Coronary Risk Factors in the Young." *Annual Review of Medicine,* 32:601-613, 1981.
2. Goldstein, J., et al.: "Defective Lipoprotein Receptors and Atherosclerosis." *New England Journal of Medicine,* 309:288-296, 1983.
3. Grundy, S.: "Can Modification of Risk Factors Reduce Coronary Heart Disease?" *Controversies in Coronary Artery Disease,* S. Rahimtoola, (ed.). Philadelphia, Pennnsylvania: F.A. Davis Co., 1983, pp. 283-296.
4. Fitzgerald, F.: "The Problem of Obesity." *Annual Review of Medicine,* 32:221-231, 1981.
5. Kohrs, M., and Tobben, C.: "Association of Obesity with Disease Among the Elderly." *Nutrition Reports International,* 25:533-541, 1982.
6. Willett, W., and McNahon, B.: "Diet and Cancer—An Overview." *New England Journal of Medicine,* 310:633-637, 697-703, 1984.
7. McNamara, D.: "Diet and Hyperlipidemia: A Justifiable Debate." *Archives of Internal Medicine,* 142:1121-1124, 1982.
8. Jarrett, R. (ed.): *Diabetes and Heart Disease.* Amsterdam: Elsevier, 1982.
9. Podell, R., and Stewart, M. (eds.): *Primary Prevention of Coronary Heart Disease: A Practical Guide for the Clinician.* Reading, Massachusetts: Addison Wesley Pub. Co., Inc., 1983.
10. Committee on Diet, Nutrition and Cancer: *Diet, Nutrition and Cancer.* National Research Council, Washington, D.C.: National Academy Press, 1982.
11. Office of Medical Applications of Research, National Institutes of Health: "Lowering Blood Cholesterol to Prevent Heart Disease." *Journal of the American Medical Association,* 253:2080-2086, 1985.

Resources for the Patient

1. *The American Heart Association Heartbook.* New York: E.P. Dutton, 1980.
2. Deutsch, R.: *Realities of Nutrition.* Palo Alto, California: Bull Publishing Co., 1976.
3. Kaercher, D.: "High Blood Pressure." *Better Homes and Gardens,* Feb., 1984, pp. 16-24.
4. High Blood Pressure Information Center, 120/80: National Institutes of Health, Bethesda, Maryland: 20205.
5. Committee on Diet, Nutrition and Cancer: *Diet, Nutrition and Cancer,* National Research Council, Washington, D.C.: National Academy Press, 1982.
6. Local Chapter, American Cancer Society, or 777 3rd Ave., New York, NY, 10017.
7. Local Chapter, American Heart Association, or 7320 Greenville Ave., Dallas, TX 75231.
8. Local Chapter, Diabetes Association, or 2 Park Ave., New York, NY 10016.
9. American Dietetic Association, 430 N. Michigan Ave., Chicago, IL 60611.

Index

Some Abbreviations Used in the Nutrition in Primary Care Series

ATP	adenosine triphosphate
c	cup
cc	cubic centimeter
CNS	central nervous system
FDA	Food and Drug Administration
gm	gram
IBW	ideal body weight
IU	International Units
kcal	kilocalorie
kg	kilogram
lb	pound
lg	large
MCV	mean corpuscular volume
MDR	minimum daily requirement
med	medium
μg	microgram
mEq	milliequivalent
mg	milligram
MJ	megajoule
ml	milliliter
oz	ounce
RDA	Recommended Dietary Allowances
RE	retinol equivalents
sl	slice
sm	small
Tbsp	Tablespoon
TPN	total parenteral nutrition
tsp	teaspoon
USDA	United States Department of Agriculture