

**An
Evaluation
of Research in the
United States on**

HUMAN NUTRITION

**Report No. 2
Benefits from Nutrition Research**

**Prepared by
A JOINT TASK GROUP OF THE
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AND THE STATE UNIVERSITIES
AND LAND GRANT COLLEGES**

Benefits from Human Nutrition Research

by

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PREFACE

This Report is No.2 in a series on evaluation of human nutrition research. It addresses itself to reviewing the current situation with respect to each nutrition-related health problem. The first sixteen pages summarize the estimated magnitude of potential benefits from nutrition research on these problems.

Estimates of potential savings are judgments based on review of scientific literature and discussions with clinicians. No claim is made that all the benefits are included or that the claims made for nutrition's contribution to the problems are as great or small as eventually may be realized. At best, they are subjective evaluations because basic data do not exist.

The balance of Report No. Z provides a concise review of background data concerning the magnitude of each nutrition-related health problem, geographical and population differences in the severity of the problem, and possible causal factors, including the known and suggestive nutrition relationships.

This evaluation of Human Nutrition Research in the United States has dual purposes, each with its own objectives.

One purpose of this study is to conduct an evaluative analysis of current problems related to human nutrition and to present the results of this analysis in a meaningful manner that will facilitate policy decisions about future programs of research on food and human nutrition topics. The specific objectives of this phase of the study are:

- 1 To appraise the current nutritional status of the population and associated nutrition-related problems.
- 2 To describe and evaluate what is currently 'known about corrective measures for nutrition-related problems.
- 3 To inventory and describe the current research that is contributing new knowledge to the correction of nutrition-related problems.
- 4 To identify the inadequacies in current and new knowledge relevant to nutrition-related problems and to propose research designed to remove these inadequacies.

The second purpose of the study is to determine the feasibility of applying cost-benefit analysis to the evaluation of research programs in the particular circumstances encountered in public research administration. The specific objectives of this phase of the study are:

1. To develop a generalized framework of analysis that could be reapplied to topical areas other than the specific one studied in this pilot effort.
2. To develop quantification and evaluative techniques useful to public research administration.
3. To evaluate the feasibility and potential usefulness of such techniques of analysis as standard procedures for research administration in the U.S. Department of Agriculture.

The basic approach to achieving the dual purposes of this study is to identify the extent of human nutrition and food oriented health problems that currently exist, determine what could be done with existing nutrition knowledge, and as a residual specify what additional new knowledge must be generated to permit alleviation of these problems.

Report No.1 is a survey of human nutrition research that is currently being supported and/or conducted by Public Research Organizations. It provides detailed information classified according to many useful ways of looking at human nutrition research, including nutrition-related health problems.

Report No.2 is concerned with the current situation with respect to each problem and estimates the potential benefits from application of new knowledge. Report No.3, to be issued, will review the state of the art of our nutrition knowledge.

It is planned to use these reports as basic documents for expert panels to react to in a modified Delphi oracle technique to improve subjective estimates of potential benefits, determine needed research, and estimate the resources required to reach research objectives. Similarly, an expert panel would be asked to determine the priorities for needed research.

The results of these subjective evaluations, together with a more complete description of the study plan and methodology, will be covered in a final report.

BENEFITS FROM NUTRITION RESEARCH

Better health, a longer active lifespan, and greater satisfaction from work, family and leisure time are among the benefits to be obtained from improved diets and nutrition. Advances in nutrition knowledge and its application during recent decades have played a major role in reducing the number of infant and maternal deaths, deaths from infectious diseases, particularly among children, and in extending the productive lifespan and life expectancy. Significant benefits are possible both from new knowledge of nutrient and food needs and from more complete application of existing knowledge. The nature and magnitude of these benefits is estimated in [Table 1](#). Potential benefits may accrue from alleviating nutrition-related health problems, from increased individual performance and satisfactions and increased efficiency in food services. A vast reservoir of health and economical benefits can be made available by research yet to be done on human nutrition.

Major health problems are diet related. Most all of the health problems underlying the leading causes of death in the United States ([Fig.1](#)) could be modified by improvements in diet. The relationship of diet to these health problems and others is discussed in greater detail later in this report. Death rates for many of these conditions are higher in the U.S. than in other countries of comparable economic development. Expenditures for health care in the U.S. are sky-rocketing, accounting for 67.2 billion dollars in 1970--or 7.0 percent of the entire U.S. gross national product.

The real potential from improved diet is preventive. Existing evidence is inadequate for estimating potential benefits from improved diets in terms of health. Most nutritionists and clinicians feel that the real potential from improved diet is preventative in that it may defer or modify the development of a disease state so that a clinical condition does not develop. The major research thrust, nationwide, has been on the role of diet in treating health problems after they have developed. This approach has had limited success. USDA research emphasis has been placed on food needs of normal, healthy persons and findings from this work have contributed much of the existing knowledge on their dietary requirements.

Benefits would be shared by all. Benefits from better nutrition, made possible by improved diets, would be available to the entire population. Each age, sex, ethnic, economic, and geographic segment would be benefited. The lower economic and nonwhite population groups would benefit most from effective application of current knowledge.

These savings are only a small part of what might be accomplished for the entire population from research yet to be done. Some of the improvements can be expressed as dollar benefits to individuals or to the nation. The social and personal benefits are harder to quantify and describe. It is difficult to place a dollar figure on the avoidance of pain or the loss of a family member; satisfactions from healthy, emotionally adjusted families; career achievement; and the opportunity to enjoy leisure time.

Major health benefits are long range. Predictions of the extent to which diet may be involved in the development of various health problems have been based on current knowledge of metabolic pathways of nutrients, but primarily of abnormal metabolic pathways developed by persons in advanced stages of disease. There is little understanding of when or why these metabolic changes take place. The human body is a complex and very adaptive mechanism. For most essential metabolic processes alternate pathways exist which can be utilized in response to physiological, diet, or other stress. Frequently, a series of adjustments take place and the ultimate result does not become apparent for a long time, even years, when a metabolite such as cholesterol accumulates. Early adjustment of diet could prevent the development of undesirable long-range effects. Minor changes in diet and food habits instituted at an early age might well avoid the need for major changes, difficult to adapt later in life.

Regional differences in diet related problems. The existence of regional differences in the incidence of health problems has been generally recognized and a wide variation in death rates still exists among geographic areas (Figs. 2, 3). These differences in death rate may reflect the cumulative effect of chronic low intake levels of some nutrients throughout the lifespan and by successive generations. A number of examples of regional health problems attributable to differences in the nutrient content of food or to dietary pattern could be given. Perhaps the best known is "the goiter belt" where soils and plants were low in iodine and the high incidence and death rate of goiter was reduced when the diet was supplemented with iodine. Another situation existed in some of the southern states where pellagra was a scourge a few decades ago. Corn was the major food protein source for low income families in these areas. The resulting niacin deficiency raised the incidence of pellagra to epidemic proportions.

Migration from the high death rate areas almost always results in a reduction in the death rate, although the improvement never approaches the level achieved by those who were born and continued to live in the low rate areas (Fig. 4). Similarly, persons who move from low rate areas into higher rate areas lose part of the advantage. If the death rate for one of the high death rate areas, Wilkes Barre, Pennsylvania, were applied to the entire U.S. population, 140,489 more persons under 65 years would have died per year/during the period 1959-61 (Table 2). If the death rate for one of the lower rate areas, Nebraska, had prevailed, there would have been 131,634 fewer deaths. The highest death rate areas generally correspond to those where agriculturists have recognized the soil as being depleted for several years. This suggests a possible relationship between sub marginal diets and health of succeeding generations.

TABLE 1

Magnitude of benefits from nutrition research**PART A.** Nutrition related health problems

Health Problem	Magnitude of loss	Potential savings from improved diet
Heart and vasculatory	Over 1,000,000 deaths in 1967 Over 5 million people with definite or suspect heart disease in 1960-62 \$31.6 billion in 1962	25% reduction 20% reduction
Respiratory and infectious	82,000 deaths per year 246 million incidents in 1967 141 million work days lost in 1965-66 166 million school days lost \$5 million in medical and hospital costs \$1 billion in cold remedies and tissues	20% fewer incidents 15-20% fewer days lost 15-20% fewer days lost \$1 million \$20 million
Mental Health	2.5% of population of 5.2 million people are severely or totally disabled. 25 million people have manifest disability	10% fewer disabilities
Infant mortality and reproduction	Infant deaths in 1967--79,000 Infant death rate 22.4 per 1,000 Fetal death rate 15.6 per 1,000 Maternal death rate 28.0 per 100,000 live births Child death rate (1-4 yrs) 96.1 per 100,000 in 1964 15 million with congenital birth defects	50% fewer deaths 50% fewer deaths 50% fewer deaths 50% fewer deaths Reduce rate to 10 per 100,000 3 million fewer children with birth defects
Early aging and lifespan	49.1% of population, about 102 million people have one or more chronic impairments People surviving to age 65: White males -- 66% Negro males -- 50% White females -- 81% Negro females -- 64% Life expectancy in years: White males -- 67.8 Negro males -- 61.1 White females -- 75.1 Negro females -- 68.2	10 million people without impairments 1% improvement per year to 90% surviving Bring Negro expectancy up to white
Arthritis	16 million people afflicted 27 million work days lost	8 million people without afflictions 13.5 million work days

	500,000 people unemployed Annual cost \$3.6 billion	125,000 people employed \$900 million per year
Dental Health	44 million with gingivitis 23 million with advanced periodontal disease \$6.5 billion public and private expenditures on dentists services in 1967 22 million edentulous persons (1 in 8) in 1957 1/2 of all people over 55 have no teeth	50% reduction in incidence, severity and expenditures
Diabetes and carbohydrate disorders	3.9 million overt diabetic 35,000 deaths in 1967 79% of people over 55 with impaired glucose tolerance	50% of cases avoided or improved
Osteoporosis	4 million severe cases 25% women over 40	75% reduction
Obesity	3 million adolescents 30 to 40% of adults 60 to 70% over 40 years	80% reduction in incidence
Anemia and other nutrient deficiencies	See Improved Work Efficiency, Growth and Development, and Learning Ability	
Alcoholism	5 million alcoholics; 1/2 are addicted About 24,500 deaths in 1967 caused by alcohol Annual loss over \$2 billion from absenteeism, lowered production and accidents	33% 33% 33%
Eyesight	48.1%, or 86 million people over 3 years wore corrective lenses in 1966 81,000 become blind every year \$103 million in welfare	20% fewer people blind or with corrective lenses
Cosmetic	10% of women ages 9 or more with vitamin intakes below recommended daily allowances	
Allergies	22 million people (9%) are allergic 16 million with hayfever asthma 7-15 million people (3-6%) allergic to milk Over 693 thousand persons (1 in 3,000) allergic to gluten	20% people relieved 90% people relieved 90% people relieved
Digestive	8,495 thousand work days lost 5,013 thousand school days lost	

	About 20 million incidents of acute condition annually \$4.2 billion annual cost 14 million persons with duodenal ulcers \$5 million annual cost 4,000 new cases each day	25% fewer acute conditions Over \$1 billion in costs
Kidney and urinary	55,000 deaths from renal failure 200,000 with kidney stones	20% reduction in deaths and acute conditions
Muscular disorders	200,000 cases	10% reduction in cases
Cancer	600,000 persons developed cancer in 1968 320,000 persons died of cancer in 1968	20% reduction in incidence and deaths

TABLE 1
PART B. Individual satisfactions increased

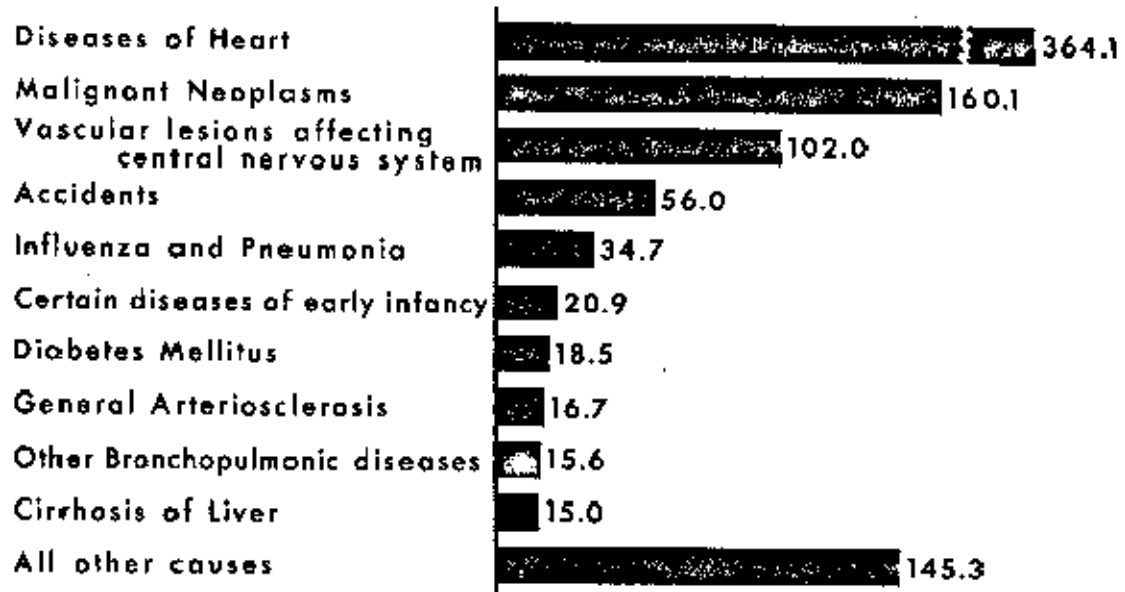
Satisfactions	Magnitude of loss	Potential savings from improved diet
Improved work efficiency		0.5% increase in on the job productivity
Improved growth and development	113,000 deaths from accident 324.5 million work days lost 51.8 million people needing medical attention and/or restricted education	25% fewer deaths and work days lost

TABLE 1
PART C. Increased efficiency in food services

Efficiency	Magnitude of loss	Potential savings from improved diet
Improved efficiency in food preparation and menu planning		Not estimated
Reduced losses of nutrients in food storage, handling, and preparation		Not estimated
Improved efficiency in food selection		Not estimated
Improved efficiency in food programs		Not estimated

FIGURE 1

Leading Causes of Death Rate
per 100,000 I.S. 1969



SOURCE: BUREAU OF THE CENSUS

FIGURE 2

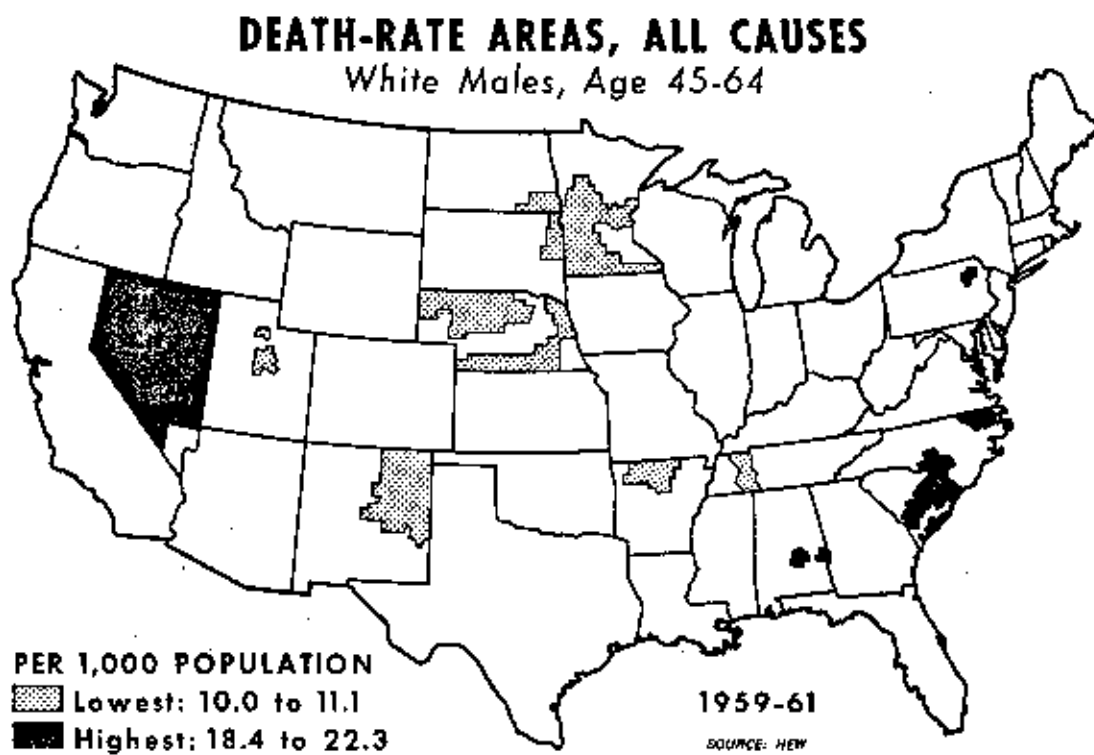


Figure 2

FIGURE 3

Death - Rate Areas, All Causes

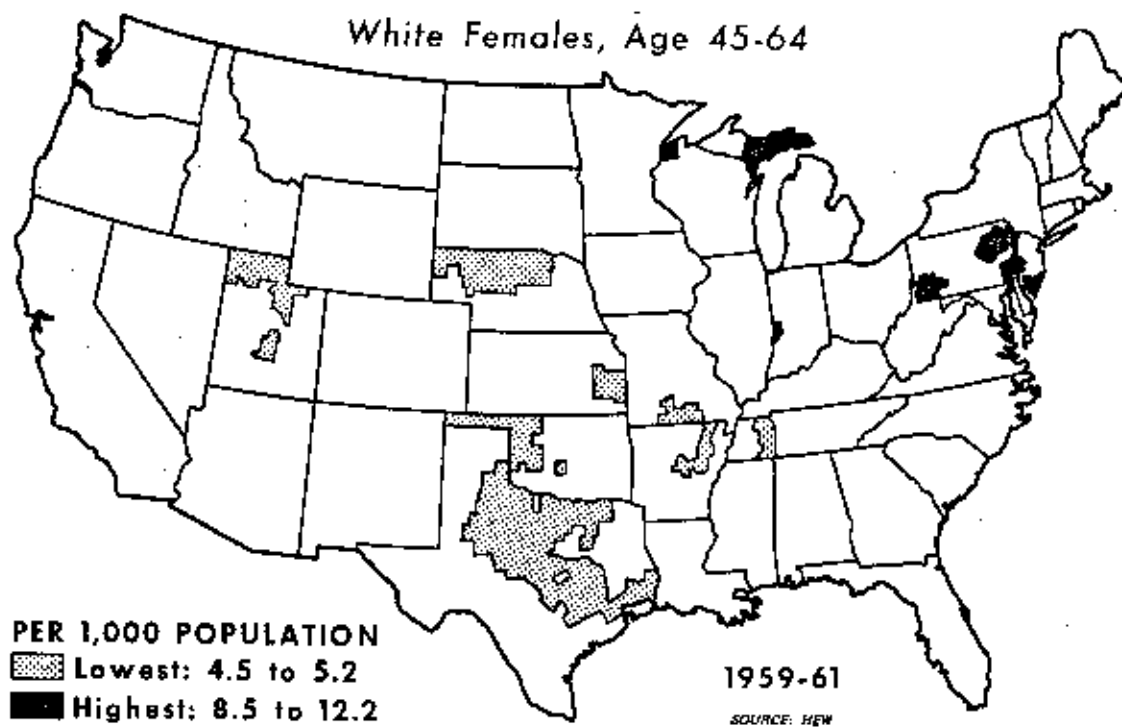


Figure 3

TABLE 2

Difference in average annual number of deaths in the
United States under different assumptions,
whites under 75 years, 1959-1961

Age and sex	If instead of the actual United States experience, the death rates for specified areas for 1959-1961 applied:			
	Four lowest economic subregions of 1949-51	Nebraska State economic area 5	Minnesota State economic area 5	Wilkes-Barre, (Luzerne County) Pennsylvania
<u>Under 35¹</u>				
Male	-1298	-9082	-6925	+2959
Female	-753	-8874	-5058	+1067
<u>35-44</u>				
Male	-4044	-6863	-5597	+8442
Female	-3672	-4541	-2035	+3786
<u>45-54</u>				
Male	-18813	-25785	-21627	+32236
Female	-10333	-8722	-12365	+5025
<u>55-64</u>				
Male	-43082	-49343	-45144	+56706
Female	-14900	-18424	-12831	+30268
Total under 65	-96895	-131634	-111584	+140489
<u>65-74</u>				
Male	-47196	-45802	-48334	+92040
Female	-20049	-23387	-29510	+72185
Total under 75	-164140	-200823	-189428	+304714

¹Calculated from crude death rates under 35 years of age, age adjusted to the U. S. in 1960 by age groups under 1, 1-4, 5-14, 15-24, and 25-34.

Source: Sauer, H. I., and D. M. Moore 1966 Area and Migration Differences in the Risk of Dying. Amer. Publ. Health Ass. Meeting, Nov. 2.

HEART AND VASCULARITY

Heart and vascular diseases are the number one cause of deaths in the U.S. accounting for about 54 percent of all deaths; ranging from one-tenth of all deaths under the age of 35 years, and one-third between 35 and 45 years, to 71 percent at age 75 years and above (Fig. 4). There were over one million deaths from heart and vascular disease in 1967. The way the incidence of heart disease is rising, more than 1.5 million Americans can be expected to suffer heart attacks and strokes in 1970. This projection was made in 1967 by a group of heart experts at an International Conference on Thrombosis sponsored by the National Academy of Sciences.

The most recent figures for incidence of heart and vascular diseases are from the Health Survey of 1960-62 (Table 3). At that time, definite heart disease had been diagnosed in 13.2 percent of the population and was suspected in an additional 11.7 percent. During 1960-62, there were 28 million adults between 18 and 79 years of age diagnosed or suspected of having heart disease. The condition is more frequently found in men than in women before the menopause and is much more prevalent in Negroes than whites (Table 4). The President's Commission on Heart Disease, Cancer, and Stroke estimated economic costs of deaths from heart disease at \$31.9 billion in 1962.

Although the percent of all deaths due to the cardiovascular diseases has increased continuously since 1900, the death rate from cardiovascular diseases has gone down (Figs. 5, 6). In 1900 cardiovascular diseases accounted for 20 percent of all deaths. Today, more than half of all deaths are from this cause. Meanwhile, in the age groups below 45 years, the death rates have gone down for both males and females. In the 45-64 age group, the death rate among females has gone down steadily since 1930. In men of the same group, the trend was upward until about 1940, plateaued for a period, and then started downward about 1950. Since then it has dropped about 7.5 percent. In the age group 65 and over, the rates have been relatively stable. However, if adjustment were made for the increasing proportion of older people in this age group, the trend would be somewhat downward.

Death rates from heart disease are much higher in the U.S. than in many other countries of comparable economic level (Table 5). Among the developed countries, 26 have lower death rates from heart disease than the U.S. The rates of death range from 51.8 per 100,000 population in Japan, and 79.8 in France, to 312.9 in the United States, 344.5 in West Berlin, and 352.3 in Scotland.

Epidemiological data indicate a high variance in death rate from heart and vascular disease among geographic areas in the U.S. (Figs. 7, 8, 9, 10). Highest rates for white males were in the Southeast, for white females in the Southeast and Upper Michigan. The effects of early environment, including diet, are apparent in the statistics. Persons born in areas where the cardiovascular mortality was high, were more likely to die from this cause even though they moved to low rate areas. However, their chances were better than if they remained in their state of birth. Persons from low rate areas fared best if they remained in their birth place. Those who moved to high rate areas were less likely to die of heart disease than those who were born and lived in the high rate area.

Any consideration of the reasons underlying geographic differences in death rate must include diet. What foods are eaten? Do the foods differ in nutrient content or value among the areas? What differences exist in the mineral content of the water supply? Areas with the highest death rate for men are those recognized as having depleted soils. Higher death rates from cardiovascular disease also are found in areas where the water is hard.

The cause of the high death rate from heart disease in the U.S. is not known. Several high risk factors have been identified including family history, sex, age, smoking, stress, blood pressure, diabetes, overweight, lack of exercise, blood cholesterol, blood triglycerides (Figs. 11, 12, 13). The importance of diet compared to the other risk factors is not known. A great deal of attention has been given to the

possible relationship between diet and heart disease because most of the conditions are associated with an alteration in fat metabolism, reflected in increased levels of blood cholesterol and/or blood triglycerides. Fat transport systems are not normal in many cardiovascular patients; five types of hyperlipoproteinemia have been identified and diets devised to control the conditions. The diets vary for each of the five types and involve control of calories, cholesterol, type, and amount of fat or carbohydrate.

Substantive data have not been obtained on the role of diet prior to or during the development of cardiovascular problems. Overweight is a problem because of the frequent association with high blood pressure and diabetes. In addition, additional body mass puts an added weight on the heart. The relationship between high blood sugar levels and stroke is clearly established although the reason is not. Depending on the individual, the blood Cholesterol level may be reduced by one or more of these dietary changes; reduction in the amount of fat, increasing the proportion of fat occurring as polyunsaturated fatty acids, or changing the type of carbohydrate. Very likely other nutrients can and do exert an effect. For example, an increased intake of chromium may increase the glucose tolerance of many individuals and thus might reduce the risk of heart disease for some persons.

A number of studies have been made on the relationship of diet and diet adjustment to the incidence of cardiovascular disease in selected populations. None of these has been conclusive. While diet may alter the risk factors, there is no clear statistical proof that the development of coronary heart disease can be slowed up by changing diet. There is no proof that lowering the dietary cholesterol intake affects the coronary patient. Scientists do not agree on the value of diet adjustment in preventing death in coronary patients. A number of diet studies have been of men who had suffered heart attacks. Coronary relapses were usually 25-50 percent less among those men on diets adjusted to reduce the intake of fat and cholesterol and to increase the proportion of polyunsaturated fatty acids. However, there was no difference in the total number of deaths. Interpretation of the results is complicated by the fact that adherence to the diets was only 50 percent.

There is no proof, but considerable evidence, that to be effective, any change in dietary patterns should begin at an early age in order to delay the onset of these diseases. The first changes in the vascular system may have occurred by the age of three, although coronary heart disease may not be diagnosed until the fourth or fifth decade. Good nutrition, including control of weight and diabetes by those having a family history of heart disease, should be encouraged from birth.

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FIGURE 4

Deaths Due to Cardiovascular Diseases -- 1962

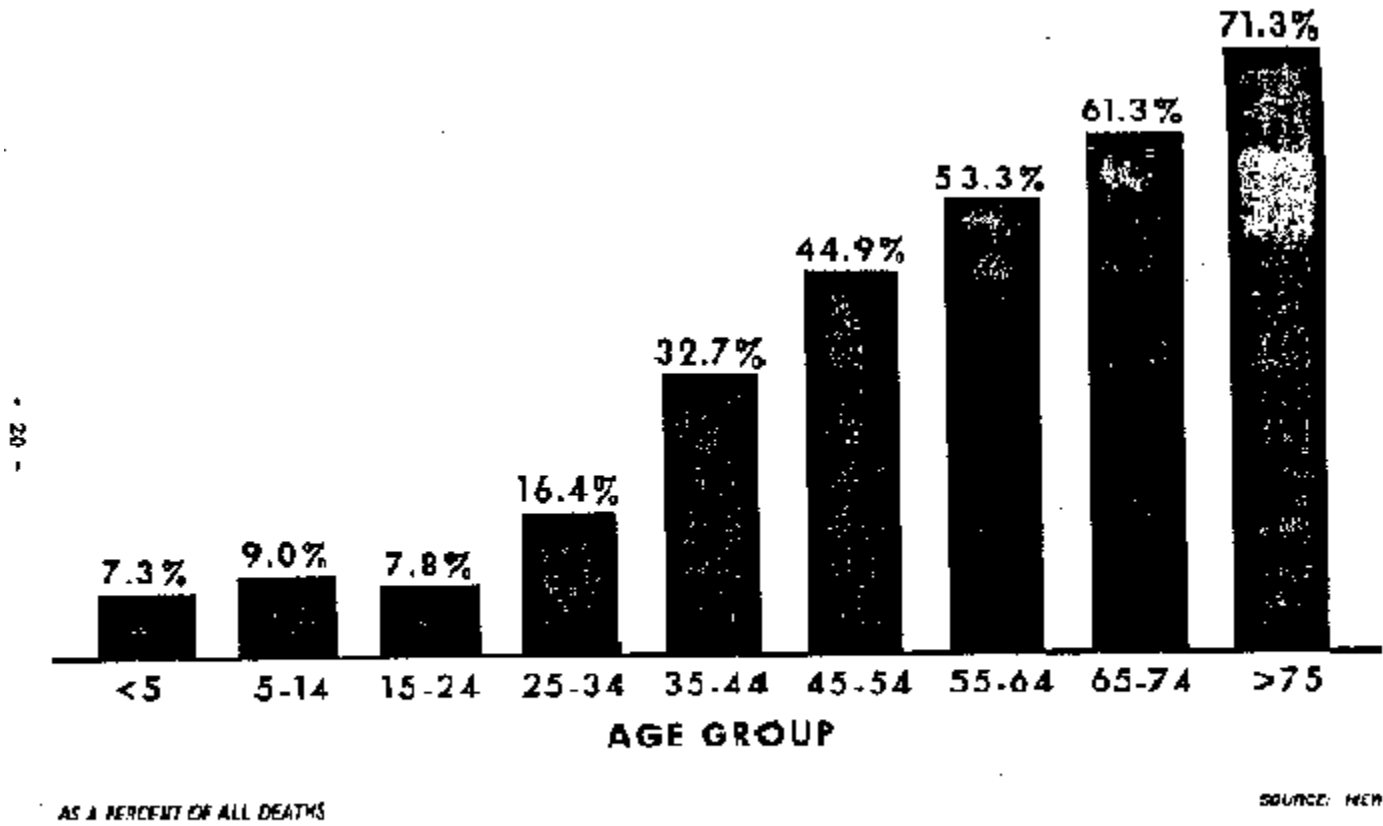


Figure 4

TABLE 3

Incidence of heart disease in adults, 1960-1962

	Number of adults (1,000)	Percent of all adults
Definite cases	14621	13.2
Male	6652	12.6
Female	7970	13.7
Suspect cases	12979	11.7
Male	7315	13.9
Female	5663	9.7

Heart and vascular problems cause 54 percent of all deaths in the United States.

Source: National Center for Health Statistics
1964 PHS Publ. 1000, series 11, no. 6.
U. S. Dept. of Health, Education, and
Welfare.

TABLE 4

Prevalence of definite and suspect heart disease
for white and Negro adults, by age and sex:
United States, 1960-1962

Age	Men		Women	
	White	Negro	White	Negro
Percent of specified population group				
<u>Definite heart disease</u>				
Total 18-79 years	11.5	23.8	12.5	24.8
18-24 years	1.4	1.9	0.8	3.2
25-34 years	2.5	7.9	1.4	6.8
35-44 years	6.1	18.1	4.9	14.0
45-54 years	11.3	33.0	9.6	36.6
55-64 years	22.5	41.6	23.7	52.2
65-74 years	31.3	56.9	43.5	70.1
75-79 years	39.3	52.3	44.8	69.5
<u>Suspect heart disease</u>				
Total 18-79 years	13.5	17.6	9.3	12.6
18-24 years	6.3	6.7	1.2	8.3
25-34 years	5.5	16.9	2.6	7.8
35-44 years	10.6	16.7	5.4	13.0
45-54 years	18.4	18.2	11.8	14.8
55-64 years	17.6	28.2	20.3	20.3
65-74 years	26.4	11.9	17.3	16.2
75-79 years	25.3	50.3	23.4	14.2

Source: National Center for Health Statistics 1964 PHS Publ. 1000, series 11, no. 6. U. S. Dept. of Health, Education, and Welfare.

FIGURE 5

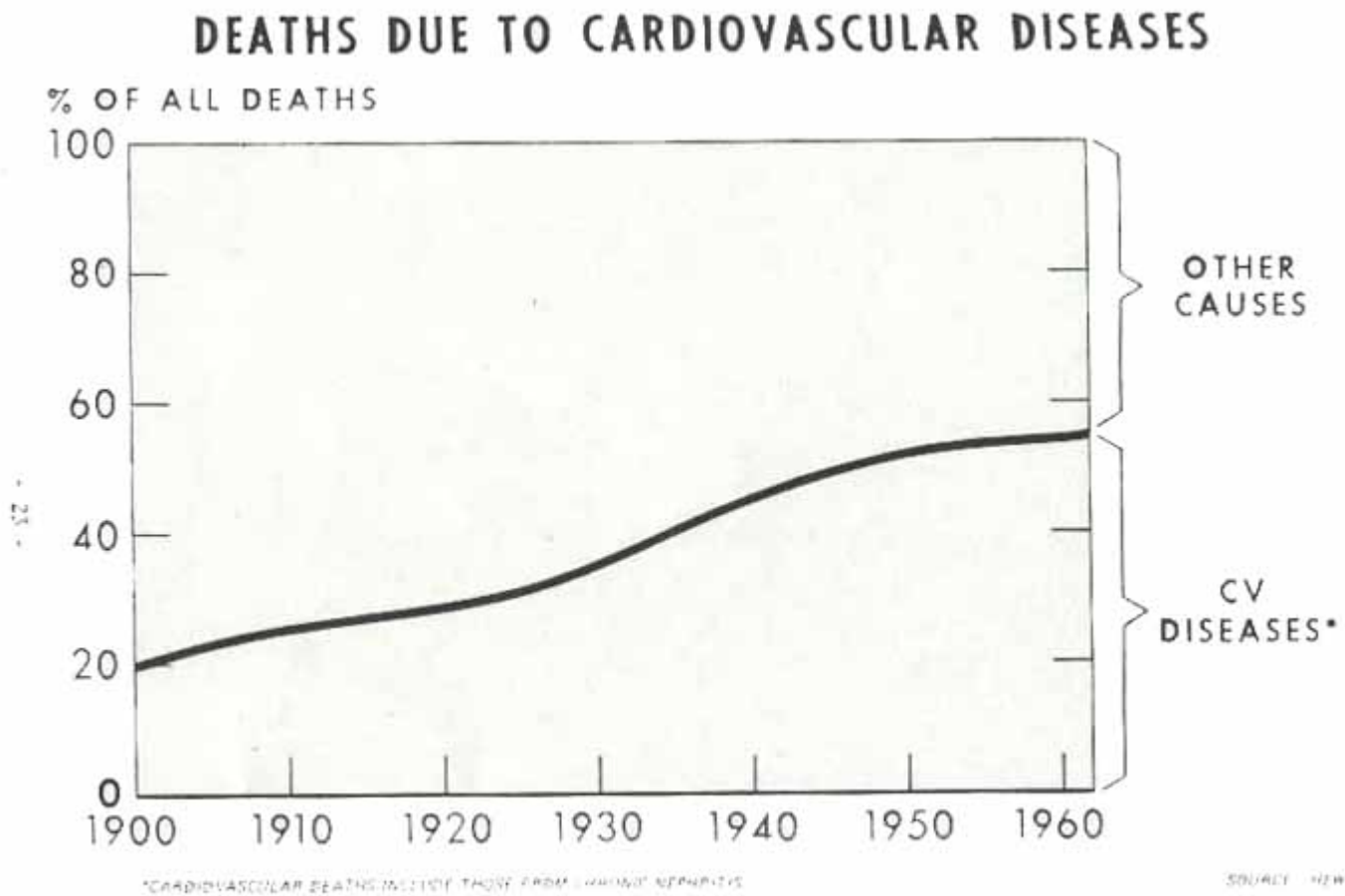
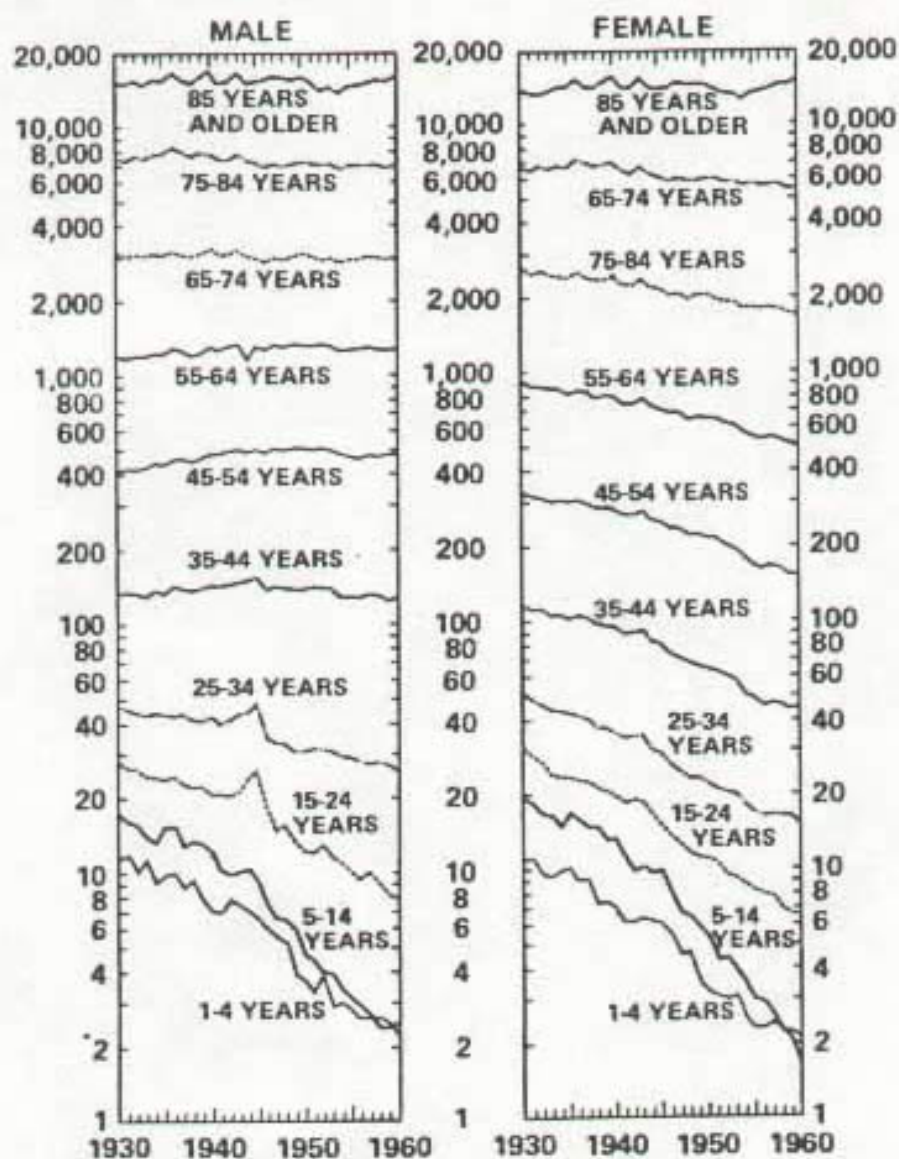


Figure 5. — In 1900 CV diseases accounted for 20 percent of all deaths. Today more than half of all deaths are due to CV diseases. Part of this increase is due to the larger proportion of older people in the population. It is in the older age groups that CV diseases take their greatest toll.

FIGURE 6

DEATH RATES FOR CARDIOVASCULAR DISEASES

White Population, U.S., 1930-60



DEATH RATES PER 100,000 POPULATION
FOR MAJOR CARDIOVASCULAR-RENAL DISEASES.

SOURCE: HEW

Figure 6

TABLE 5

Deaths from arteriosclerotic and degenerative
heart disease per 100,000 population in
selected countries, 1963 or 1964

Country	Death rate
Netherlands	182.1
Norway	263.5
Sweden	298.0
Iceland	171.8
Denmark	263.2
Israel (1)	154.4
Switzerland	242.2
New Zealand	256.1
Ireland	299.6
France	79.8
England & Wales	306.8
Japan	51.8
Czechoslovakia	157.3
West Germany (2)	210.4
Australia	286.2
United States	312.9
Scotland	352.3

(1) Jewish population only

(2) Including West Berlin

Source: United Nations 1966 Demographic Yearbook
1965, United Nations, New York.

FIGURE 7

DEATH RATES; CARDIOVASCULAR DISEASES

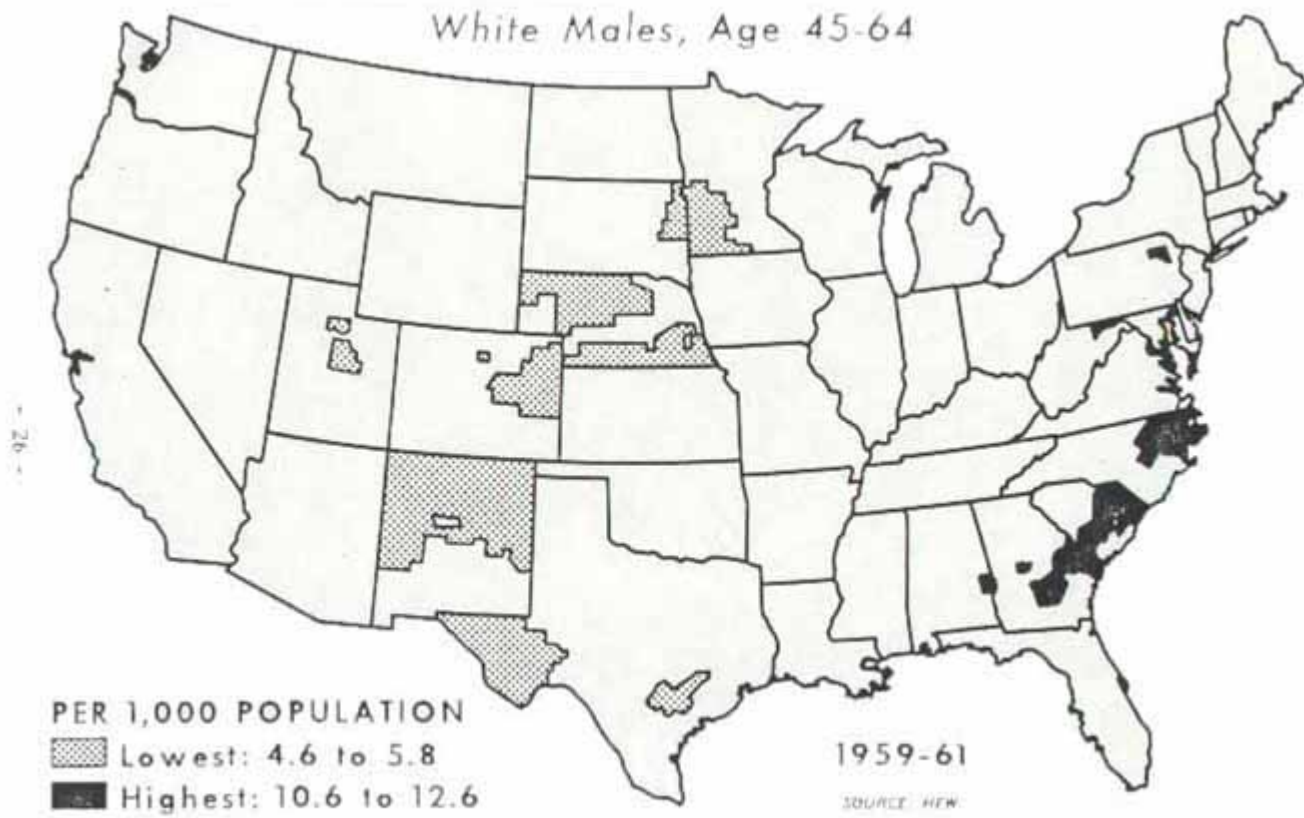


Figure 7

FIGURE 8

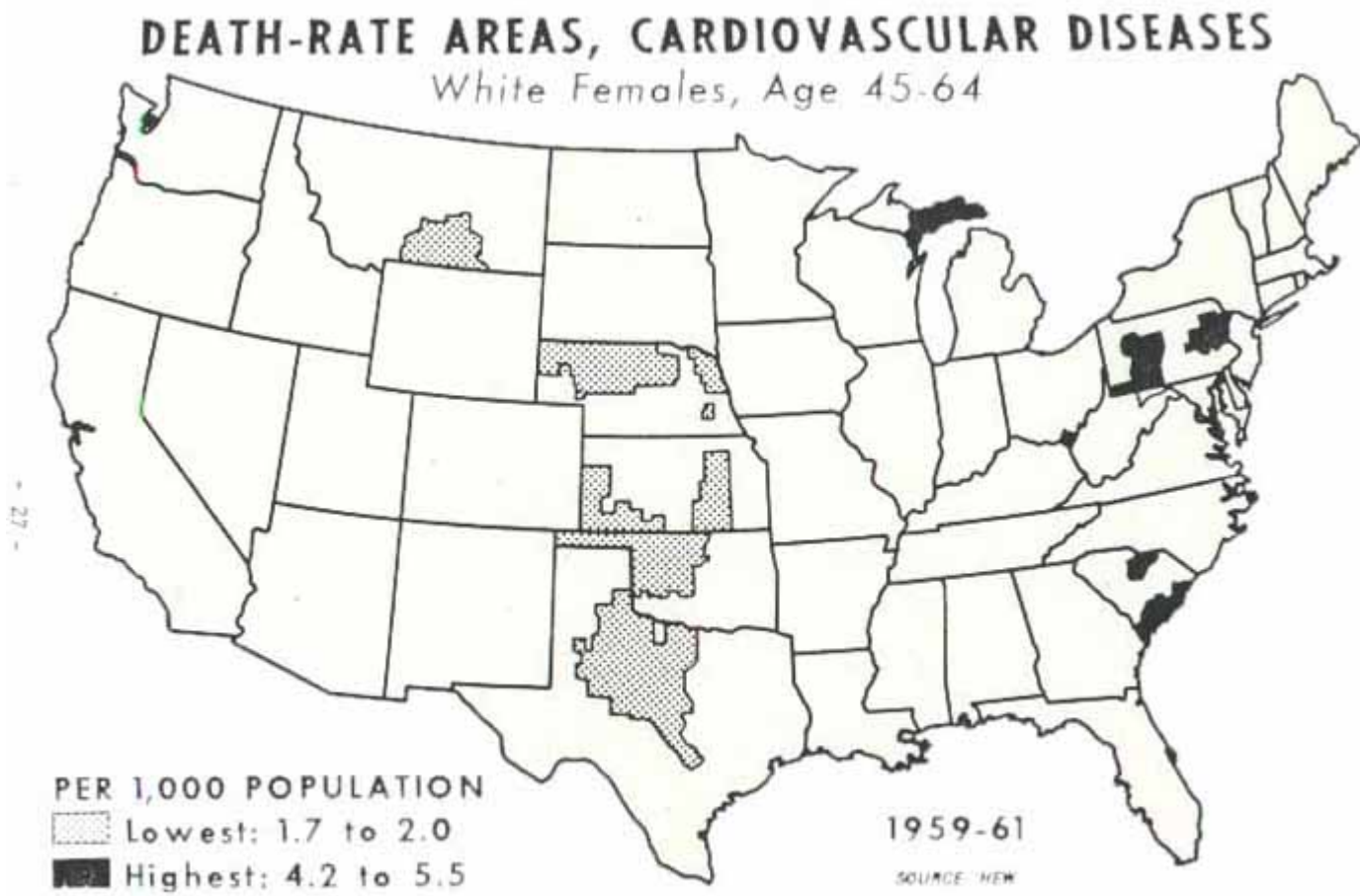


Figure 8

FIGURE 9

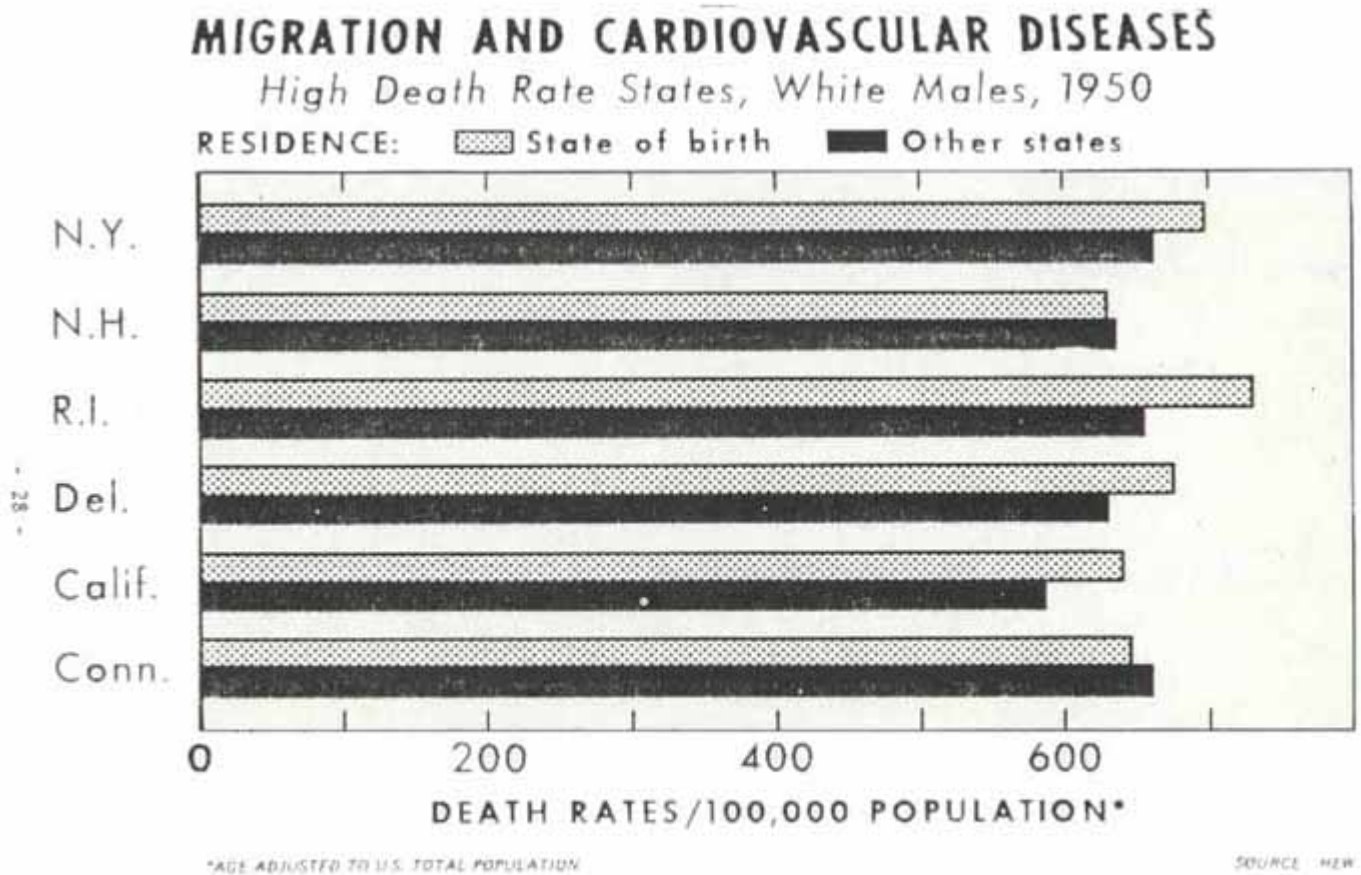


Figure 9. — Migration from high death rate areas for heart and vascular diseases decreases likelihood of death from that condition. Heredity, prenatal, infant and childhood environment, including diets also are factors. Coronary heart disease death rates are for white males ages 40-69, 1950 (age-adjusted to U.S. total population age 40-69 in 1950, by 10-year age groups).

FIGURE 10

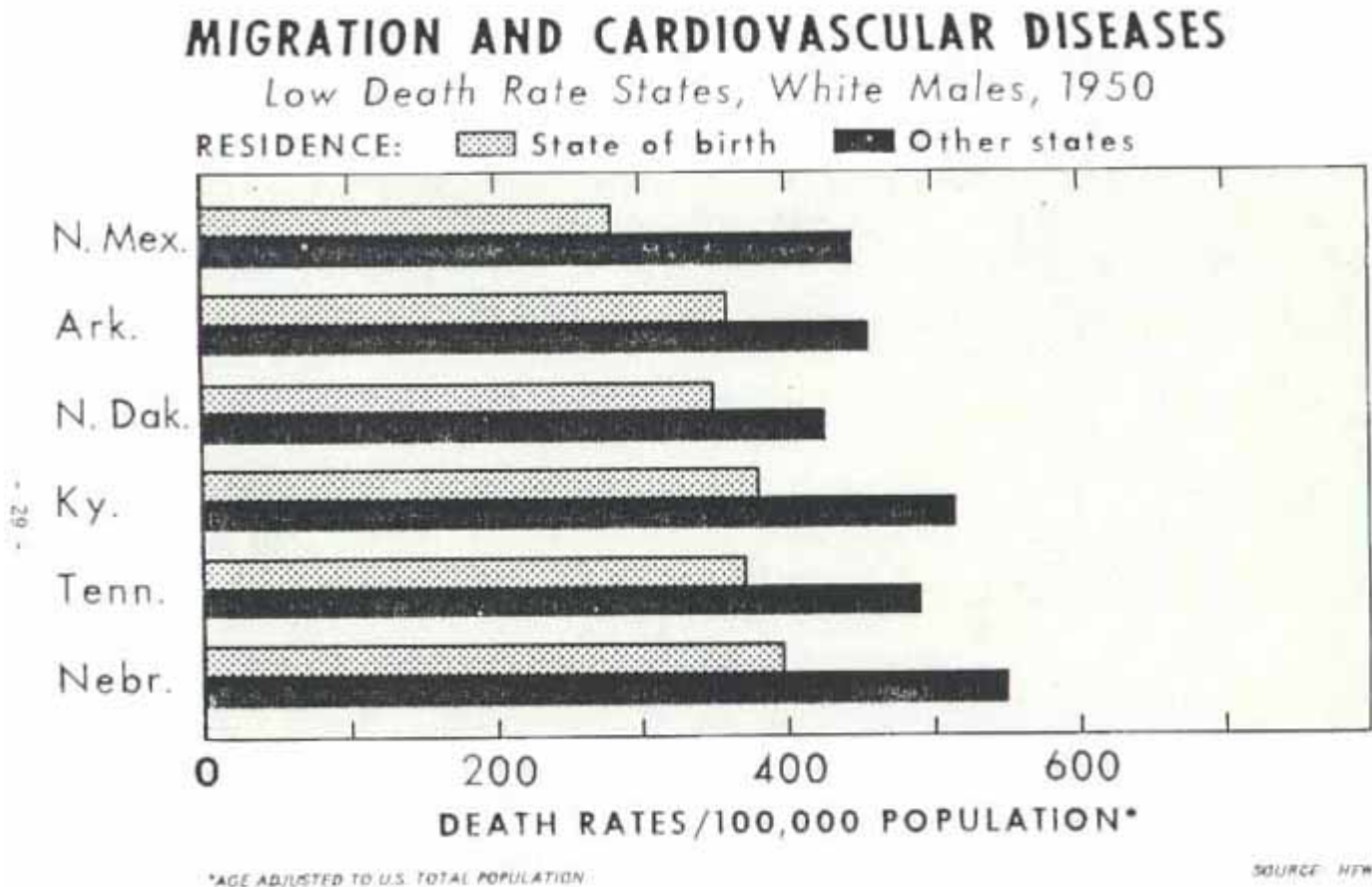


Figure 10. — Migration from low death rate areas for heart and vasculatory diseases increases likelihood of death from that condition. Heredity, prenatal, infant and childhood environment, including diets also are factors. Coronary heart disease death rates are for white males ages 40-69, 1950 (age-adjusted to U.S. total population age 40-69 in 1950, by 10-year age groups).

FIGURE 11

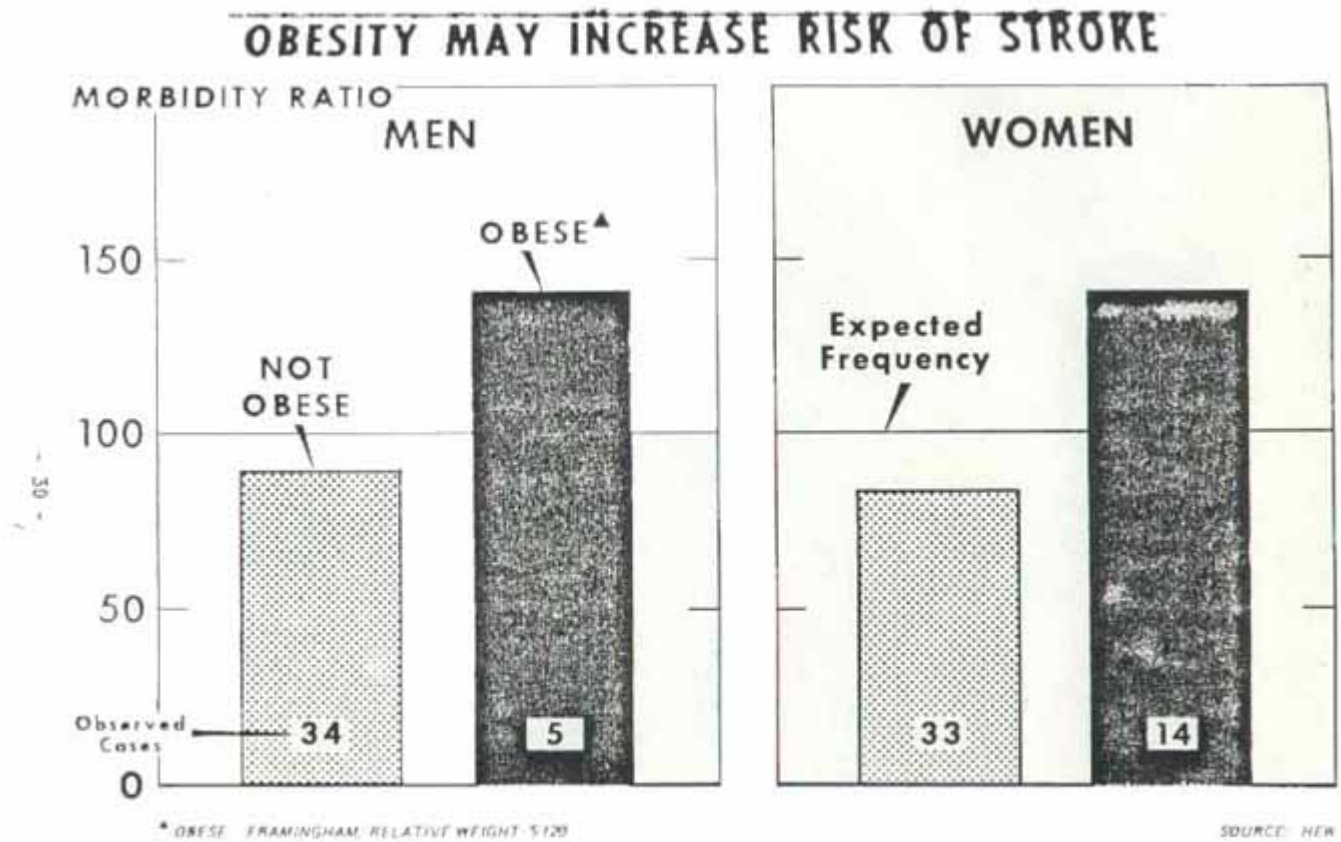
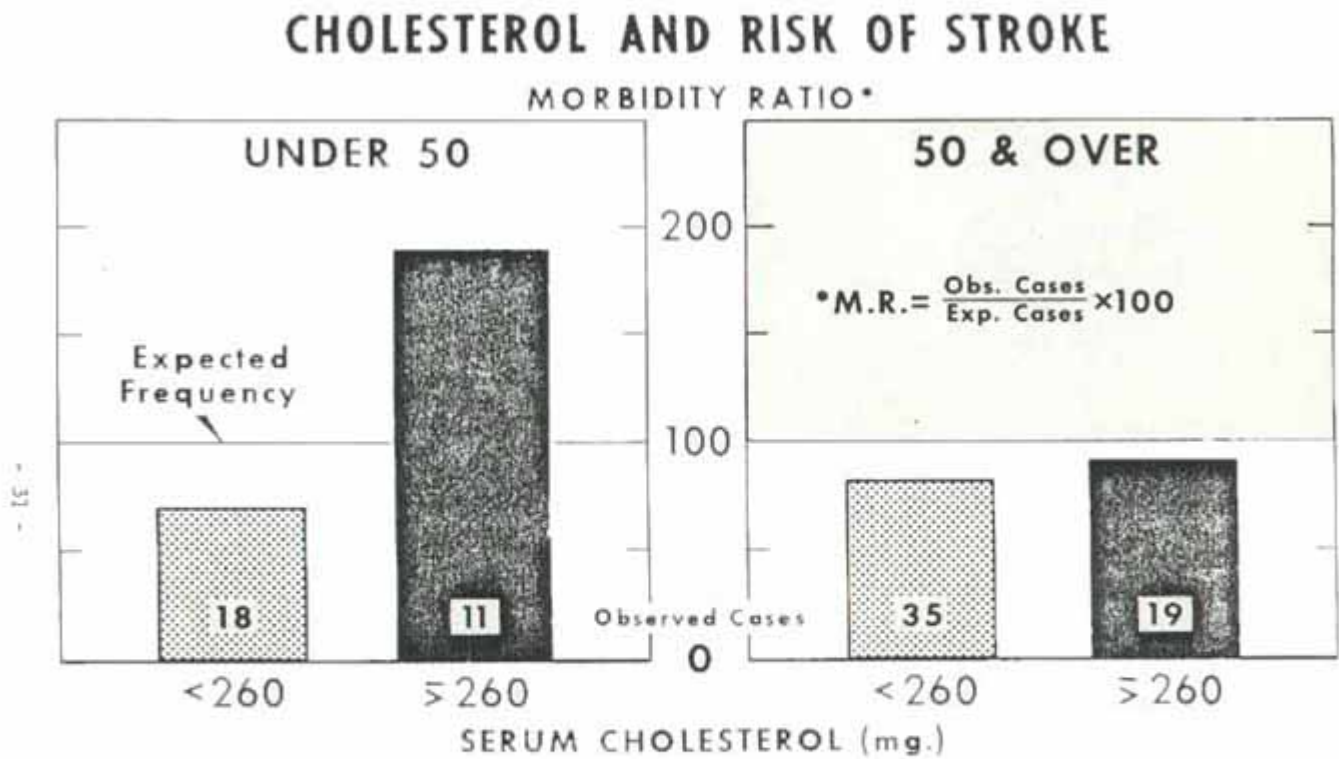


Figure 11. — The risk of stroke may be increased by obesity, but the increase in risk is relatively modest. The major threat inherent in obesity may be that it is often accompanied by an increase in blood pressure. Obesity also increases the work load of the heart and appreciably increases the individual's risk of angina and sudden death. Surprisingly, it does not appear to influence risk of a myocardial infarction.

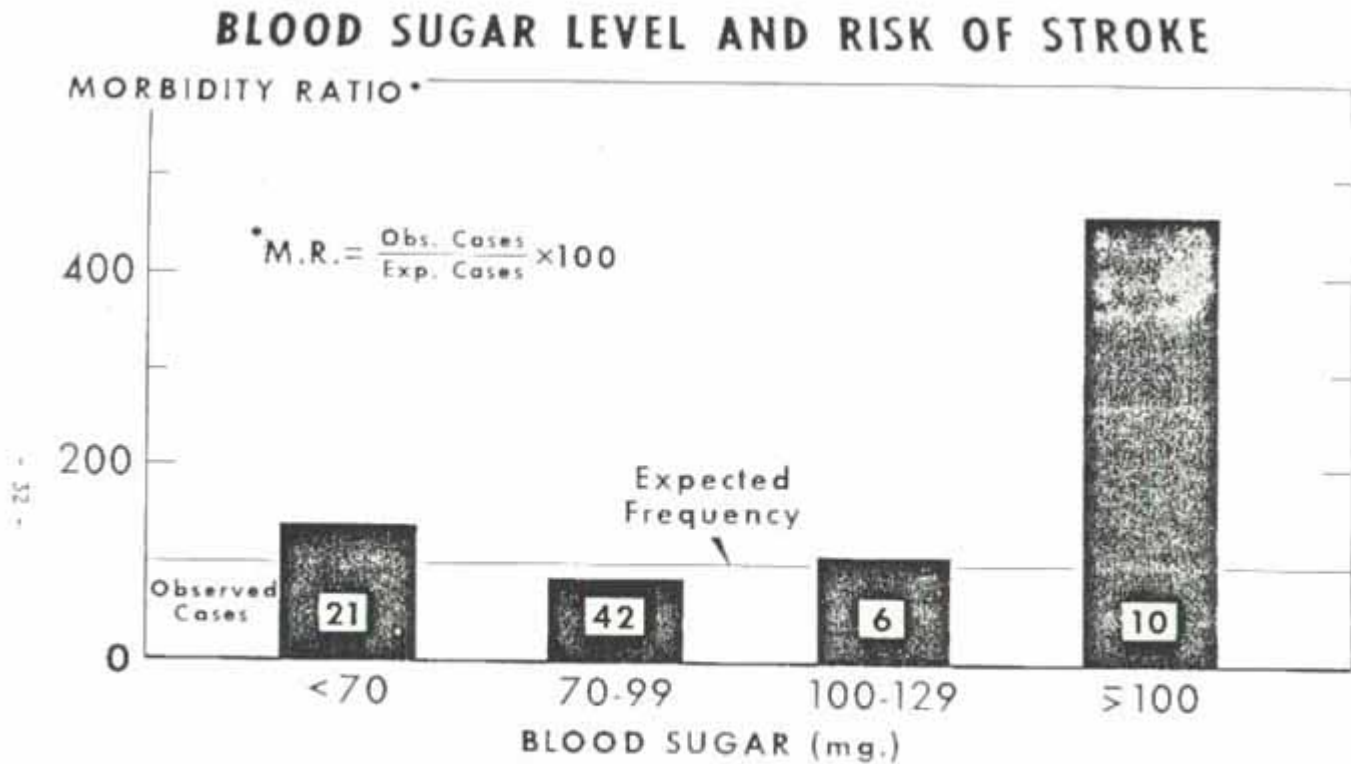
FIGURE 12



SOURCE: NEW

Figure 12. — Elevated blood cholesterol levels obtained in subjects under 50 were strongly associated with an increased risk of stroke. Elevated blood lipid levels have been a factor consistently associated with increased susceptibility to atherosclerosis. After age 50, blood lipid levels are not reliable as indicators of susceptibility to either stroke, coronary heart disease or occlusive peripheral vascular disease.

FIGURE 13



SOURCE: HEW

Figure 13. — Evidence of impaired carbohydrate metabolism is associated with increased stroke risk. The relationship between diabetes and disease of the heart and blood vessels is well documented. An increased risk of stroke was observed even among those with moderately elevated blood sugar and possibly also among those with an abnormally low blood sugar. The reason for the apparently increased risk associated with a low blood sugar may also reflect an early phase of impaired carbohydrate metabolism.

RESPIRATORY AND INFECTIOUS

Despite great advances in the control of infectious diseases in the past decades, acute respiratory infections remain the most frequent cause of illness and the most important cause of loss of time from work and school in the U. S. (Tables 6, 7). Pneumonia and influenza ranked fifth and other bronchopulmonic diseases tenth as causes of death in the U. S. in 1967; together they accounted for over 85,000 deaths. Acute respiratory infections are the most important single cause of illness. One-third to one-half of industrial absenteeism from sickness is caused by acute respiratory infections. In addition, mild infections may reduce efficiency without occasioning absenteeism. Young adults and children suffer the highest incidence of these infections, while the long lasting morbidity associated with chronic diseases is more frequent in older adults. The economic importance of morbidity from acute respiratory infections is impossible to determine precisely, but it has been estimated to be well over five million dollars per year. In addition, one billion dollars alone are spent for cold remedies and facial tissues.

Diet and the nutritional State of the individual involved are clearly associated with the incidence, duration, and severity of respiratory and infectious diseases. Nutrition is most likely to be a factor when the lower respiratory tract is involved, when bacteria are involved, or a chronic condition exists. Individuals in good nutritional state are less likely to succumb to the disease and those with high levels of nutrient reserves are more likely to recover quickly. These reserves are of special importance when the disease state results in loss of appetite due to coughing and vomiting, and increased caloric expenditure due to added difficulty in breathing.

There are many reports that malnutrition lowers resistance to infection and that nutritional deficiencies may be precipitated by an acute infection in subjects with borderline nutrient inadequacies. Few statistics are available to show a direct relationship between nutrition and infection. One of the best studies was carried out in Guatemala at INCAP. Three matched villages were studied. In two, health measures were introduced, the third remaining as a control. The health measures in one village involved adding supplementary food to the diet of children during and after weaning; in the other village, preventive and curative medical care was offered. Overall death rates declined in all three villages beyond what was expected from trends prior to the study. Reductions in mortality were as follows: in the medical care village 31 percent (50 percent beyond that expected), in the feeding village 56 percent, and in the control village 38 percent. Fully half of the deaths occurred during the second year of life.

Further evidence of the relationship between nutrition and infection rate has been observed. Virus infections hit harder among the undernourished, and the severity of the infection is directly proportional to the degree of malnutrition--these data are from studies with mice. Acute diarrhea in young infants results from a synergism between poor nutritional state and infection.

In children, acute infections such as pneumonia, rheumatoid arthritis, acute tonsillitis, and rheumatic fever reduce the levels of vitamin A in the blood as does vaccination against small pox and measles. Xerophthalmia, night blindness, frequently follows these infections indicating the depletion of body reserves of vitamin A. Vitamins B₁, B₆, and C, and protein also are implicated. Unfortunately, there are no satisfactory ways to determine the extent of body stores for most nutrients or to identify the level of nutrient intake needed to maintain adequate stores for resistance to infection.

Despite major advances in drug treatment prior to 1950, the incidence of respiratory and infectious disease remains high for the very young, 1 to 4 years, whose body reserves are low. The incidence increases with age where the cumulative effects of a lifetime of chronic marginal nutrient intake and reserves show up (Fig. 14).

The manner by which good nutrition and diet combat infectious diseases is not well understood. Healthy cells and membranes may be more resistant to the entry of microorganisms. Protein, several vitamins, and minerals are needed to produce the antibodies to resist and recover from infectious diseases, although their role in the production of antibodies is not clear.

Recent studies with animals have shown a direct relation between specific nutrients and production of antibodies to specific stimuli such as disease organisms or organ transplants. The relationship exists when a specific nutrient, usually a vitamin, is lacking in the diet. Increased resistance to disease has not been demonstrated when individual vitamins are added to marginal or normal diets.

Lung irritants present in the atmosphere, such as ozone and nitrogen dioxide, are an increasingly important contributor to respiratory problems. Vitamins A and E may help protect the lungs from the adverse effects. Vitamin A is essential for production of healthy mucus secreting tissue in the lung while vitamin E may protect the vitamin A from destruction by air pollutants.

Diet is additionally involved in the transmission of several infectious diseases including salmonellosis, typhoid fever, dysentery, hepatitis, and gastroenteritis. Most of these diseases are transmitted through contamination of food and water supplies. Statistics on the incidence of illness from food poisoning are inadequate. Only those cases are recorded where the causative organism is isolated from both the food and the stricken individuals. Probably not more than one percent of all cases of food poisoning are reported. The causative organisms, primarily salmonella, clostridium perfringens, and staphylococci, are widely distributed in food. They become a health problem when the food is improperly handled and the microorganisms have the opportunity to grow, reproduce, and in some instances produce toxins. About 99 out of 100 cases of food poisoning are due to improper handling of food during preparation and storage by the consumer.

In 1966, it was estimated that two million Americans or one percent of the population suffered from attacks of salmonellosis often self-diagnosed as "24-hour flu" or stomach upset. If the average duration of each incidence is two days then a total of 1.5 million work days were lost. The estimate of two days per incident is considered conservative.

Chronic and respiratory diseases other than tuberculosis are at the present time rapidly increasing in the U. S. For example, since 1949 the death rate for pulmonary emphysema with or without chronic bronchitis, has increased faster than that for any other leading cause of death. The rate of increase in death and incidence is of epidemic proportions. About one percent of deaths of males and 0.5 percent of deaths of females are caused by chronic nontuberculous respiratory diseases. Atmospheric pollution, cigarette smoking, and constitutional factors are implicated as important causes of the chronic respiratory diseases. Some of them such as bronchial asthma may be allergic disorders (ALLERGIES).

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TABLE 6

Incidence of respiratory and infectious conditions by age group in 1967

Age group (in years)	Number of conditions ¹		Rate per 100 population	
	Infective and parasitic	Respiratory	Infective and parasitic	Respiratory
Total	45,526	201,016	23.7	104.5
Under 5 years	10,063	39,708	51.4	202.7
5-14 years	17,336	54,907	43.0	136.2
15-24 years	5,643	31,168	18.7	103.3
25-44 years	7,244	39,311	16.0	87.1
45-64 years	4,108	26,602	10.5	67.8
65 and over	1,133	9,321	6.3	52.1

¹In thousands for year ending June 30. Data refer to civilian noninstitutional population. Estimates include only acute conditions which were medically attended or caused at least one day of restricted activity.

Source: National Center for Health Statistics 1968 PHS publ. 1000, series 10, no. 44, U. S. Dept. of Health, Education, and Welfare; and U. S. Bureau of the Census, Statistical Abstract of the United States: 1969, 90th ed., p. 77, table 104.

TABLE 7

Incidence of acute conditions and days lost from
work and school: United States, July 1965-June 1966¹

	Incidence in thousands	Days lost in thousands		Days lost per 100 persons per year	
		School	Work	School	Work
Respiratory conditions	240,069	122,422	119,980	288.3	164.1
Infectious and parasitic diseases	47,909	43,375	20,966	102.1	28.7
Total	287,978	165,797	140,946	390.4	192.8

¹Data are based on household interviews of the civilian, noninstitutional population.

Source: National Center for Health Statistics 1967 PHS publ. 1000, series 10, no. 37, tables, 4, 7, and 8. U. S. Dept. of Health, Education, and Welfare.

FIGURE 14

INFLUENZA AND PNEUMONIA DEATH RATES *White Population, U.S. 1930-60*

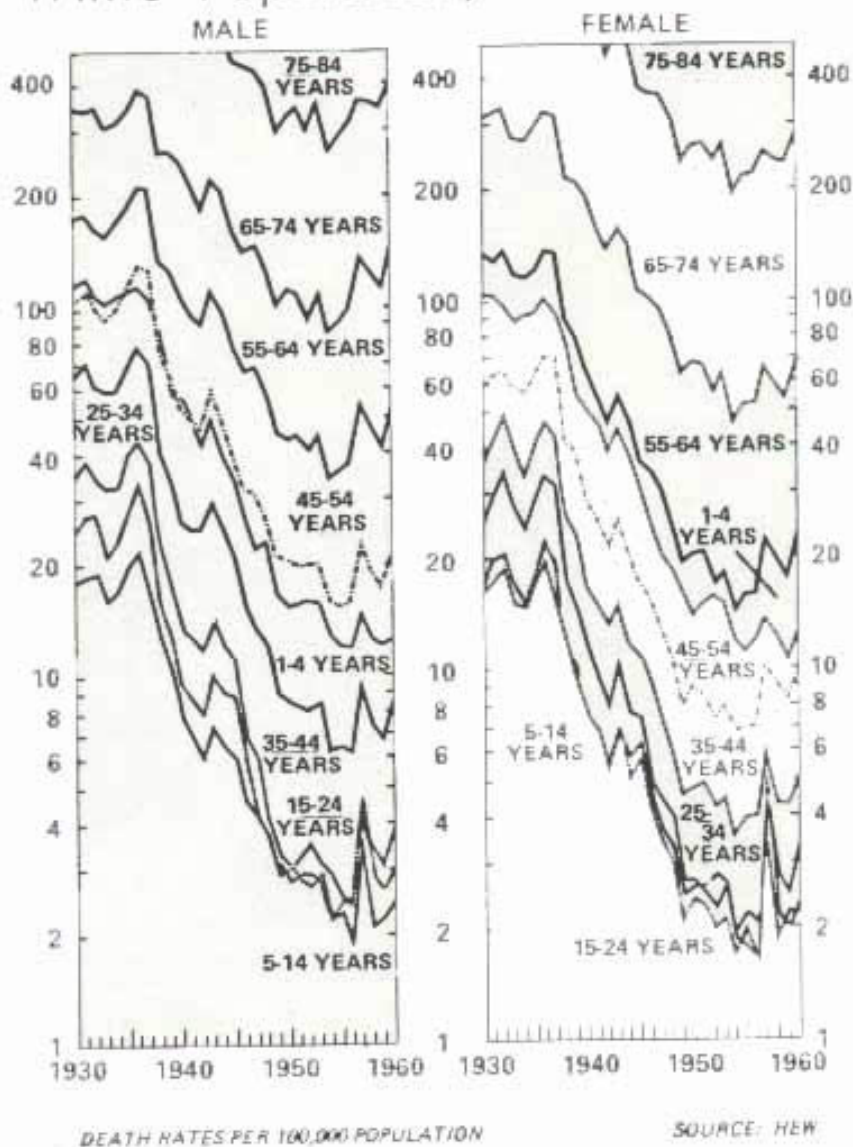


Figure 14. — Death rates per 100,000. Death rates are high for the very young whose nutrient reserves are less. The rates increase with age where the accumulative effects of chronic marginal nutrient intake and reserves are likely to show up. Rates are higher for nonwhites who also are more likely to have had poor diets.

MENTAL AND EMOTIONAL HEALTH

Mental illness is difficult to define and even specialists in the field are dissatisfied with present classifications. Thus, data on its incidence vary widely. Estimates of impaired disability due to disturbances of thought, mood, perception, and behavior, vary from one percent to more than 20 percent of the population. The National Association for Mental Health estimates that 19 million people in the United States (about 1 in 10) are afflicted with some form of mental or emotional illness requiring mental care. Moreover, mental disorders are a significant factor in many physical illnesses. Estimates, based on a study by the Commission of Chronic Illness in Baltimore in 1952-55, and other data indicate that at any point in time 12 percent of the population are suffering from psychiatric disorder and that 2.5 percent (over 52 million persons) are severely or totally disabled by it. Only 19 percent were considered entirely free of psychiatric symptoms. Prevalence of mental illness increases with age and is higher in the lowest socioeconomic groups.

A direct relationship can be drawn between nutrition and much of the mental illness resulting from organic brain disorders. Dietary improvement results in increased resistance to infection, better management of alcoholics, fewer circulatory disturbances and cardiovascular conditions, control of metabolic disturbances due to diabetes, hyperthyroidism, and nutrient deficiencies. The relationship of nutrition and mental disorders not associated with organic brain damage is less clear. There is no doubt that mental disorders can lead to poor eating habits and malnutrition. Also, it is clearly established that good nutrition is necessary for proper development and function of the central nervous system. Recovery from mental disability can be delayed if the condition is complicated by nutritional inadequacy.

Conceivably as much as 80 percent of the U.S. population could benefit from improved mental health with 12 percent having a major benefit. Benefits would be economic, through reduced hospital and psychiatric costs, improved ability and opportunities on the job, and fewer work days lost (Table 8). Social benefits would be of even greater importance; less family stress, fewer broken homes, and greater social acceptance of the individuals and their families.

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TABLE 8**Disability from psychoneuroses and psychoses**

Ages	Annual incidence per 1,000 personnel	Annual days per 1,000 personnel	Average days per claim
Males			
Ages 17-64	4.4	549.2	123.7
17-24	2.7	282.3	102.7
25-44	3.3	300.0	91.4
45-64	6.6	990.5	150.5
Females			
Ages 17-59	7.3	870.1	119.2
17-24	4.3	517.8	121.0
25-44	9.3	1113.3	120.3
45-59	10.5	1232.9	116.9

Metropolitan Life Insurance Company personnel claims incurred in 1963-64 traced to end of 1965.

The figures are based on temporary disability under the Company's Insurance and Retirement program. The first seven days of illness and disability days beyond a year are not included in the above figures.

Personnel in the Pacific Coast states and in Canada are not included.

Source: Mental Illness at the Working Ages 1967 Statistical Bull. 48: 6, Metropolitan Life Insurance Company.

INFANT MORTALITY AND REPRODUCTION

In 1968 there were approximately 3.5 million children born in the U.S. Of these live births, 75,000 infants died within the first year of life. The infant mortality rate in the U. S. has shown a constant decline during this century, but it has not declined as rapidly, or to as low a level, as in several other countries ([Table 9](#), [Figs. 15, 16](#)). In 1950, the U. S. ranked sixth among a group of countries with characteristics which make comparison possible. In 1961-63, the U. S. had moved to tenth place and to thirteenth in 1968. Sweden had the lowest average annual infant mortality rate, about 13 per thousand in 1968. In 1968, the infant mortality rate in the U.S. was 21.7, a slight decrease from 22.4 in 1967. The mortality rate for white infants in 1967 was 19.7 per thousand as compared with 35.5 for nonwhite infants ([Table 10](#)). A large part of these infant deaths were neonatal or occurred during the first month of life. Neonatal death rate was 16.5; with the rate for white infants being 15.0 as compared with 23.8 for nonwhite infants. The large proportion of the neonatal deaths occurred in infants who were small at birth, either because they were "prematurely" born, or because they were "small-for-date" infants. Since 1960, about 325,000 "premature" babies, "babies with birth weight of 5.5 pounds or less", have been born in the U.S. each year.

The infant mortality rate for nonwhites was 40.3 in 1965, nearly double the rate in the nonwhite population. The same causative factors apply that make for high rates among the poor: premature termination of pregnancy, lack of health and medical care services, inadequate diet and health practices, and inadequate living conditions. The impact of the level of living on infant survival is

illustrated by the fact that the post-neonatal (age 1-11 months) death rate in the 17 states with the lowest per capita income was over a third above the national average in 1965.

The incidence of low birth weight in the U. S. is increasing. In 1950, 7.6 percent of live-born infants were "premature"; in 1960, 7.7 percent; and in 1964, 8.2 percent. Among the white infants, the incidence has hovered about 7.0 percent. The incidence among nonwhite infants increased from 10.4 percent in 1950 to 13.8 percent in 1964. To a large extent, these small babies are the result of poor fetal nutrition. Recently developed techniques for taking intra-uterine fluid samples will make it possible to identify and study nutritional problems during the fetal period. Until the development of this technique, very little was known about the direct interrelationship of nutrition and fetal development in humans.

A number of studies have been done with animals showing the severe effects upon the full-term animal fetus of nutritional deficiencies during pregnancy. Zinc deficiency will cause such skeletal malformations as cleft palate, cleft lip, club feet, missing eyes, missing vertebra, and abnormalities of other body systems. A manganese deficiency during pregnancy produces abnormal body righting reflexes in the young.

The first evidence that a change in maternal nutrition could disrupt the normal development of mammals appeared in 1935. The relationship was established between diets deficient in vitamin A and a variety of birth defects including missing eyes in pigs. Since that time, a number of abnormalities have been deliberately induced by nutritional deficiencies. Among the nutrients studied were riboflavin and folic acid. Significantly, folic acid and vitamin A are two of the vitamins most likely to be deficient in the U.S. diet.

One of the earliest deficiencies to be recognized for its effect on prenatal development was a deficiency of iodine. This results in the birth of a somewhat overweight, but seemingly normal, infant. However, by the sixth month, the clinical picture of cretinism is clearly defined. This is of particular economic significance in the U. S. at the present time because of the increasing prevalence of goiter in several parts of the U. S. among girls of childbearing age. This increased incidence may be due to the increasing consumption of prepared foods made with salt which has no iodine added.

Since 1910 the percentage of infant deaths due to birth defects has steadily increased. Many millions of children have handicaps (Fig. 17) In fact, the 1964 Vital Statistics Survey in the U. S. showed that congenital defects, including genetic metabolic disorders, was the leading cause of death in the first year. At least 62,000 deaths each year in all age groups in this country may be attributed to birth defects. Actually, as a cause of death, birth defects are outranked only by heart disease. The National Foundation has estimated that today in the U. S. there are 15 million persons with one or more congenital defects that affect their daily lives. There is considerable evidence relating to the relevance of birth defects to poor nutrition. The Health Insurance Program of New York and others have found that babies who weighed less than 5.5 pounds at birth are twice as likely to have birth defects. Some of these relationships have been discussed elsewhere (EYESIGHT). The incidence of blindness is two to three times as high in infants of low birth weight. The long-range effects of malnutrition on brain development are discussed in IMPROVED LEARNING ABILITY.

Malnourishment in the mother usually results in the birth of a baby who is underweight. These babies are more likely to have birth defects. This has particular significance in the U.S. where there are probably more child pregnancies than in any other nation in the world (Table 11). In 1965 in the U. S., there were more than 196,000 live births to girls 17 years of age or younger. Statistics are not available to show the relation of the age of the mother to the incidence of birth defects. However, young mothers are in the sex-age group most likely to have nutritional deficiencies as indicated by the National Nutrition Survey and the data for individuals obtained during the Nationwide Food

Consumption Survey of 1965. In the Nationwide Nutrition Survey of 1968 in Louisiana, 40 percent of 7- to 17-year-olds had unacceptable plasma vitamin A values. This vitamin has been implicated in birth defects.

Complications during pregnancy resulting in maternal death may also be related to the nutritional state of the mother. In 1967, the maternal death rate was 28.0 per 100,000 live births. The rate for white mothers was 19.5 and for nonwhite mothers 69.5 (Table 10). While hygiene and other factors are also causative agents, the role of nutrition may be very important particularly with the nonwhite mothers, many of whom are from low economic groups. There are a number of ways in which nutrition influences maternal death. The frequency of misshapen pelvic bones, a cause of difficult labor and frequently of adverse effects on the infant, has been much reduced by the prevention of childhood rickets. Because the principal cause of rickets is an inadequate intake of vitamins A and D and is more often present among economically deprived populations, we have an example of the influence of economic status and malnutrition in early life on the outcome of pregnancies many years later.

Nutrition has been recognized as a possible major cause of the toxemias of pregnancy for several years. The specific nutrient involvement is not well understood. The relative importance of nutrition in the cause and course of toxemia in pregnancy has been the subject of controversy for many years. Greatest interest has centered on the intake of calories, protein, and salt. It appears likely that the problem is the result of a very complex metabolic disturbance involving abnormal hormone activity and an unbalanced dietary intake, particularly an abnormal intake of salt. Vitamin B₆ also has been implicated. The clinical pattern and geographic distribution of pre-eclampsia is reminiscent of primarily nutritional disorders, particularly pellagra.

The increased nutritional needs of women during pregnancy has been recognized for many years. Yet information from human metabolic studies on the nutritional requirements of this important group is only fragmentary, and few new studies have been made in the past 15 years.

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TABLE 9

Live births and infant deaths

(Prior to 1960, excludes Alaska and Hawaii. See also Historical Statistics, Colonial Times to 1957)

Year	Number (thousands)		Rate per 1,000 population	
	Births ¹	Infant deaths ²	Births ¹	Infant deaths ²
1910	2,777	NA	30.1	NA
1915	2,965	78 ³	29.5	99.9 ³
1920	2,950	130 ³	27.7	85.8 ³
1925	2,909	135 ³	25.1	71.7 ³
1930	2,618	142 ³	21.3	64.6 ³
1935	2,377	120	18.7	55.7
1940	2,559	111	19.4	47.0
1945	2,858	105	20.4	38.3
1950	3,632	104	24.1	29.2
1955	4,104	107	25.0	26.4
1960	4,258	111	23.7	26.0
1962	4,167	105	22.4	25.3
1963	4,098	103	21.7	25.2
1964	4,027	100	21.0	24.8
1965	3,760	93	19.4	24.7
1966	3,606	86	18.4	23.7
1967	3,521	79	17.8	22.4
1968 (prel.)	3,467	75	17.4	21.7

NA - not available

¹ Through 1955 figures adjusted for under registration.

² Represents deaths of infants under 1 year old, exclusive of fetal deaths; rates per 1,000 registered live births.

³ Represents birth registration states only.

Source: U.S. Bureau of the Census. Statistical Abstract of the United States; 1969, 90th ed., p.47, table 54.

COMMENT: INFANT MORTALITY HAS GRADUALLY DECLINED. THE U.S. FALLS BEHIND MANY COMPARABLE COUNTRIES IN INFANT SURVIVAL. IN 1968, THE U.S. INFANT MORTALITY WAS STILL CONSIDERABLY HIGHER (21.7) THAN THE LEVEL REACHED BY SWEDEN (15.5) IN 1961-63.

FIGURE 15

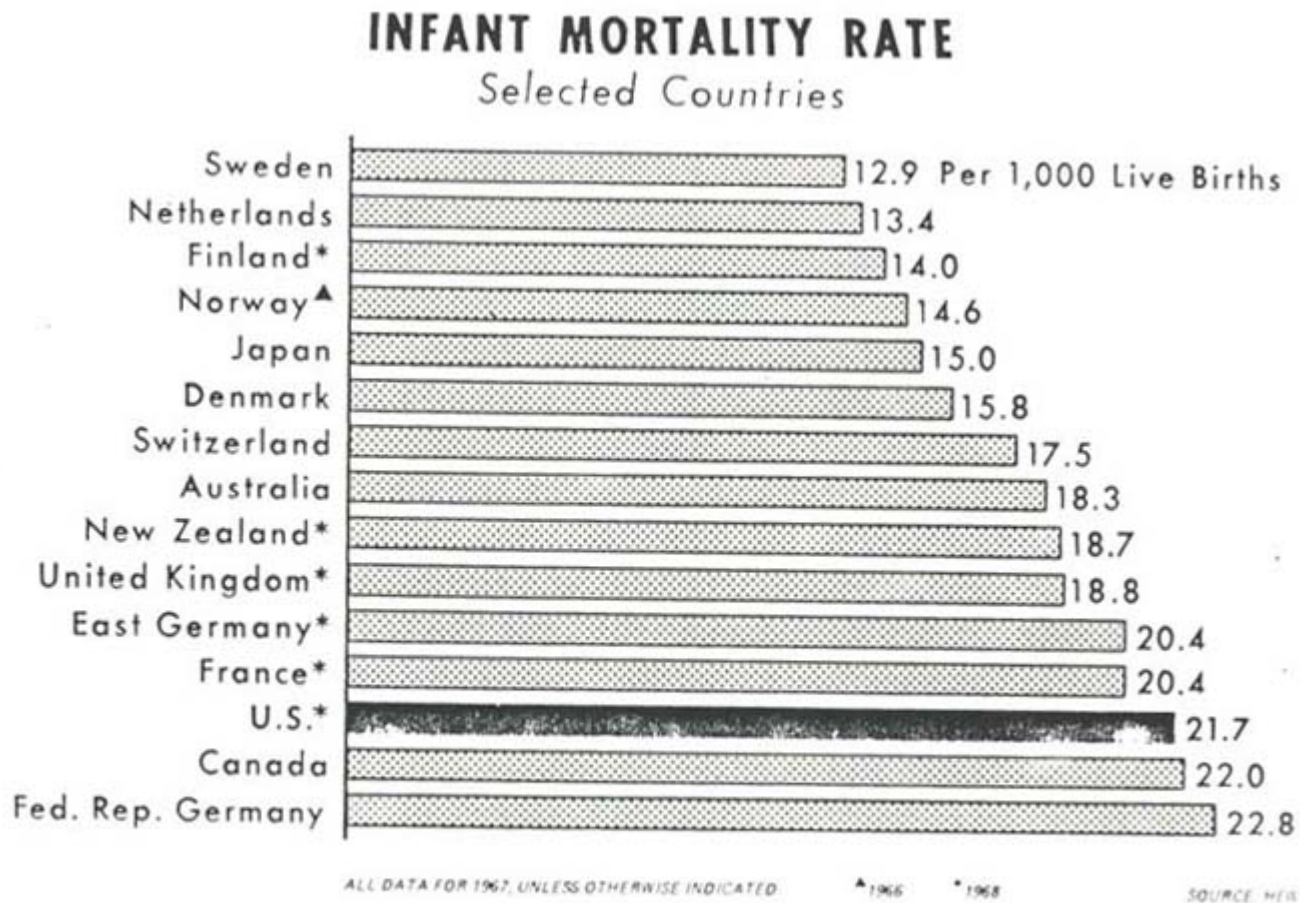


Figure 15

FIGURE 16

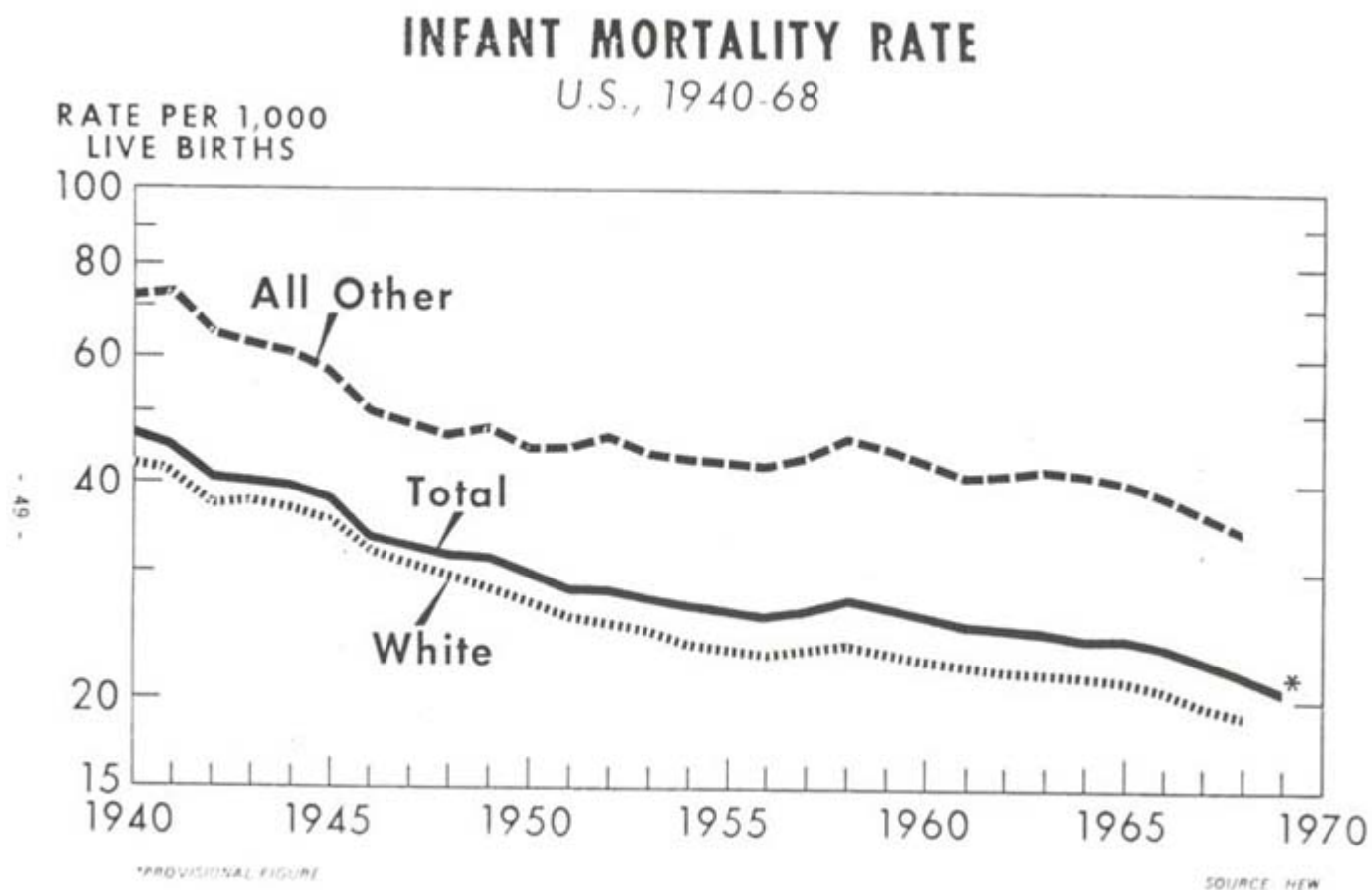


TABLE 10

Infant, maternal, fetal, and neonatal death rates,
by color: 1940 to 1967

(Deaths per 1,000 live births, except as noted,
prior to 1960, excludes Alaska and Hawaii)

Item	1940	1945	1950	1955	1960	1965	1966	1967
Infant deaths ¹	47	38	29	26	26	25	24	22
White	43	36	27	24	23	21	21	20
Nonwhite	74	57	45	43	43	40	39	36
Maternal deaths ²	376	207	83	47	37	32	29	28
White	320	172	61	33	26	21	20	19
Nonwhite	773	455	222	130	98	84	72	69
Fetal deaths ³	NA	24	19	17	16	16	16	16
White	NA	21	17	15	14	14	14	13
Nonwhite	NA	42	33	28	27	27	26	26
Neonatal deaths ⁴	29	24	21	19	19	18	17	17
White	27	23	19	18	17	16	16	15
Nonwhite	40	32	27	27	27	25	25	24

NA - not available.

¹Represents deaths of infants under 1 year old, exclusive of fetal deaths.

²Per 100,000 live births from deliveries and complications of pregnancy, childbirth, and the puerperium.

³Includes only fetal deaths (stillbirths) for which period of gestation was 20 weeks (or 5 months) or more, or was not stated.

⁴Represents deaths of infants under 28 days old, exclusive of fetal deaths.

Source: U. S. Bureau of the Census. Statistical Abstract of the United States; 1969, 90th ed., p. 55, table 70.

COMMENT: IN 1967, THERE WERE ABOUT 79,000 INFANT DEATHS. IF THE U. S. INFANT DEATH RATE WERE THE SAME AS IN SWEDEN IN 1961-1963, ONLY 54,576 INFANTS WOULD HAVE DIED. IN THIS ONE YEAR ALONE, OVER 25,000 LIVES WOULD HAVE BEEN SAVED.

FIGURE 17

MILLIONS OF CHILDREN HAVE HANDICAPS

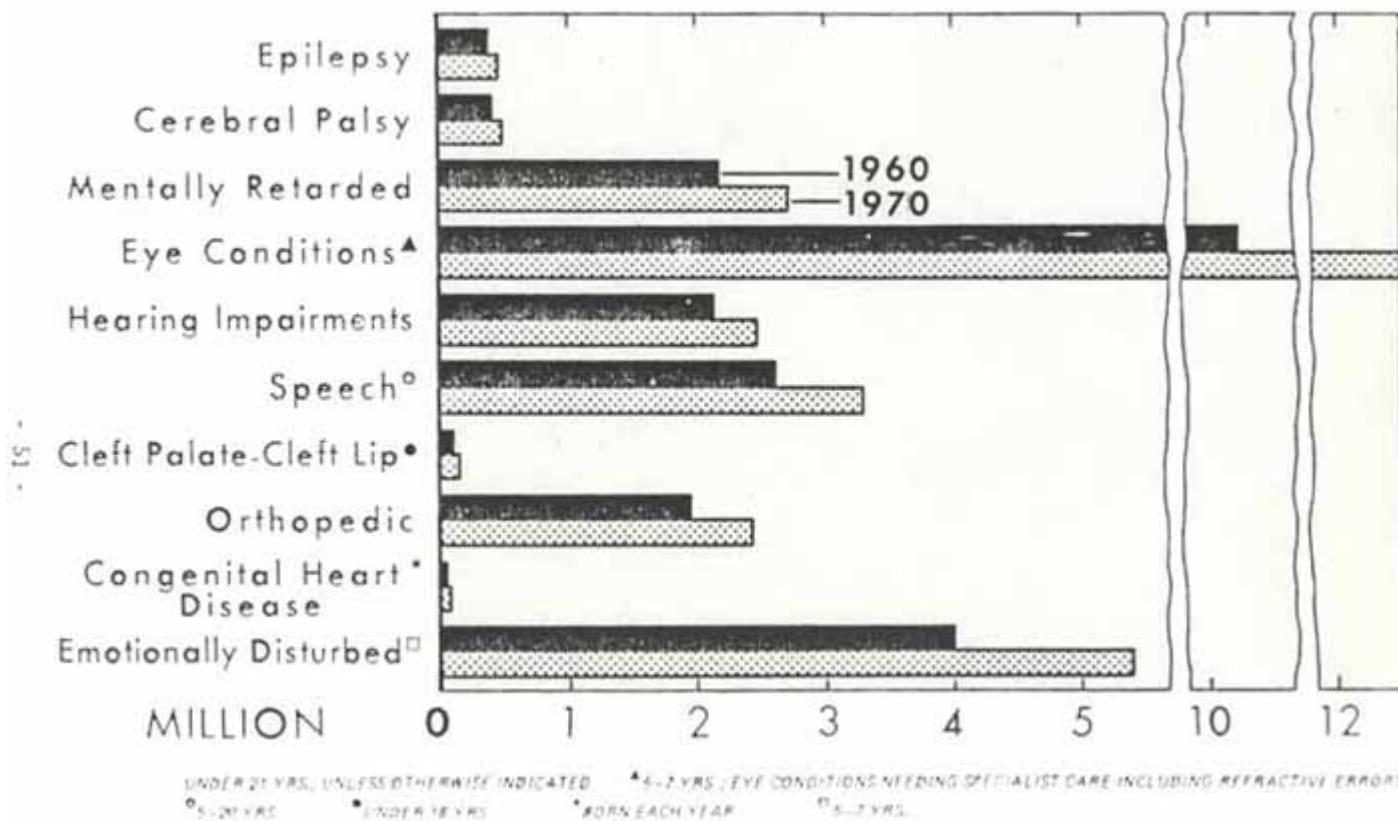


TABLE 11

Childbearing children in the United States, 1965

Number of babies born to mothers
ten to fourteen years of age

Number of children born	White	Nonwhite	Total
One child	2,450	4,985	7,434
Two children	72	248	320
Three children	2	10	12
Four children	<u>2</u>	<u>-</u>	<u>2</u>
	2,526	5,242	7,768

Statistics are not available to show the relation of the age of the mother to the incidence of birth defects. However, a sample of the statistics provided by the National Center for Health Statistics showing the mother's age and the number of births is adequate to cause speculation. Note that two girls had had four children each by the time they were fourteen.

The United States probably has more child marriages and pregnancies than any other nation in the world. This creates the likelihood of a steadily increasing percentage of birth defects due to poor nutrition because, the younger the mother, the less likely she is to enjoy professional guidance during pregnancy and the more likely she is to commit all the nutrition sins common to teenagers.

Source: Hurley, L. S. 1968 The Consequences of Fetal Impoverishment. *Nutrition Today* 3(4):2.

EARLY AGING AND LIFESPAN

Aging is an inevitable and irreversible process which begins no later than early adulthood. Improved diet has as a goal the deferment of the aging Process so that people can benefit from better health, less pain, increased activity, and satisfaction during all of the lifespan. For maximum benefits, nutrition should be good from conception to death. The impact of fundamental aging changes become more obvious and important as man increases his ability to control infectious diseases, trauma, nutritional, and environmental stress. Death rates rapidly declined from 1938 to 1953 and then leveled (Fig. 18) largely as a result of improved control of infectious and parasitic diseases. Expectation of longer life improved as did the proportion of men and women surviving to adulthood and older ages (Fig. 19, Tables 12, 13). Similar changes took place in most countries but some have plateaued at a lower rate than the U. S.; for instance, Denmark has a death rate of about 7.5 per 100,000 compared to 9.3 in the U. S. (Table 14). The 'mean life-span in the United States has remained essentially constant since 1950 (Fig. 18). The rate of increase in mean lifespan in the future is likely to be slow unless new ways are found to inhibit biological degradation.

The nature of the aging process is not well defined. It is likely that changes in the concentration and structure of deoxyribonucleic acid (DNA) molecules are a major factor. DNA is formed only at the time of cell division and is of first importance in controlling the chemical activities of cells. Some cells do not divide after they reach maturity and in them the DNA is almost as old as the person of whom it is a part. The complex DNA molecules are exposed to attack by other cell constituents and by radiation-like effects. Eventually changes occur in the DNA molecule and the cell no longer functions efficiently setting in process a deteriorating sequence of events resulting in death. The best protection against the undesirable biochemical changes is for each cell to be optimally nourished throughout life.

The time between nutritional insult and measurable effect in terms of health, may be quite long. A period of 40 or more years may elapse before a secondary manifestation occurs. Such is thought to be the case in Parkinson's syndrome characterized by neurological tremors and progressive rigidity of limbs, trunk, and face. Parkinson's disease is thought to be due to a deficiency of an enzyme essential in the metabolism of the amino acid phenylalanine which is critical to the formation of adrenalin.

The rate of aging varies widely among individuals as apparent from the number of persons over 65 years of age who continue to be both mentally and physically productive. During human evolution, men and women died young because of a hostile environment, and evolutionary pressures did not eliminate biologic processes which lead to deteriorative changes late in life or senescence. Gradually reduced are the functional performance of body systems and their ability to cope with stress, either external or internal. Early aging changes are seen in the incidence of chronic disease.

Neither all parts of the body nor all cell functions age at the same rate. As a result, there are changes in cellular metabolism and nutrient requirement profile. Many of the metabolic changes leave the individual susceptible to disease. The immune mechanisms of the body become weaker with age, increasing susceptibility to infections and possibly to cancer. Another example is found in the fact that most persons over 40 years of age metabolize glucose less efficiently than young persons. This impairment in carbohydrate metabolism may have an important bearing on the development of atherosclerosis; so also may the impairment of lipid metabolism indicated by the progressive rise in serum lipids that occurs with increasing age.

An estimated 93.7 million persons in the civilian, noninstitutional population, about 49.1 percent, reported one or more chronic impairments during the period from July 1965 to June 1966. The incidence of chronic conditions by age and sex is shown in (Table 15).

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FIGURE 18

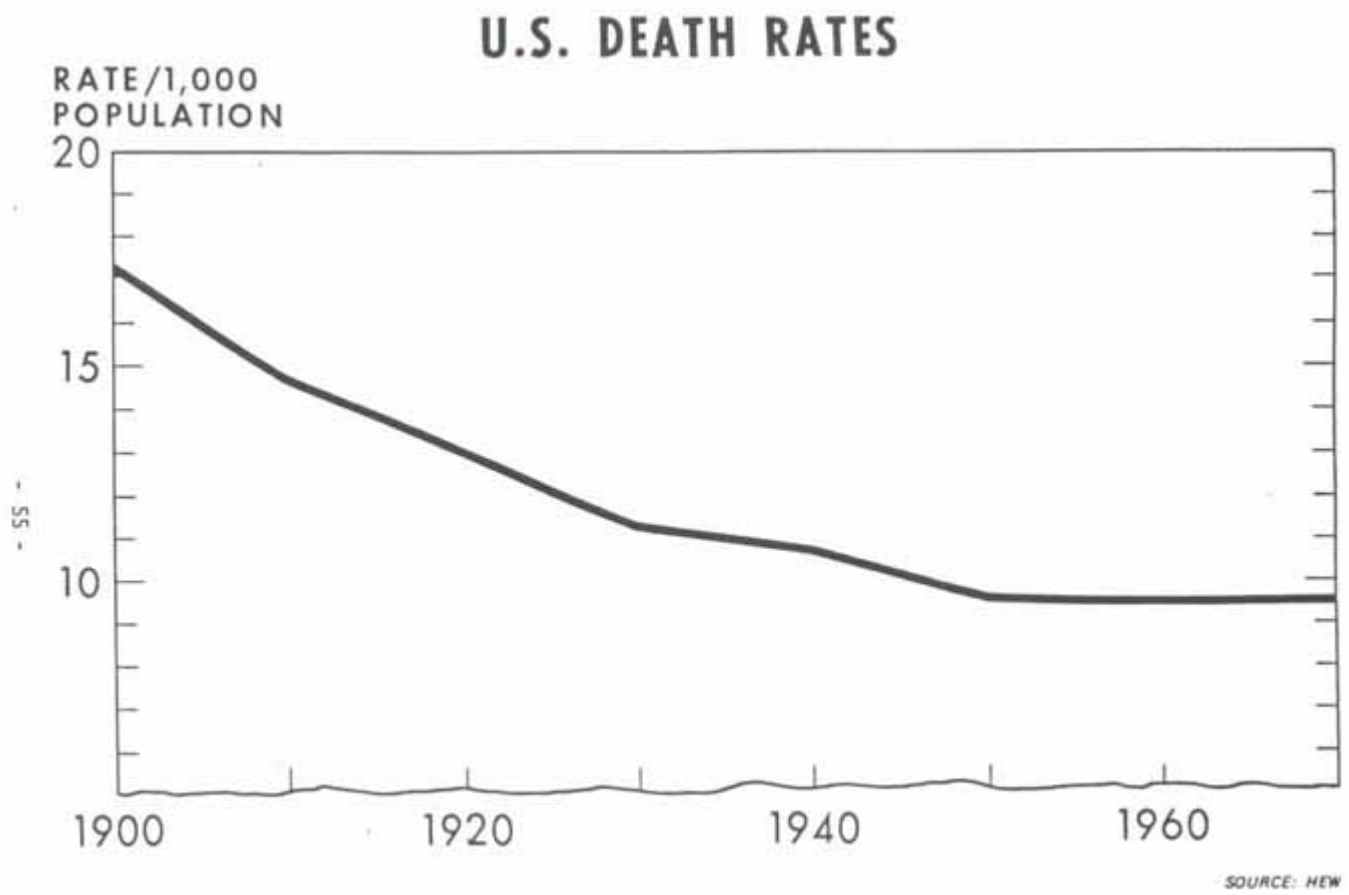


FIGURE 19

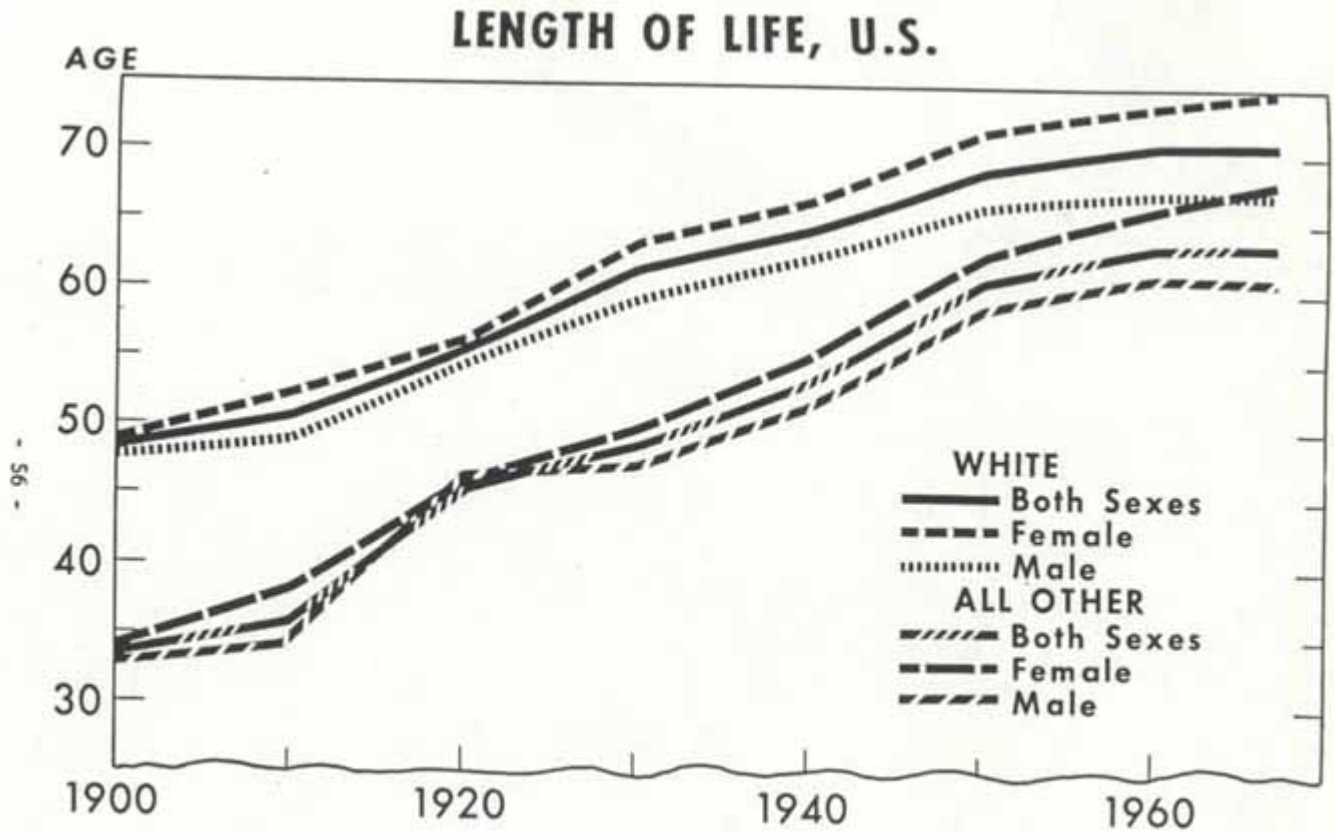


Figure 19. — Children born today have a greatly increased chance of reaching adulthood compared with those born at the beginning of the century.

TABLE 12

Average expectation of life in years

Age and sex	1900 - 1902	1919 - 1921	1939 - 1941	1959 - 1961	1967
White					
<u>At Birth</u>					
Male	48.2	56.3	62.8	67.5	67.8
Female	51.1	58.5	67.3	74.2	75.1
<u>Age 20</u>					
Male	42.2	45.6	47.8	50.3	50.2
Female	43.8	46.5	51.4	56.3	56.9
<u>Age 40</u>					
Male	27.7	29.7	30.0	31.7	31.8
Female	29.2	30.9	33.3	37.1	37.8
<u>Age 65</u>					
Male	11.5	12.2	12.1	13.0	13.0
Female	12.2	12.7	13.6	15.9	16.5
Nonwhite					
<u>At Birth</u>					
Male	32.5	47.1	52.3	61.5	61.1
Female	25.0	46.9	55.5	66.5	68.2
<u>Age 20</u>					
Male	35.1	38.4	39.7	45.8	44.8
Female	36.9	37.1	42.1	50.1	51.3
<u>Age 40</u>					
Male	23.1	26.5	25.2	28.7	28.3
Female	24.4	25.6	27.3	32.2	33.4
<u>Age 65</u>					
Male	10.4	12.1	12.2	12.8	12.7
Female	11.4	12.4	13.9	15.1	15.8

Source: U.S. Public Health Service, U.S. Life Tables and Actuarial Tables. 1939-41, Vital Statistics--Special Reports, vols. 41 and 52, Dept. of Health, Education, and Welfare; and Annual Report, Vital Statistics of the United States, 1968.

TABLE 13

Percent of population surviving to specified age

Age and sex	1900 - 1902	1919 - 1921	1939 - 1941	1959 - 1961	1967
White					
<u>Age 20</u>					
Male	76.4	85.0	92.3	96.0	96.3
Female	79.0	87.3	94.0	97.1	97.5
<u>Age 40</u>					
Male	65.0	75.7	86.9	92.4	92.6
Female	68.0	77.6	89.8	95.3	95.7
<u>Age 65</u>					
Male	39.3	50.7	58.3	65.8	66.0
Female	43.8	54.3	68.7	80.7	81.5
Nonwhite					
<u>Age 20</u>					
Male	56.7	79.1	86.8	93.1	94.0
Female	59.1	80.2	88.5	94.7	95.5
<u>Age 40</u>					
Male	43.0	61.4	72.8	85.8	85.0
Female	46.2	61.1	76.0	89.7	90.5
<u>Age 65</u>					
Male	19.0	34.1	35.9	51.4	50.2
Female	22.0	31.1	40.7	60.8	64.3

Source: U.S. Public Health Service, U.S. Life Tables and Actuarial Tables. 1939-41, Vital Statistics--Special Reports, vols. 41 and 52, Dept. of Health, Education, and Welfare; and Annual Report, Vital Statistics of the United States, 1968.

TABLE 14

Life expectancy at birth by sex for selected countries

Country	Expectation of life at birth				
	Year	Rank	Male	Rank	Female
Netherlands	1956-60	1	71.4	5	74.8
Norway	1956-60	2	71.3	1	75.6
Sweden	1962	2	71.3	2	75.4
Iceland	1951-60	4	70.7	4	75.0
Denmark	1962-63	5	70.3	7	74.4
Israel ¹	1964	6	70.2	14	72.9
Switzerland	1959-61	7	69.5	5	74.8
New Zealand	1960-62	8	68.4	9	73.8
Ireland	1960-62	9	68.1	20	71.9
France	1964	10	68.0	3	75.1
England & Wales	1961-63	11	67.9	8	73.9
Northern Ireland	1962-64	11	67.9	16	72.8
Japan	1964	13	67.7	14	72.9
Czechoslovakia	1963	14	67.5	11	73.4
West Germany ²	1963-64	15	67.3	12	73.1
East Germany ³	1960-61	15	67.3	19	72.2
Australia	1953-55	17	67.1	16	72.8
United States	1964	18	66.9	10	73.7
Scotland	1964	19	66.7	16	72.8
U.S.S.R	1962-63	20	65.0	13	73.0

¹ Jewish population only.² Including West Berlin³ Including East Berlin**Source:** United Nations 1966 Demographic Yearbook 1965. United Nations, New York

TABLE 15

Number and percent of persons with one or more chronic conditions, by sex and age:
United States, July 1965 - June 1966¹

Sex and Age	Total population in thousands	Persons with one or more chronic conditions	
		Number in thousands	Percent of population
<u>Both sexes</u>			
All ages	190,840	93,668	49.1
Under 17 years	66,840	14,950	22.4
17-24 years	22,393	9,671	43.2
25-44 years	45,185	26,756	59.2
45-64 years	38,713	27,316	70.5
65 & over	17,578	14,976	85.2

¹ Data are based on household interviews of the civilian noninstitutional population.

Source: National Center for Health Statistics 1967 PHS publ. 1000, series 10, no.37, table 9. U.S. Dept. of Health, Education, and Welfare.

ARTHRITIS AND RHEUMATISM

Arthritic and rheumatic diseases represent a number of musculo-skeletal conditions which cause a greater loss of time from work than ~ other set of health problems with the exception of nervous and mental disorders and respiratory diseases. This loss was recently estimated at 27 million days annually. About 16 million people in the U. S. are afflicted. About one of four victims of arthritis and rheumatism is restricted from carrying on any major activities and one of ten is confined to the home. Present estimates are conservative because there is little precise information regarding the true prevalence of the chronic rheumatic disorders in the general population. Recent estimates are that arthritic conditions cause unemployment each year to the equivalent of nearly one-half million people, cost the Government nearly 200 million dollars annually in lost income taxes, and account for about 12 percent of welfare expenditures. The total cost to the individuals involved and to the Government from arthritis and related disorders is estimated at 3.6 billion dollars annually. No price tags, however, can be placed on the untold suffering, pain, invalidism, and mental anguish which these disorders impose on individuals and their families.

The conditions most often found are rheumatoid arthritis, gout, and osteoarthritis. All three are associated with adverse changes in metabolism. Rheumatoid arthritis is the most painful and the most crippling. It may attack any age group, particularly women (Table 16). It is a chronic inflammatory disease primarily of the connective tissue, which affects the entire body. No dietary deficiency has been causally related to rheumatoid arthritis, but as in any chronic, progressive disorder, good nutrition of the individual is of fundamental importance. Recently the possibility has been raised that metabolism of the amino acid histidine may be involved. Persons with rheumatoid arthritis have a

negative nitrogen and calcium balance. To control the progress of this disease, it is important to enhance protein and calcium ingestion. While diet will not change the course of the disease, it does lessen the effects. No information is available relating the effect of adequate nitrogen and calcium intake in early life to incidence of rheumatoid arthritis.

Gout is usually an inherited condition and is associated with the absence of an enzyme necessary in urine metabolism and of a uratebinding protein in the blood plasma. Diets low in purines help to alleviate the adverse effects.

Osteoarthritis occurs primarily with advancing age and is a degenerative, condition of the joints. The structure of the cartilage is affected. The cause of Osteoarthritis is not known. Heredity and diet are believed to be underlying factors.

All of the arthritic conditions appear to be associated with adverse changes in nutrient metabolism. The dietary changes needed to prevent or modify the severity of the arthritic condition are not known. There is a good possibility that research on the special nutrient requirements and food needs of persons predisposed to arthritis would yield great benefit to those likely to be afflicted. It has been suggested that drug control of the pain could increase the active lifespan of arthritics by one to five years. It is reasonable to expect that improved diet practices could extend the active lifespan by as much as two years.

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TABLE 16

Arthritis in adults -- number and rate, by sex and by age groups: 1960 - 1962¹

Item	Total	Years						
	18-79	18-24	25-34	35-44	45-54	55-64	65-74	75-79
<u>Rheumatoid arthritis</u>								
Number of adults (thousands)	3,591	39	71	314	633	988	1,026	540
<u>Rate per 100 adults</u>								
Male	1.7	0.2	-	0.5	1.5	4.2	3.1	14.1
Female	4.6	0.3	0.6	2.1	4.4	8.3	14.1	23.5
<u>Osteoarthritis</u>								
Number of adults (thousands)	40,481	646	2,093	5,842	9,590	10,848	9,013	2,449
<u>Rate per 100 adults</u>								
Male	37.4	7.2	13.6	30.2	47.0	63.2	75.8	80.9
Female	37.3	1.6	6.2	19.6	46.3	75.2	84.7	89.8

- Represents zero

¹(Excludes Alaska and Hawaii.) Units are annual averages based on direct examination from October 1959 to December 1962. Refers to civilian noninstitutional population ages 18 to 79 years.

Source: National Center for Health Statistics 1966 PHS publ. 1000, series 11, nos. 15 and 17. U.S. Dept. of Health, Education, and Welfare.

DENTAL HEALTH

Diet serves three major roles in the maintenance of good dental health. Adequate nutrition is essential for the proper development of tooth structure before eruption and later for the maintenance of a firm, healthy tooth surface and resistance to the cariogenic organisms in the mouth. These microorganisms are generally accepted as responsible for conversion of sugars to acids in the mouth, the latter dissolving the calcium in the tooth to form the hole. Some sugars have very high cariogenicity, for example, sucrose. Other sugars (and starches) have very low cariogenicity. The presence of sucrose, especially the sticky Sweets eaten between meals, encourages the increase in numbers of cariogenic organisms. A change in food habits is necessary to make this means of control effective.

The third critical area for diet in dental health is in the maintenance of healthy gums and teeth in adults to prevent or modify the onset of periodontal disease. The Health Examination Survey, conducted during 1960-62 by the U. S. Department of Health, Education, and Welfare, estimated that about 44 million adults, age 18 to 78 years had gingivitis, and about 23 million had chronic destructive disease indicative of advanced periodontal disease. Both dental caries and periodontal disease also are influenced by a number of nonnutritional factors, particularly oral hygiene.

An examination of the economics of health services in the U. S. indicates that the consumer spends one-seventh to one-ninth of his health dollar for dental health services, a total of about 3 billion dollars in 1966. This cost represents the 20 percent of the population estimated to receive adequate dental care

during the calendar year. At that rate, care for the total population of the country would have approached 15 billion dollars or 2 percent of the country's gross national product. The size of the dental health problem is reflected in the fact that in 1957 there were 22 million persons in the U. S. who had no natural teeth. This is equivalent to one out of every eight persons. Loss of teeth increases progressively with age and half of all persons past the age of 55 years have no natural teeth. Over 98 percent of the U. S. population is afflicted with dental decay, and the proportion is rising. Dental caries without proper dental services and hygiene are the main cause of the problems. The preventive role of proper diet is not clearly established.

The influence of nutrition in dental health begins before birth. Fluoride taken by the pregnant mother and passed in limited amounts through the placenta to the fetus makes the child's teeth significantly more resistant to dental caries. Changes in oral structures of experimental animals have been reported in relation to prenatal nutrition. These include basic changes in the dentofacial pattern ranging from minor abnormalities to cleft palate and harelip; changes in size and shape of both molars and incisor teeth; delay in eruption of molars; and an association with increased dental caries. A deficiency or an excess of a nutritional factor normally required, or an antagonist which can disrupt the normal metabolic process may interfere with embryonic development. Some of the nutritional factors which have been associated with these changes include riboflavin, folic acid and their antimetabolites; vitamin A; and diets high in sugar or phosphate. Each factor tends to be involved in a characteristic pattern of effects which are not necessarily limited to the oral structures. Changes in the maternal diet can affect the fetus without being detrimental to the mother. The mechanism of this nutritional influence appears to result in the death of the cell or in alteration in the rate of cell growth.

Clear-cut cause and effect relationships between nutrition and periodontal disease have not been established. Gingival inflammation can be induced by nutritionally inadequate diets. Healing of existing lesions has been delayed by protein-deficient diets. Also, the morphology of the dental plaque closely associated with the presence of periodontal disease can be varied by alterations in the composition of the diet.

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DIABETES AND CARBOHYDRATE DISORDERS

Problems of Carbohydrate metabolism, including reduced glucose tolerance and intolerance to certain disaccharides affect a large proportion of the adult population. Severely reduced glucose tolerance, resulting from the inability of the body to efficiently utilize glucose is commonly referred to as diabetes mellitus. Less severe reduction in glucose tolerance does exist unrecognized in large numbers of persons. The diabetic population is increasing. Diabetes stood seventh among the causes of death in the U. S. in 1969 accounting for over 35,000 deaths. Over 4 million diabetics were estimated in the U.S.A. in 1967. There are an additional 5,600,000 potentially diabetic persons. Thus, one in twenty has diabetes or is potentially diabetic. Nearly seven out of ten known persons with diabetes had their diabetes discovered at age forty-five years or older.

In diabetes, the body is unable to metabolize carbohydrates normally, being unable to convert carbohydrates into the stored form, glycogen, or to utilize them for the energy required for normal body functions. Glucose disappears from the bloodstream at a slower than normal rate following carbohydrate intake. The condition is associated with deficiency or inadequate utilization of insulin. As the disease progresses, abnormal carbohydrate metabolism becomes associated with a derangement in the metabolism of fats and proteins. Health conditions associated with diabetes are extreme tiredness, leg pain, eye trouble, sudden weakness, frequent urination, thirst, itching, loss of weight, changes in appetite, and degenerative vascular disease.

Diabetes has been known for some time to be a hereditary disorder which can be controlled by insulin therapy and diet management. During the past decade, the trace mineral chromium has been shown to improve the body's ability to use carbohydrate, particularly when the reduction in glucose tolerance is associated with aging. It has been postulated that the decreasing ability to handle glucose with age may reflect chronic marginal intake of chromium throughout life. It is known that the original content of chromium or its biologically available form, as of other trace elements, is markedly reduced by refining and processing of foods. U.S. Public Health Service studies have suggested that as many as 14 percent of the U.S. population may have reduced glucose tolerance. A recent study in 1965 found that 77 percent of "normal" subjects over 70 years of age have abnormal glucose tolerance. The reduced glucose tolerance, a characteristic of the aging process, has been associated with increased incidence of coronary heart disease and stroke (HEART, [Fig. 13](#)).

Blood sugar levels increase with age ([Table 17](#)). Evidence of reduced glucose tolerance is apparent before age 30 years. This reduction in glucose tolerance may result from aging, a high prevalence of diabetes-related genes or₁ as recently suggested, a reduction in body chromium stores resulting from a chronic marginal intake during the lifetime. Women tend to have a slightly higher blood sugar level than men. The tendency increases with succeeding pregnancies and may be due to decreased body stores of trace elements such as chromium.

Considerable attention is now being given to the significance of lactose intolerance in nutritional problems in the U. S. Lactose is the principal sugar naturally occurring in milk. Normally, it is changed during digestion to glucose and galactose which are absorbed. In the adult, and occasionally in the infant, not enough lactase is produced to break down the lactose. In these "lactose intolerant" individuals, the sugar passes into the intestine where it is acted on by microorganisms with the production of gas and accompanying discomfort from diarrhea and intestinal distension. The incidence of lactose intolerance in healthy adults is shown in [Table 18](#). As many as 19 percent of adult Caucasians, 74 percent of Negroes and 95 percent of Orientals in the U.S. may be affected.

Persons who are unable to metabolize lactose find it necessary to exclude milk and many milk products from their diets. Milk is a major dietary source of calcium. Diets without milk frequently contain less of this important mineral than is recommended by the Food and Nutrition Board of the

National Research Council. This is particularly important in evaluating and improving the diets of low income families. About three-quarters of the black adults in this group probably cannot consume milk without distress. About 45% of Negro school children in Baltimore, Maryland, had a reduced ability to metabolize milk sugar. Milk given with the school lunch was more likely to be rejected by these children even though small amounts of milk could be consumed without major discomfort.

Monosaccharides also may present a metabolic problem. An inborn error in the metabolism of galactose results in abnormally large amounts of this sugar in the blood. The condition is characterized by nutritional defects, mental and physical retardation, enlargement of liver and spleen, osteoporosis, and cataracts. Eyesight is frequently affected.

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TABLE 17

Mean blood glucose¹ in adults Health examination survey, 1960-1962

Age (years)	Mean glucose in mg %	
	Males	Females
18-24	96.5	104.6
25-34	102	110.0
35-44	113.5	119.9
45-54	118.8	132.7
55-64	131.8	144.8
65-74	137.9	157.8
75-79	151.6	173.3

¹Excludes persons with diagnosed diabetes and pregnant women. Blood glucose measured 1 hour after ingesting 50 grams of glucose without regard to time or content of previous meal.

Source: National Center for Health Statistics 1966 PHS publ. 1000, series 11, no. 21. U.S. Dept. of Health, Education, and Welfare.

COMMENT: BLOOD SUGAR LEVELS INCREASE WITH AGE. WOMEN TEND TO HAVE A SLIGHTLY HIGH BLOOD SUGAR LEVEL THAN MEN. GLUCOSE LEVELS FOR WHITE AND NEGRO POPULATIONS DID NOT APPEAR TO DIFFER. HAVING CHILDREN WAS NOT, IN GENERAL, ASSOCIATED WITH HIGHER BLOOD GLUCOSE LEVELS.

TABLE 18

Lactose intolerance in "healthy" adults

Group	Number Studied	<u>Lactose intolerant (percent)</u>		
		By symptoms	By blood sugar	By Lactas assay
Caucasians (U.S., Great Britain, Australia) (several studies combined)	217	17	19	15
Black, U.S.A. (several studies combined)	107	63	74	73
Black, Central Africa, various countries	16	50	88	--
Black, Bantu, various tribes	66	40	59	70
Black, Hamitic tribes	10	--	0	--
Oriental, U.S.A	31	70	95	100
Oriental, Australia	20	95	85	--
Oriental, India	18	22	22	11
Oriental, Thailand	215	88	97	95
Australian aborigine	19	--	79	--
North American Indian	3	--	67	--
North American (Colombia)	24	58	100	--
North American Mestizo and Antioqueno	"many"	"high"	"high"	--
Greek Cypriot	17	--	88	--
North American Arab	3	67	100	--

Source: Lutwak, L. 1970 The significance of lactose intolerance in nutritional problems. Eastern Experiment Station Collaborators' Conference on Human Nutrition, October 28, 1969 ARS 73-67. U.S. Dept. of Agriculture.

OSTEOPOROSIS

Osteoporosis is a disease of the bone characterized by increased porosity and softness in which the amount and strength of the tissue has been decreased. The bones are susceptible to fracture, and in Severe cases of osteoporosis, wider normal mechanical stress. It is one of the most common and yet least understood afflictions of bone. It occurs during middle or old age and is observed more frequently in women than in men. Osteoporosis is one of the major causes of disability in age. The spine is affected first. Thinned by disease, the bones of the spine are compressed by body weight resulting in low back pain, back deformity, loss of weight and the capacity for physical activity.

The significance of the disease as a basis of vulnerability to fracture and disablement is of real or potential importance to millions of persons over 40 throughout the world. Recent surveys indicate that osteoporosis is more widespread than arthritis and about three times as common as diabetes. Using the severe criterion of vertebral compression, these surveys suggest that approximately 25 to 30 percent of women and 15 to 20 percent of men over the age of 50 have osteoporosis of this high degree. An extensive study of osteoporosis in 2,000 women of Puerto Rico and Michigan indicated that nearly 50 percent of women over 45 years and 80 percent of women over 65 have "significant vertebral atrophy."

Disturbances in protein, mineral, or hormonal aspects of bone metabolism have been implicated as causative factors which lead to increased resorption of bone. The rate of bone resorption is twice normal in osteoporosis while the rate of bone formation is about normal. Dietary calcium, phosphate,

vitamin D, fluoride, and possibly magnesium are thought most likely to be involved. A study is being undertaken at Cornell University of 50-100 individuals with "early osteoporosis" defined as bone density significantly below the mean for age and sex. The effectiveness of therapeutic dietary regimens including the nutrients noted above will be evaluated. The individuals for intensive study will be selected after a survey of about 2,000 individuals in the general population for subclinical osteoporosis.

Some investigators have suggested that primary osteoporosis could be the result of a prolonged chronic submarginal intake of calcium. These investigators also conclude that unless supplemented by milk or calcium therapy, the diet presently selected by the geriatric population in the U. S. is generally deficient in calcium. This premise is supported by the findings from the Nationwide Diet Survey in 1965. Defective mineral absorption from the intestine, excessive calcium excretion, and physical inactivity may be contributing factors. Osteoporosis is generally considered a physiological characteristic of deterioration with age. Its relation to nutritional state is generally recognized. There is insufficient information at this time to identify what dietary control is necessary to defer, modify, or avoid the onset of this condition. However, nutritionally induced osteoporosis in dogs was recently demonstrated, lending increased credence to fragmentary data on human subjects, indicating that proper diet can prevent or alter the course of osteoporosis in man.

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OBESITY

Obesity is a prevalent health problem, at every age, in both sexes, and at every economic level in the U. S. today. Precisely how prevalent is difficult to assess, and there are no exact statistics. Almost 3 million adolescents (10 percent) in the U. S. are estimated to be seriously ill with overweight. In adults, the percentage of persons above their best weight is considerably higher (Table 19). A person is generally considered to be obese if he weighs more than 20 percent above the average for his age and height. Obesity is more prevalent in women than in men and is more likely to occur as age increases. The greatest increase in weight occurs in the 20 to 30 age group. About 60 to 70 percent of men and women over 40 years are above their best weight.

Obesity and overweight are not considered to be a cause of death; however, they are closely associated with increased mortality from other conditions (Fig. 20). Insurance statistics reveal that overweight people are more likely to develop certain diseases and to die at a younger age than people of normal weight. Diseases such as diabetes mellitus, gall bladder disease, gout, kidney and digestive diseases, hypertension, and possibly coronary heart disease are significantly associated with obesity (Figs. 21, 22). Obesity increases surgical risk; is a hazard in pregnancy; prevents ambulation and self care in arthritis and fractures of the lower extremities in the aged; places a greater load on the heart and circulatory system; and increases the work in breathing. Reduction in weight to normal levels increases the likelihood of success in treating these health conditions. Weight reduction alone is not a

cure, but it may modify the condition so that it is no longer critical. In addition to health problems, there are a number of social and psychological consequences arising from obesity. Good nutrition and maintenance of normal weight may prevent many health conditions from becoming debilitating.

There has been considerable research on various aspects of the causes of obesity, the nature of the disorder, and its treatment. Obesity is not a disease entity as such but a symptom of some underlying difficulty which may have many causes. A number of diverse factors are indicated: genetic, physiologic, psychologic, and social economic influences contribute to the development and perpetuation of the condition. Culture, activity, food habits, and way of life, all are involved.

So far, no successful long-term treatment of obesity has been found. The direct cause of obesity is the consumption of more calories than needed to provide the energy needs of the individual (Fig. 23). Obese children and adolescents are more likely to remain obese as adults and to have difficulty in losing fat and maintaining fat loss. A longitudinal study of obese children showed that 86 percent of the men and 80 percent of the women who were overweight as children were overweight as adults. This has been shown to occur in developing countries where the incidence and severity of undernutrition is high. It probably is a factor in the high incidence of obesity in low income families in the U. S.

Malnutrition during pregnancy and early life may be reflected in obesity in adulthood. The total number of cells in the body are determined during the prenatal period, infancy, and early childhood. Later periods of growth in adulthood influence the size of the cells rather than the total number. Poor nutrition and undernutrition during the period of cell formation means that the adult will have fewer cells to carry on body processes and store fat. Malnourished children are likely to be obese adults, because fewer cells are available to the body for fat storage. Even though their height-weight ratio is close to average, these individuals have a lower proportional protein and higher fat content in their body mass than do well nourished people. Overfeeding early in life may establish metabolic pathways which predispose to adult obesity.

A very important factor in the development of obesity is the amount of exercise. The periods of rapid growth and high activity during adolescence are accompanied by high caloric requirements. When caloric needs are less, excess calories are retained as fat unless diet is adjusted. This should be a normal process regulated by appetite. When this does not occur, body fat increases over a period of time leading to obesity.

The wide variation in the efficiency with which people use calories suggests that heredity is also a factor in obesity. Studies of obese and normal adolescents and young adults show that the non-obese individual tends to burn up rather than store excess calories in short-term dietary excesses while the obese individual stores them as fat. Obese persons also are less likely to mobilize body fat to meet short-range caloric deficits than the non-obese. In addition, some persons convert carbohydrate to fat at an increased rate.

Food habits are important in both the development and control of obesity. Traditional and family eating and cultural patterns are often conducive to overeating and obesity and contribute to the high incidence of obesity in some families. Food preferences may be established as early as three years of age. Because food provides so many satisfactions besides nutritional needs, bad habits are not easy to change. The difficulty in making permanent adjustments in living patterns is one of the main reasons for lack of success in weight reduction by regulation of diet.

There are many economic costs arising from obesity and overweight, including the greater likelihood of early death and lost productivity. In addition, there are direct costs to the individual such as increased insurance premiums. Costs due to increased likelihood of developing certain diseases have

been included elsewhere in the cost of those health conditions. Obese persons tend to be inactive and lethargic which may result in a reduced work efficiency.

The social costs of obesity are less easy to identify and gratify. Obese individuals are less attractive and are less readily accepted in the community. They are at a disadvantage in employment because of lesser agility, and they create a poor image in their relationships with other persons. Because of these factors and the greater likelihood of developing debilitating health conditions, obesity is frequently a handicap to career advancement.

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TABLE 19

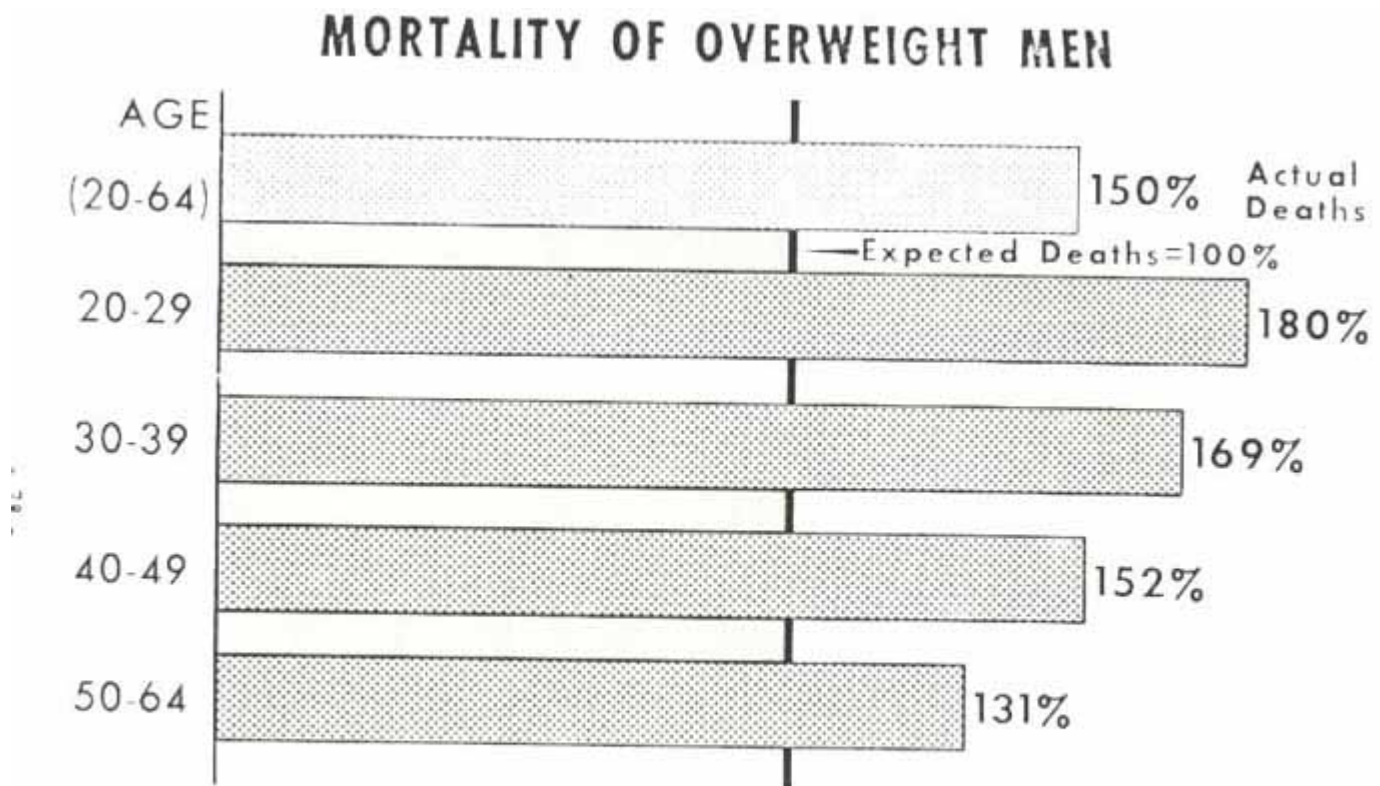
Percentage of persons deviating from best weight¹

Age (years)	Men		Women	
	10-19% above best weight	20% or more above best weight	10-19% above best weight	20% or more above best weight
20-29	19	12	11	12
30-39	28	25	16	25
40-49	28	32	19	40
50-59	29	34	21	46
60-69	28	29	23	45

¹Adapted from Metropolitan Life Insurance Co., New York. Frequency of overweight and underweight, Statistical Bulletin 41(4): January 1960

Source: National Center for Chronic Disease Control 1966 Public Health Service publ. 1485. U.S. Dept. of Health, Education, and Welfare.

FIGURE 20



SOURCE: H&W

Figure 20. — A marked increase in mortality occurred in all age groups of overweight men. However, these mortality figures represent only the first 11 percent of deaths in the group studied. The worst mortality record is apparent in the younger age groups (20-29 years).

FIGURE 21

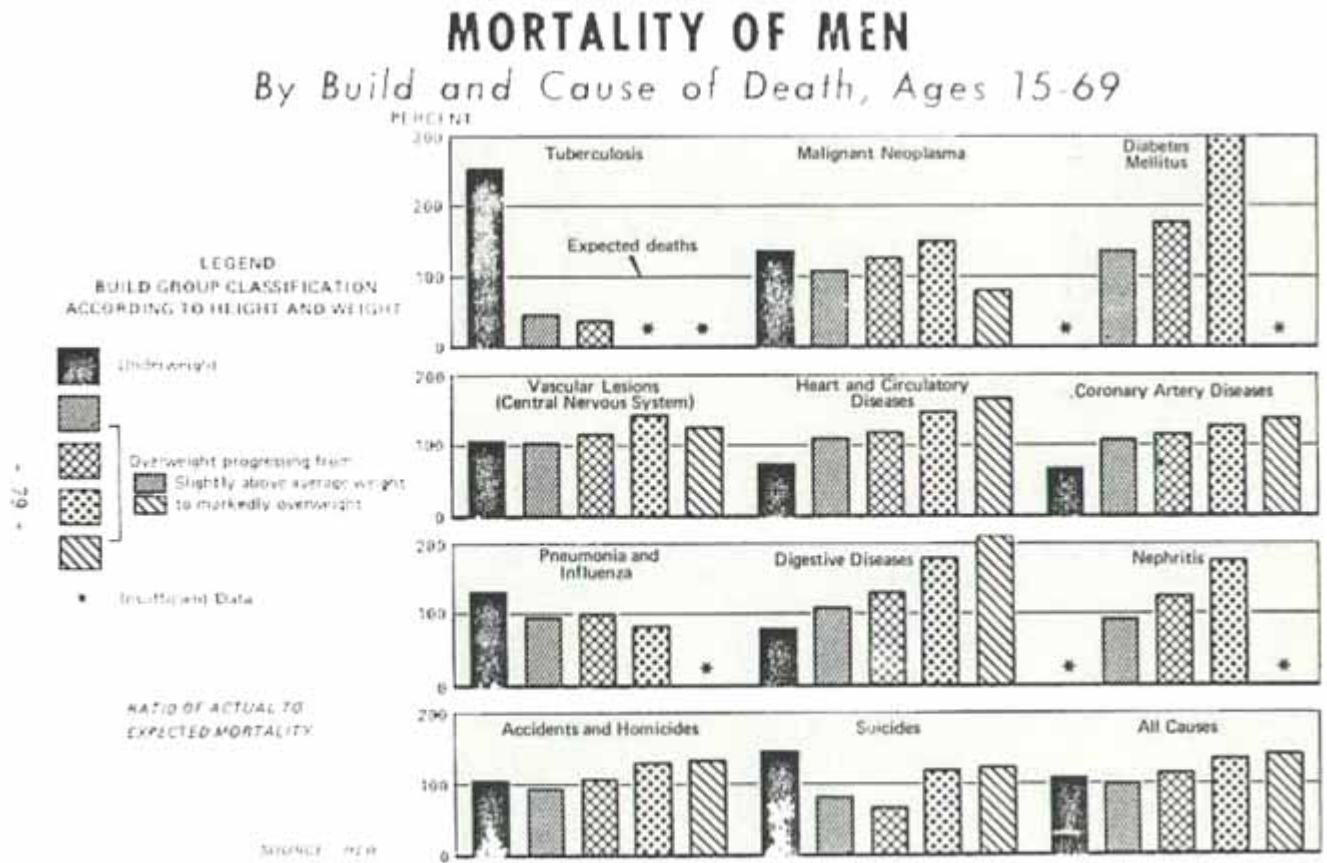


Figure 21.— An increase in weight is associated with a high mortality from all causes. The increase in deaths is largely attributable to diabetes, heart and circulatory diseases, digestive diseases and nephritis. The degree of overweight is directly related to higher mortality rate.

FIGURE 22

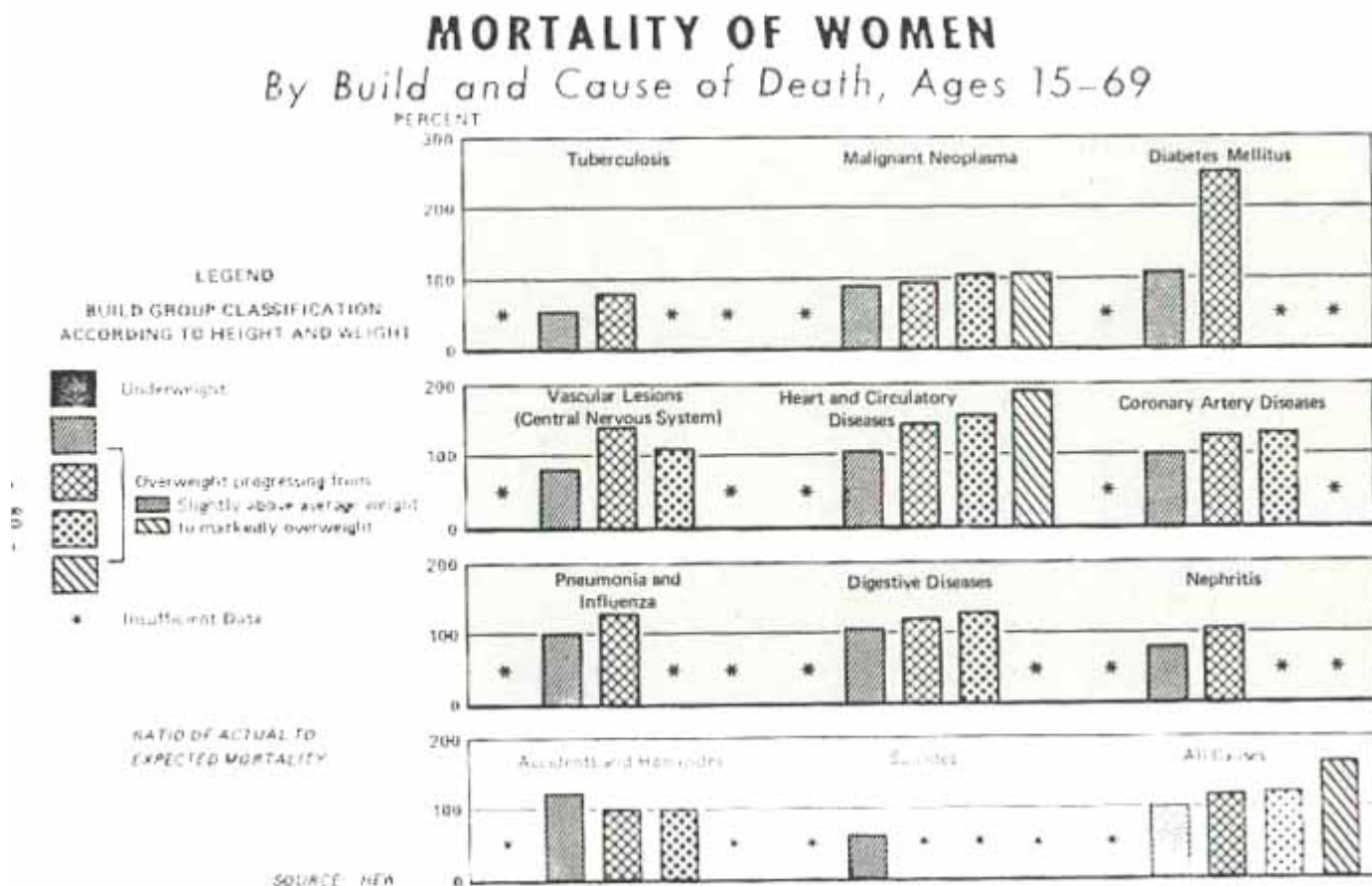


FIGURE 23



***“ You’ve gained 10 pounds
in 6 months!!...In 30 years
you’ll weigh 770 pounds .”***

Figure 23

ANEMIA AND OTHER NUTRIENT-DEFICIENCY

Gross clinical Occurrence of nutrient-deficiency diseases other than anemia rarely occurs in the U.S. There has been little documentation of subclinical deficiencies, because there are no specific and rapid procedures available for their identification. The Nationwide House-Hold Food Consumption Survey of 1965 indicated that some nutrients in the diets of certain sex-age groups were below the 1968 NAS-NRC Recommended Dietary Allowances. This survey provided a means for identifying population groups which need immediate special attention. People having low incomes are more likely to have poor diets (Fig. 24), but malnutrition is found in affluent groups as well.

The National Nutrition Survey begun by the U.S. Department of Health, Education, and Welfare in 1968 has been confined largely to low income families and indicates some deficiencies apparent on clinical examination. Iron, vitamins A, B₁, B₂, C and folacin were the major nutrient deficits. There was also a low incidence, 3-1/2 percent, of retarded growth. A number of deficiencies have been identified by the biochemical data from the survey. In Texas, 41 percent of the individuals surveyed had unacceptable levels of serum the Louisiana survey had 15 percent. Over 60 percent and children had unacceptable levels. The prevalence was much lower for adults. Twelve percent of the people surveyed in percent in Louisiana had unacceptable serum levels of Thiamine and riboflavin nutriture was unacceptable in 10 percent and 16-21 percent of the surveyed people respectively. Some preliminary results from the Louisiana portion of the study are given in Table 20.

Nutritional anemia is one of the most widely occurring deficiencies. These anemia's are most likely to develop during periods of rapid growth, such as infancy and adolescence, and during the childbearing years in Women. During these stress periods it is difficult to select diets to meet the increased needs for iron. Anemia due to iron deficiency is presently recognized as the most common type of nutritional anemia. Folic acid, vitamin B₁₂, and protein often are involved. There is not complete agreement on the significance of anemia in terms of health. Anemia is common in infants, 12 to 24 months of age, regardless of family income. More than two-thirds of ghetto children in this age range may be affected. These infants appear normal in other respects. However, anemia adds to the incidence and seriousness of other health hazards such as fevers. Anemia is also detrimental to learning ability (IMPROVED LEARNING ABILITY).

There is good evidence that folic acid deficiency may be a real problem in the U.S. Megaloblastic anemia associated with folate deficiency is frequently found during pregnancy, particularly in mothers from low income families. Apart from this, folate deficiency may be widespread among the poor, the alcoholics, and the cirrhotics. A 1965 report of a municipal hospital in Jersey City suggested that folate deficiency is the commonest form of hypovitaminemia to be found in the sick and injured. Green vegetables are a major source of folic acid. If a poor family is able to grow vegetables, the members are not likely to suffer from folate deficiency. The population shift from rural to urban and the decreasing consumption of green vegetables may be reflected in the increased incidence of folate related anemia. Any condition resulting in an increased need for blood formation will increase the needs for dietary folic acid. Available knowledge of the requirements for folate is not conclusive. The requirement is thought to be from 50 to 200 micrograms daily. It is difficult to predict whether there may be folate deficiency from dietary studies because of inaccurate and insufficient data on folic acid content in foods. Present methodology does not indicate folate actually available for human nutritional requirements.

Vitamin A and vitamin D may also be insufficient, particularly in the diets of children up to 8 to 10 years of age. The incidence of rickets was higher than expected in the National Nutrition Survey. Serum levels of vitamin A were below acceptable levels in about 40 percent of the children under 17 years studied in Louisiana (Table 21). Income level was a minor factor. The situation with regard to

vitamin A may be even worse than indicated by these data because of recent findings that the acceptable level for serum vitamin A may be higher than the survey criteria.

It is important to recognize that individuals vary in the amount of nutrients needed, and that some cases, clinical and biochemical deficiencies may appear in spite of a diet which would be adequate for most persons. Very little is known of the upper limits of nutrient requirement or the incidence of persons having unusually high needs.

There may be a number of chronic dietary deficiencies which have not been identified. Some of these may be trace elements which have been provided in the past in adequate amounts, or nearly so, by diet. Changes in food technology, including formulation of foods, may result in chronic marginal intakes of some nutrients with the development of subclinical deficiencies not recognized at this time as nutritionally caused.

Among the nutrients likely to be deficient in certain areas of the country and segments of the population are cobalt, copper, chromium, and iodine. Selenium and molybdenum may occur in toxic amounts in some regions of the U.S. (Fig. 25). For decades, the need to add iodine to the diet in some areas has been recognized. More recently, there has been a reduced consumption of iodized salt, probably because changed technology and processing may require the use of noniodized salt.

Changes in environment also may contribute to the problem of excesses. For example, the fertilization of the soil may increase the nitrate and cadmium levels to the point where the foods produced may contain high enough levels of these nutrients to be adverse in infant feeding. Increasing levels of lead, carbon dioxide, and ozone in highly populated areas may stress individuals consuming diets borderline in nutrients.

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FIGURE 24

**NUTRIENTS LESS THAN THE
RECOMMENDED DIETARY ALLOWANCES**

SEX-AGE (YEARS)	PROTEIN	CALCIUM	IRON	VITAMIN A VALUE	THIAMINE	RIBO- FLAVIN	ASCORBIC ACID
MALE AND FEMALE:							
UNDER 1			* * * *				o o o
1-2			* * * *				o o o
3-5			* *				o o o
6-8		o o	o	o	o		o
MALE:							
9-11		* o o			o		
12-14		* * o o	* * *		* o		
15-17		* o o	* o		o		o o
18-19		o o o					
20-34							o
35-54		*					o o o
55-64		* *					o
65-74		* *				o	o
75 & OVER		* * * o		*		* * o	* o o o
FEMALE:							
9-11		* * * o	* * * *		* o		
12-14		* * * o	* * * *	* o o	* * o		o o
15-17		* * * *	* * * *	*	* * o		o o o
18-19		* * * o	* * * *			o o	
20-34		* * * o	* * * *			* *	o o
35-54		* * * *	* * * *	o o o	* o	* *	o o
55-64		* * * *	* * * *	o o	* *	* *	o o
65-74		* * * *	* o	*	* * o	* *	o
75 & OVER		* * * *	* o	*	* * o	* * *	o o

1 SYMBOL - 10% 2 SYMBOLS - 11-20% 3 SYMBOLS - 21-29% 4 SYMBOLS - 30-50% 5 SYMBOLS - 51-59%

*INCIDENCE FOR ALL INCOMES *ADDITIONAL INCIDENCE FOR INCOMES UNDER \$1,000 *LASVINS, 1958

DIETS OF MEN, WOMEN, AND CHILDREN - 1 DAY IN SPRING, 1959

TABLE 20

Nutritional status by age group¹

	<u>Percent with less than adequate levels</u>				Total
	Age group (years)				
	0-6	7-17	18-59	60+	
	%	%	%	%	%
Plasma vitamin C	9	10	11	17	14
Plasma vitamin A	43	40	2	1	26
Hemoglobin males	39	37	45	57	--

¹Preliminary results based on 3,346 individuals

Source: Unglaub, W. 1968-69 National Nutrition Survey, Louisiana data, unpublished.

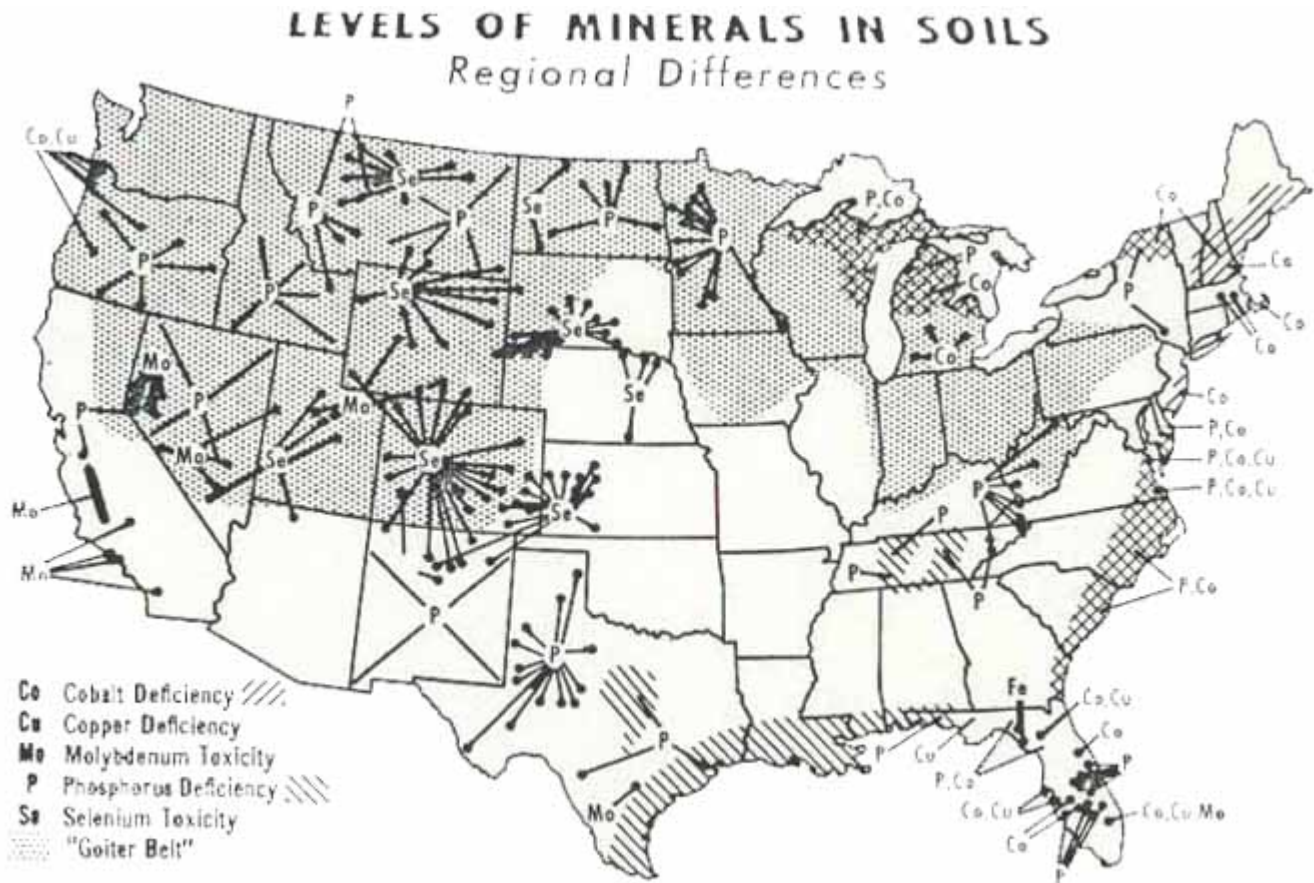
TABLE 21

National nutrition survey, Louisiana, 1968-1969 preliminary results for plasma vitamin A

Age (years)	Number of persons	Unacceptable values
		%
0-6	642	45
7-17	1,200	40
18-59	1,092	2
Over 60	412	1
Total	3,346	25
Income level	Unacceptable values	
	Males	Females
	%	%
Poverty	37	28
Above poverty	20	17

Source: Unglaub, W. 1968-69 National Nutrition Survey, Louisiana data, unpublished.

FIGURE 25



ALCOHOLISM

Alcoholism is a metabolic disease associated with social and physiological stress. According to the National Council on Alcoholism, 5 million alcoholics live in the U.S. This estimate is for 1970. Firm figures for incidence are not available because many alcoholics, particularly women are not identified. Alcoholism is occurring much more frequently among very young people. The incidence is high among the lower social and economic classes. Persons with a history of alcoholism have a death rate 2-1/2 to 3 times higher than standard risks. The National Council on Alcoholism estimates an annual loss to industry of over 2 billion dollars, resulting from absenteeism, lowered productivity, and accidents associated with alcoholism.

Good diet is an important factor in maintaining the productivity and health of alcoholics. It has generally been supposed that it is alcoholism, which is usually accompanied by a lack of interest in food, that leads to malnutrition. Not until recent months has poor diet been implicated as a cause. There is now some evidence with rats that a craving for alcohol can result from a chemical imbalance created by inadequate diet. Switching to a well-balanced diet was accompanied by a reduction in alcohol consumption.

Alcohol is a food contributing seven calories per gram of alcohol. It has been estimated that alcohol contributes 15-20 percent of the total caloric intake in U. S. diets. The alcoholic individual substitutes alcohol for much of the normal food intake and as a consequence the intake of proteins, minerals, and

vitamins may be grossly deficient. About 50 percent of alcoholics have anemia due to hemorrhage, ulcers, or malnutrition. Many of the symptoms characteristic of alcoholics may be attributed to nutritional deficiencies rather than to toxicity of alcohol *per se*. Weakness, numbness, fatigue, and lack of interest typical of alcoholism also are characteristic of thiamine deficiency. When vitamin B₁ is supplied, many of the symptoms disappear. Skin conditions characteristic of pellagra are sometimes seen in alcoholics and may be reversed by increasing niacin intake. Lack of vitamin B₆ and pantothenic acid also may be responsible for neurological changes. A reduction in serum magnesium levels is occasionally seen in delirium tremors. Diets containing good quality protein and vitamins may help prevent many adverse changes in alcoholics and permit them to be gainfully employed.

Chronic intake of large amounts of alcohol is associated with the development of fatty liver and ultimately cirrhosis. In 1967, cirrhosis of the liver ranked eleventh as the leading cause of death accounting for almost 28,000 deaths. There has been a marked increase in the death rate from cirrhosis of the liver during the past decade (Fig. 26). Alcohol was the major factor in 88.5 percent of the deaths from cirrhosis in Baltimore in the years 1957-58 and 1965-66. The increase in the death rate from cirrhosis was thought to reflect the improved control of tuberculosis since 1961. Prior to that date, many alcoholics died from tuberculosis before cirrhosis had progressed far enough to be fatal.

Nutrition has contributed significantly in alleviating the results of alcoholism. There are still many people who could benefit from existing knowledge who have not been reached. These are the persons whose condition has not reached the clinical stage. More help could be given if we understood better the factors responsible for fat deposition and mobilization in the liver. This knowledge is also fundamental to understanding the problems of obesity and of the undesirable changes in fat metabolism associated with heart and vasculatory disease. More complete knowledge of the mechanisms of fat metabolism is required before sound recommendations can be made for altering diets.

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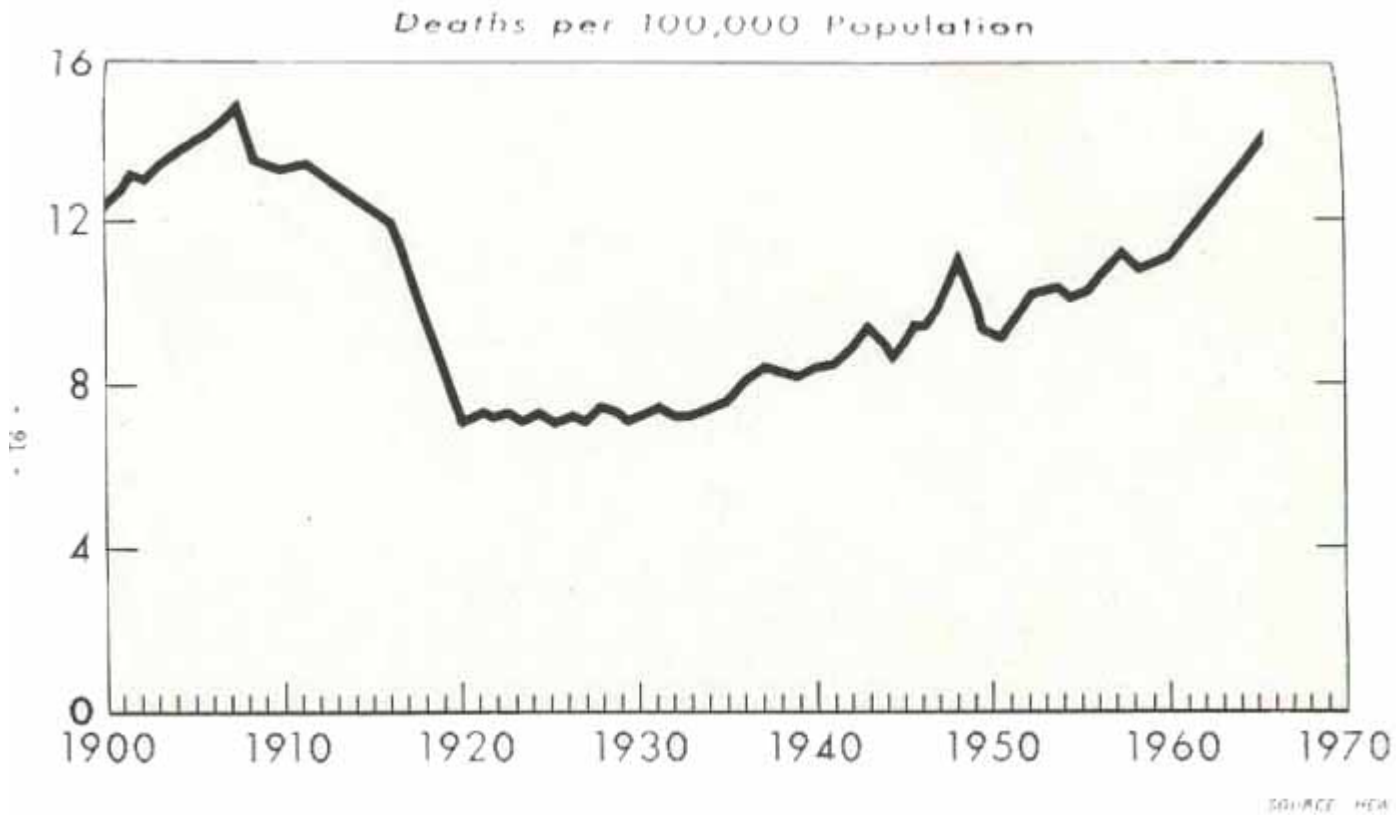
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FIGURE 26

CIRRHOSIS OF LIVER



EYESIGHT

The eye is particularly sensitive to nutritional inadequacy. Vision is one of man's most precious faculties. Good nutrition and intact vision are inextricably linked together throughout all phases of life. The eye as well as the brain has its most rapid rate of growth while the fetus is taking form and growing in the uterus. The eye continues to grow rapidly during most of the prenatal period and after birth commencing to slow in the third year of life. The eye increases in size hardly at all after age five. The brain-eye system is most vulnerable to the effects of deprivation of food during the early months and years of life. Some of the results of nutritional inadequacy during this early period do not become apparent until later in life when the eye is more susceptible to infection. Degenerative changes occur at an earlier age and progress to greater severity.

The social and economic costs of poor eyesight and blindness are great. Forty-eight percent of the U. S. population over three years of age wore corrective lenses in 1966 ([Table 22](#)). Included were over 8 million children, 15 percent, between the ages of 3 and 16 years and about 78 million or 88 percent of the population 45 years of age and over. In 1968, almost 81,000 blind persons received public assistance payments at an estimated cost in public assistance of over 103 million dollars. Statistics are not available on the number of persons who are partially or severely handicapped in their employment because of poor vision nor are the number of accidents which occur from this cause. About 81,000 persons become blind every year.

Lack of vitamin A is responsible for the most widespread form of blindness of nutritional origin in the world today. Insufficient vitamin A results in damage to the cornea. In its early stages, it is reversible if treatment is instituted in time. The disability changes in the eye take place only after a long period of deprivation of vitamins. The incidence of adverse eye changes due to vitamin A deficiency in the U.S. is not well documented. Recent developments indicate that vitamin A deficiency is much more common than predicted. A nationwide survey of household food consumption in 1965 indicated that 27 percent of all households consumed diets below the recommended daily allowance for vitamin A. More recent, preliminary results from the National Nutrition Survey begun in 1968 are showing that about 33 percent of children under five years of age and 29 percent of those aged six to nine years have blood vitamin A levels below that considered adequate (Fig. 27). In some areas about 40 percent of children up to 17 years of age had unacceptable plasma vitamin A levels (Table 21). About twice as many children in low income brackets had unacceptable vitamin A levels as in more affluent families. Of even greater concern are clinical observations made in Iowa where adverse changes in the eye indicative of vitamin A deficiency are being found in individuals having plasma vitamin A values twice as high as the level generally accepted as being satisfactory.

There are indications, not well documented, that myopia in children is probably due to malnutrition. The normal, well-developed young child is long sighted. If all goes well, the refractive state of the eye gradually arrives at adult status before school age. About one-half of U.S. children have less than 20/20 vision (Table 23). There is evidence that severe nutritional stress during the period of active growth may throw the delicate compensating mechanisms off balance and lead to myopia. Additional evidence comes from the observation that premature infants are much more myopic than full-term infants. Also, recent study of 553 blind children born in New York State over a 12-year period revealed that many were of low birth weight indicative of poor nutrition during fetal development.

Deficiencies of the B-complex vitamins, thiamine, niacin, riboflavin, and vitamin B₁₂ are associated with impaired vision. In some instances, adverse changes in vision thought to be due to vitamin A have responded to vitamin B therapy but not to additional vitamin A. The B vitamin deficiencies are more likely to be associated with deterioration of vision resulting from optic nerve degeneration. This condition is more often found in the adolescent school child or in young adults eating a monotonous poorly balanced diet. B vitamin deficiency also is likely after periods of calorie restriction, whether deliberate or involuntary. Dimness of vision from B vitamin deficiency may be recognized with greater frequency in the future as greater demands are placed on acuteness of vision by wider education and the need for more skilled labor.

Problems of eyesight also are associated with other diet based problems. It is not uncommon to find cataracts in diabetics and in galactosemia. The latter condition occurs as a result of the inability to metabolize lactose from milk sugar.

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TABLE 22

Persons wearing corrective lenses --1966

Sex and age (years)	Population, 3 years old and over	Total with lenses
Both sexes, total	<u>178,907</u>	<u>86,020</u>
3-16	55,037	8,263
17-44	67,579	28,224
45 and over	56,292	49,533
Male	86,195	36,880
Female	92,712	49,140
Both sexes, percent	<u>100</u>	<u>48</u>
3-16	100	15
17-44	100	42
45 and over	100	88
Male	100	43
Female	100	53

In thousands, except percent

Source: National Center for Health Statistics 1967 PHS publ. 1000, no. 37. U.S. Dept. of Health, Education, and Welfare.

FIGURE 27

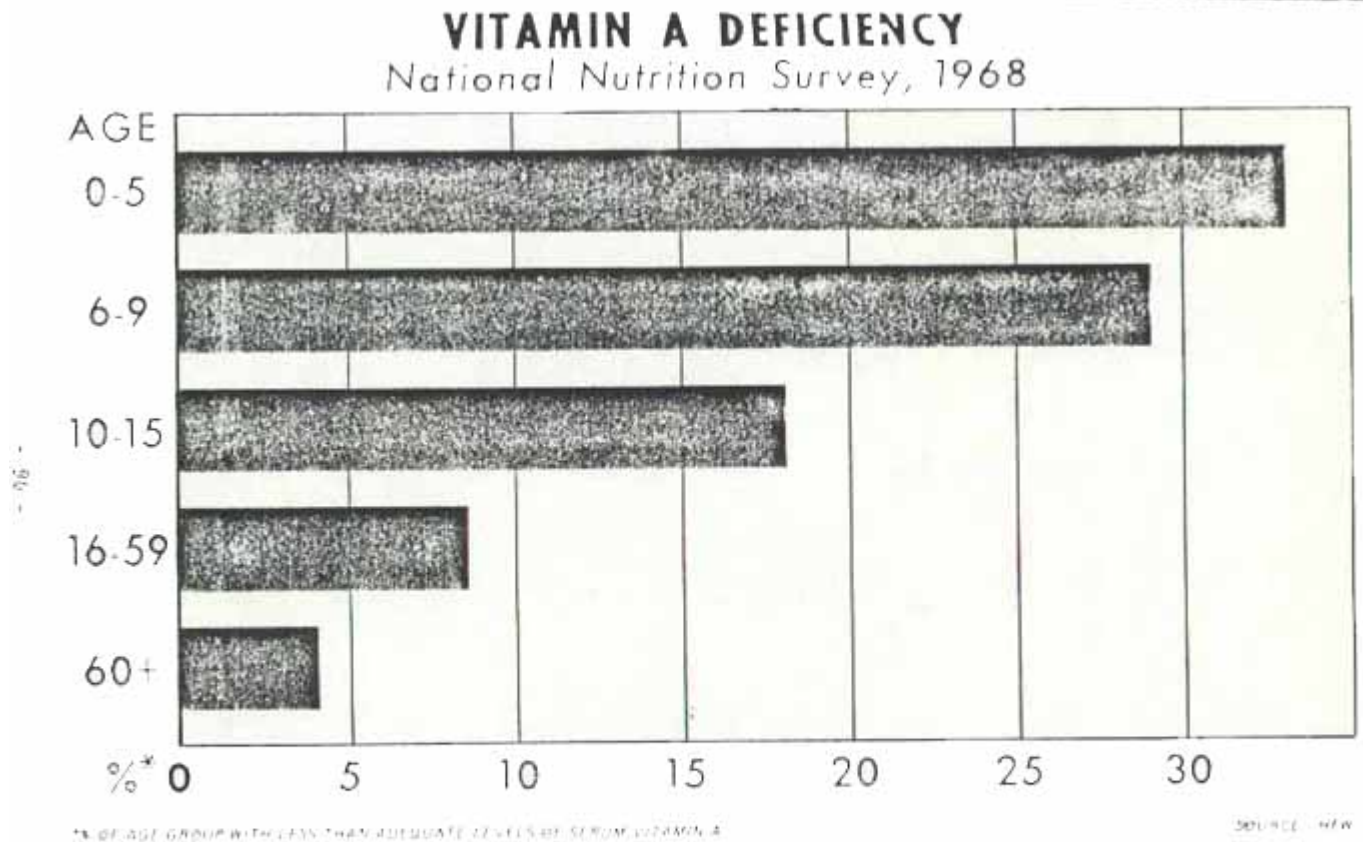


Figure 27. — Impaired vision results when body reserves of vitamin A are exhausted. Food consumption surveys show a continuing drop in consumption of dark green and yellow vegetables per capita. These foods are among the best sources of vitamin A and its precursors. Autopsy data indicate that liver stores in many people are nonexistent or marginal. Studies in Iowa lead us to believe that levels of serum vitamin A now accepted as satisfactory may be too low. There may be a much higher incidence of unacceptable vitamin A levels than this graph indicates.

TABLE 23

Proportion of children reaching visual acuity levels of 20/20 or better

Age (years)	United States 1963-65 ¹	Private patients, Houston, Texas 1950 ²	School children, Toronto, Canada 1952 ³
Percentage			
6	51	44	--
7	46	52	72
8	51	56	84
9	58	61	83
10	58	69	80
11	56	75	78

¹U.S. Health Examination Survey 1963-65.

²Slataper, F.J. 1950 Age norms of refraction and vision. A.M.A. Arch. Ophth. 43(3):466-481, March

Source: National Center for Health Statistics 1970 PHS publ. 1000, series 11, no. 101. U.S. Dept. of Health, Education, and Welfare.

COMMENT: DIFFERENCES IN RATES AMONG THE THREE STUDIES IS DUE IN PART TO DIFFERENCES IN THE PROCEDURES USED TO EVALUATE ACUITY. PROCEDURES ARE NOT STANDARDIZED.

COSMETIC

A clear, soft, unblemished skin and glossy hair have long been considered indices of good health. Changes in the skin and hair are often the first indication of nutritional deficiency. The hair loses its glossy appearance, becomes rusty, and is easily plucked. The skin becomes dry, scaly, inelastic, and pallid in appearance. A brownish pigmentation appears in niacin and protein deficiencies.

Vitamins are the nutrients most often implicated in unhealthy appearance of hair and skin. The skin and hair changes associated with vitamin deficiency were characterized long before the nutritional origins of the conditions were recognized. Riboflavin, niacin, pyridoxine, and possibly pantothenic acid are the members of the B-complex group of vitamins that have clinical dermatological significance for man. Vitamins A and C also are involved. Changes in skin and hair appearance with age may be partially attributable to chronic marginal intakes of some of the vitamins. Pallor and skin changes are being found by Hodges and Sauberlich in ongoing studies with adults on vitamin A deficient diets.

Some skin disorders are accompanied by alteration of trace mineral metabolism. People with psoriasis, photodermatitis, radiodermatitis, and several forms of eczema frequently have increased nickel levels in the blood and often in the skin. The rate of healing from wounds and burns is increased by zinc supplementation. Those persons with prolonged healing problems often show low serum and hair zinc levels.

There are no statistics on the numbers of persons in the U.S. having adverse changes in the skin and hair because of nutritional deficiency nor of the extent to which improvement in appearance might be brought about by change of diet. Skin eruptions, loss of hair, scaliness or roughness of skin, and

itching have been suggested to result from poor diet or nutrient insufficiency, but improvement from adding specific nutrients has not been demonstrated when diets are adequate. The potential for improvement lies in the number of individuals who consume diets containing less than recommended allowances for vitamins A, thiamine, riboflavin, and ascorbic acids. Women and young girls would be the most likely to benefit. Data from the National Nutritional Survey will provide biochemical and clinical evidence of vitamins A, C, B₁, and B₂ nutritional status. These data should provide a better base for estimating the number of persons likely to benefit from diet improvement.

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ALLERGIES

The actual incidence of food allergy is difficult to determine. Estimates are controversial because a large number of persons suspected of having food allergies have not been identified. Estimates, derived from answers provided by 20 practicing allergists over a two year period, are that 22 million people are allergic. Sixteen million of these have hay fever or asthma. Some allergists believe that food is frequently a cause of allergic symptoms. Most agree that the incidence seems greatest in infants. This is attributed to a physiologic, immunologic immaturity that decreases with age and to a tendency to absorb unaltered proteins. This is in line with recent studies of the development of biochemical and physiological systems in various organs of neonates and infants by Winick and others.

Allergy to food may show itself in a number of ways. Vomiting, colic, diarrhea, irritability, fatigue, edema, allergic rhinitis, and eczema are some of the symptoms. The most common sites of response to ingested allergens are the skin and the respiratory tract. The symptoms are not specific for any one food or allergy.

There are two distinct types of allergic reactions to foods. One is characterized by a rapid appearance of symptoms within minutes after the food is eaten. Foods that are common causes of the immediate type reaction are fish, seafood, berries, and nuts. The second is characterized by a delayed type of response and is less easy to diagnose. A number of hours or days may intervene between the ingestion of the food and the appearance of the symptoms. Cereal, milk, eggs, beef, whole potato, orange, pork, chocolate, or legumes may cause the delayed response. Examples are sprue and celiac disease caused by intestinal sensitivity to gliadin, a protein fraction of gluten found in wheat, rye, oats, and barley. About one person in one thousand is allergic to gluten.

In the delayed type reaction, the protein breakdown product which forms during the process of digestion may be the allergen. In the case of the immediate type response, it has been suggested that the actual allergen is whole protein. The incidence of reported milk allergy varies from three percent to six percent. This does not include cases of lactose intolerance. Nuts, fish, chocolate, peas, tomatoes, and corn have also caused allergic reactions in children when they have been included in the diet. Raw foods are more likely to cause allergy than cooked.

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DIGESTIVE DISEASES

The food we eat has an intimate relationship to the gastrointestinal tract, and it would be expected that diet would play an important part in the development and severity of gastrointestinal diseases. The diversity and magnitude of gastrointestinal disorders combine to place these diseases in a prominent position among the chronic infections occurring in man. Disorders resulting from infection or the inability to utilize certain food constituents, such as gluten and lactose, have been discussed elsewhere in this report. Among the better ~ disorders of the gastrointestinal tract are peptic ulcer, ileitis, ulcerative colitis, and cystic fibrosis.

Digestive diseases are widespread and are next to infectious and respiratory diseases in responsibility for work and school days lost. It is estimated that approximately 14 million Americans, or over seven percent of the U. S. population, now have or have had an ulcerative duodenum. Each day, it is estimated that 4,000 more individuals develop ulcers and every year about 10,000 persons die of peptic ulcer complications. The cost in terms of lost man hours and direct medical expenses due to peptic ulcer alone is estimated at 5 million dollars annually. In one recent year, direct expenditures for diseases of the digestive tract in the U. S. amounted to 4.2 billion.

Digestive diseases accounted for about one-eighth of the new cases of disability lasting more than a week in a 1963-64 study of Metropolitan Life Insurance Company employees. Women had a higher rate of disability from digestive diseases than men (Table 24). The incidence of disability rises rapidly with advance in age, especially for the men.

Peptic ulcer is probably the most common of the digestive diseases. Numerous attempts have been made to relate diet to the incidence of this disease. However, there is insufficient evidence to incriminate any single food or particular nutritional pattern. Most of the research on diet has related to therapy after the ulcer has been diagnosed, rather than the potential of good nutrition in preventing the development of the condition.

The increase in morbidity and mortality from liver disease since 1960 is greater than that from any other disease. It is the fifth most common cause of death in American males over 40 years of age. The death rate from cirrhosis for white males between 45 and 64 rose from 39.9 per 100,000 in 1959 to 52.7 in 1967. Increased drug and alcohol use and addiction are implicated.

Proper functioning of the liver is closely related to diet. The diet functions in the intraconversion of carbohydrates, fats, and proteins; in storage for certain nutrients, particularly sugars and certain vitamins; and in production of blood proteins, antibodies, enzymes necessary for digestion. Excessive accumulation of fat cholesterol in the liver is considered an indication of an undesirable health state. The proportion and kinds of fats and carbohydrates in the diet are a major factor in controlling these simulations. When the level of fat is excessive, cirrhosis is result.

Single nutrient is identified as being more important than another the maintenance of a healthy digestive system. Most nutrients have shown to take an active part in the function of the cells of the intestinal tract. Most recently, vitamin A has been shown to a specific function.

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TABLE 24

Disability from diseases of the digestive system Average annual incidence per 1,000

Cause of disability	Males, at ages			
	17-64	17-24	25-44	45-64
All causes	104.3	86.4	71.7	158.5
All diseases of the digestive system	18.5	8.9	13.7	28.1
Ulcers and other diseases of the stomach and duodenum	5.3	2.1	4.4	7.3
Hernia of the abdominal cavity	4.6	1.1	2.4	8.6
Diseases of the gallbladder	1.9	--	1.1	3.4
Appendicitis	1.8	3.0	2.0	1.3
Diarrhea and enteritis	1.8	2.5	1.4	2.2
Malignant neoplasms	0.4	--	0.1	0.8
Other digestive diseases	2.9	0.2	2.1	4.6

Cause of disability	Females, at ages			
	17-64	17-24	25-44	45-64
All causes	196.0	147.1	192.4	277.0
All diseases of the digestive system	20.4	16.4	19.8	27.4
Ulcers and other diseases of the stomach and duodenum	3.5	2.2	3.1	5.8
Hernia of the abdominal cavity	0.9	0.2	0.6	2.2
Diseases of the gallbladder	2.7	1.0	3.5	4.6
Appendicitis	2.8	4.8	1.7	0.8
Diarrhea and enteritis	6.3	5.2	7.4	7.2
Malignant neoplasms	0.3	--	--	0.9
Other digestive diseases	4.0	3.1	3.4	6.0

Personnel of the Metropolitan Life Insurance Company, 1963-64, exclusive of the Pacific Coast states and Canada. Cases lasting eight days or more. Benign tumors of the digestive system are not included

Source: Metropolitan Life Insurance 1967 Disability for diseases of the digestive tract. Statistical Bull. 48: 10.

KIDNEY AND URINARY

In kidney and urinary disorders, as in chronic disease in general, emphasis has been placed on therapeutic rather than preventive measures. Statistical data on incidence are inadequate with more \approx of mortality than morbidity. Kidney disease is difficult to diagnose. In many cases, renal disfunction is associated with other health problems such as cardiovascular disease, and many deaths from the combination of the two conditions are classified under cardiovascular disease. Today in the U. S. an estimated 55,000 individuals die each year of irreversible kidney failure.

Very little is known concerning the mechanisms of prevention and control of kidney disorders. Very few major illnesses fail to involve the kidneys. By selective excretion of certain substances and reabsorption of others, the kidneys play an important role in regulating the composition of blood and other body fluids. They continually process blood to eliminate harmful waste products of metabolism. When kidney function is impaired, diet regulation is critical to maintain life. The alternative is kidney dialysis or transplantation. Because the kidney is so closely related to nutrient metabolism in its function in disposing of metabolic waste, it would be reasonable to consider the role of diet and nutrition in preventing the development or in modifying the severity of kidney disease. Almost no attention has been given to this aspect of kidney disease, although it would benefit many more people at much less expense and inconvenience than the more drastic methods of transplant and dialysis.

A disturbance in mineral metabolism, particularly calcium, is the first nutrition-related function to appear in chronic renal failure. One of the problems arising is the production of kidney stones. The incidence of kidney stones may be as high as 9.47 persons per 10,000 population. Vitamin D, excessive dietary alkali, excessive dietary calcium, and vitamin A deficiency have all been implicated. Diets high in carbohydrates also may be conducive to stone formation. The incidence of calculi is greater when sucrose is the source of carbohydrate than when starch or dextrose is eaten. Starch produces fewer calculi than dextrose or sucrose. This has great significance in U. S. diets where there is a trend towards a decreasing consumption of starchy foods and an increase in the proportion of carbohydrate calories from sugars. This shift in recent years in U.S. diets may be conducive to an increased incidence of kidney stones.

Many researchers consider that the occurrence of urinary calculi falls into the general class of deficiency disease. The relation of diet to urinary calculi formation is unknown. Many of the same dietary factors may be involved as in the formation of kidney stones. Vitamin A deficiency has been suggested as a cause in animal studies but has not been demonstrated in human patients. Animal studies also suggest that pyridoxine deficiency may be a factor, particularly in relation to the magnesium and calcium content of the diet.

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MUSCLE DISORDERS

Because most muscle disorders develop over a long period of time, and many are characterized by remissions and recurrences over a period of many years, data on the incidence of muscle disorders are inadequate. Nerve as well as muscle tissue is frequently involved. Many conditions are included in this category including muscle atrophy, muscle dystrophy, and multiple sclerosis. Very little is known about the underlying causes of the adverse muscle changes.

Many of the muscular dystrophies and atrophies are inherited traits. There are about 200,000 cases in the U.S. The conditions are characterized by a degeneration of muscle and connective tissue indicating the existence of a metabolic disorder. It is likely that diet therapy would assist in regulating the development and severity of the conditions. Limited preliminary data with chicks suggest that a biologically active material in some vegetable oils can cause regeneration of muscle in some cases.

Multiple sclerosis is primarily a disease of the nervous system involving the degeneration of the myelin sheath of nerves. Classic features include impairment of vision, loss of control of both voluntary and involuntary muscles, tremor, loss of balance and ataxia. There is wide variation in the incidence of multiple sclerosis among geographic areas. It is more common in the northern hemisphere except for Japan. Death rate from this cause in Montana, North Dakota, and in Nebraska was almost five times greater than in Georgia and Louisiana. Migrants from high risk to low risk zones carry with them a high risk of multiple sclerosis, even though the disease may not become apparent until 20 years after migration. Estimates of its incidence in the U.S. range from 70,000 to a quarter of a million persons. Numerous hypotheses, including dietary patterns, have been proposed to explain the geographic distribution. Although many patients have symptoms early in life, the diagnosis is rarely made before the age of twenty-one. Women have a higher prevalence of multiple sclerosis than do men. A low fat diet has been successful in controlling progress of the disease in some instances, especially if the diet is begun in the early stages of the disease.

Good nutrition is essential for good muscle development and maintenance. Undernutrition is associated with a reduced body muscle mass and a reduction in the ability of the existing muscle to do work. Muscle disorders caused by vitamin deficiencies, fortunately, are DOW rare. The weak muscles and relaxed ligaments associated with vitamin D deficiency, rickets, are often correctable if found early and a therapeutic regimen of vitamin D and calcium is established. Also rare are the neuromuscular conditions pellagra and beri-beri associated with deficiencies of niacin and thiamine respectively. Sufficient vitamin E, either alone or in combination with minute amounts of selenium, causes regression of some nutritional deficiencies.

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CANCER

Cancer is second only to diseases of the heart and blood vessels as a cause of death in the U.S. In 1968, approximately 600,000 people developed cancer and approximately 320,000 died of cancer during the year. The incidence of death from cancer of the stomach and uterus has been decreased since 1930 while deaths from lung cancer and leukemia have increased markedly (Fig. 28). The relationship between age and cancer is shown in Figure's 29 and 30.

There is no diet that prevents cancer in man. However, individuals in good nutritional state are less likely to develop cancer. Cancer cells require the same type of nutrients as do normal body cells. They compete favorably for nutrients, particularly calories and nitrogen, with the tumor growing at the expense of normal tissues. Some cancer cells have greater nutrient needs than normal cells. For instance, leukemia cells in children require both more folic acid and more asparagine.

The major known causes of cancer are felt to be viruses and cancer-producing chemicals in food and the environment. The food we eat may contain preservatives and other purposefully introduced additives; chemicals may be altered by heating and other processes; or contamination by bacteria, mold, fungi, and other organisms may produce cancer-producing metabolites. Some cancer-producing chemicals occur naturally in food. For example, the alkaloid of chili peppers led to the development of liver cancers in rats. These chemicals are normally detoxified by the liver and may produce a carcinogenic effect at very low levels of concentration. The B vitamins, particularly riboflavin, have been shown to be essential for some of the detoxification processes and their presence in the diet, in adequate amounts, has been shown to protect against the development of liver cancer in rats.

For several years, a higher occurrence of cancer was thought to occur among persons who were overweight. Further evaluation of the data has shown that overweight women with diabetes do develop somewhat more cancer of the uterus and pancreas, but there is no general increase in cancer related to excess weight in men.

There is a small but growing body of data suggesting that chronic low-level intake of some nutrients is a factor in the incidence of cancer in man. There is evidence that vitamin deficiency plays a role in the occurrence of cancer of the oral cavity in the esophagus.

Chronic vitamin B complex deficiency, due to inadequate supply of vegetables in the diet, appears to be incriminated. There is recent evidence, March 1970, that dietary iodine deficiency may contribute to breast cancer, at least in rats. Demographic studies reveal that human breast cancer incidence is high in iodine-deficient areas.

Epidemiologic data suggest the possibility of a relationship between fat in the diet and cancer. A strong positive relationship has been shown between dietary fat intake and the death rate from breast cancer in various countries of the world. Also, an increased incidence in cancer was seen in men who ate a diet high in polyunsaturated fat as a substitution for saturated fat to protect against fatal atherosclerotic events. Refined carbohydrates also have been linked to an increase in cancer of the colon.

Data relating nutrition to the incidence and control of cancer are still too fragmentary and hypothetical to provide a basis for estimating benefits from diet management. The results of ongoing research may justify appreciable benefit claims from regulation of diet in the avoidance and management of cancer.

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FIGURE 28

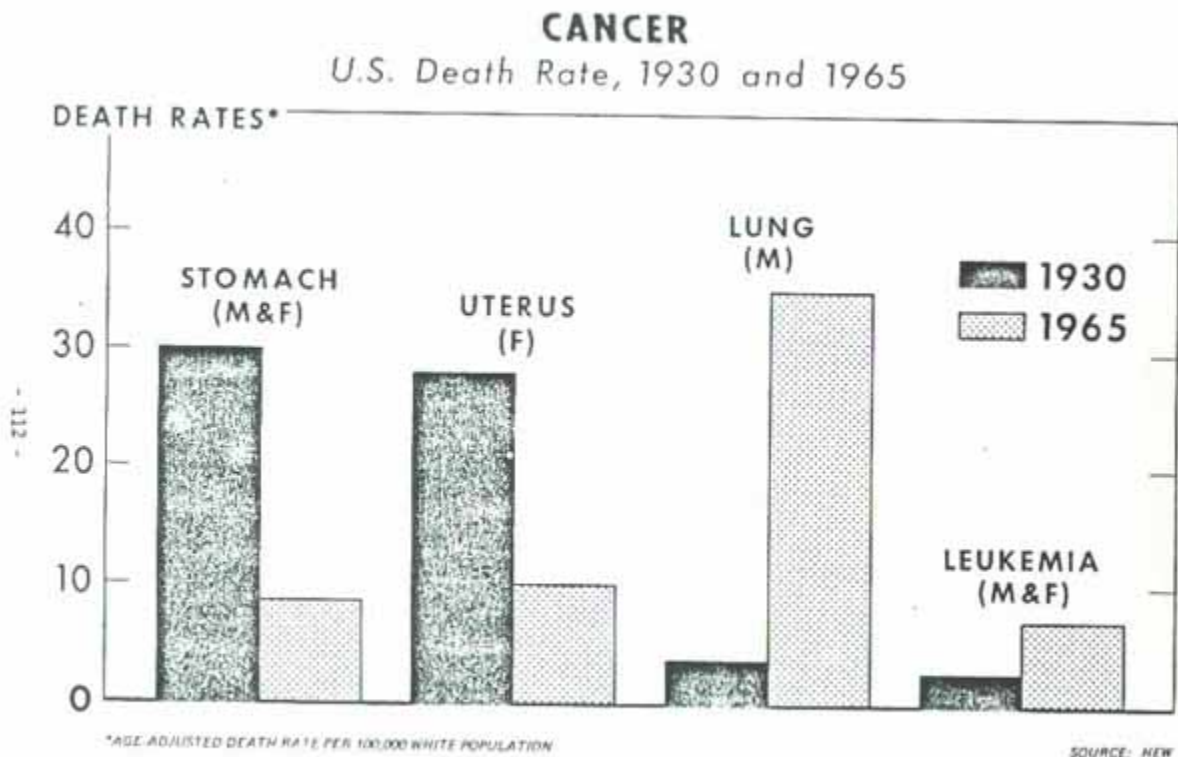


Figure 28

FIGURE 29

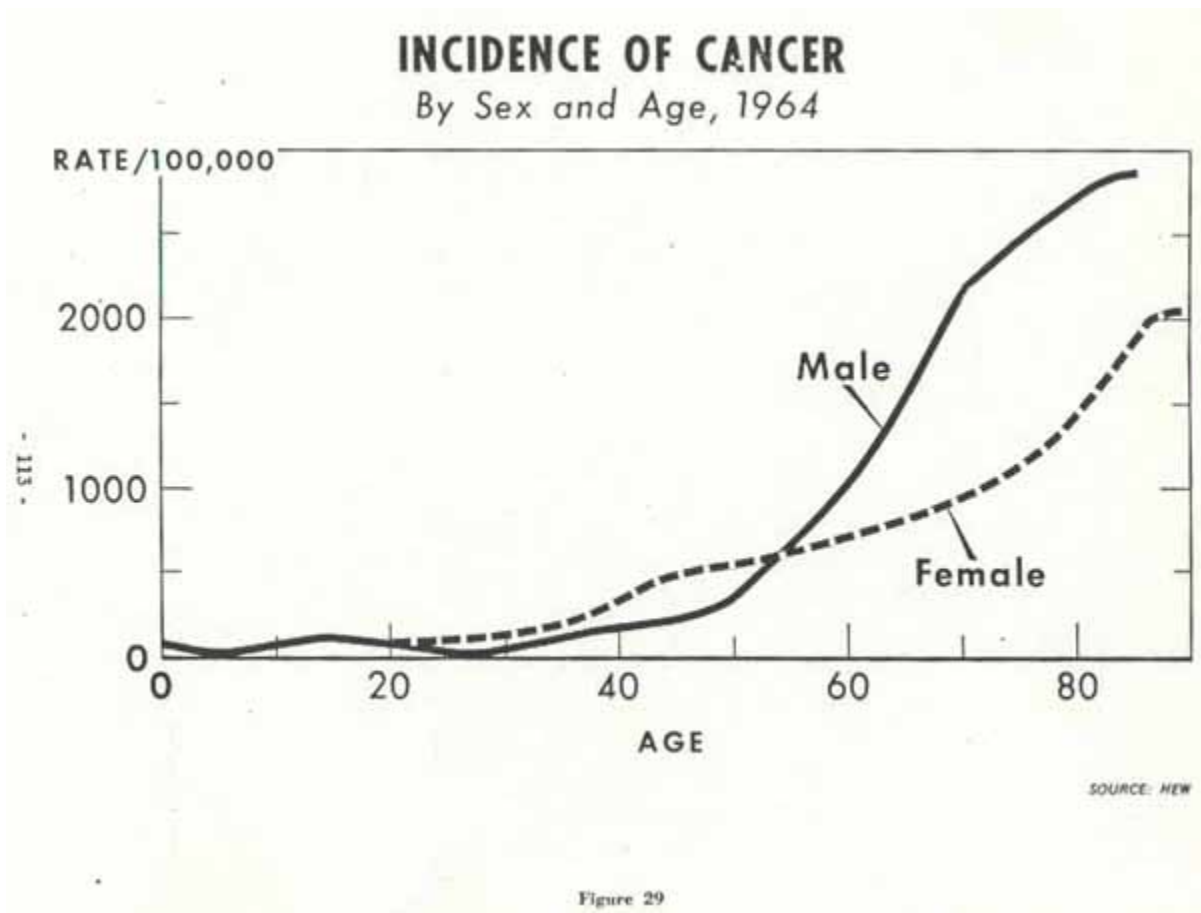
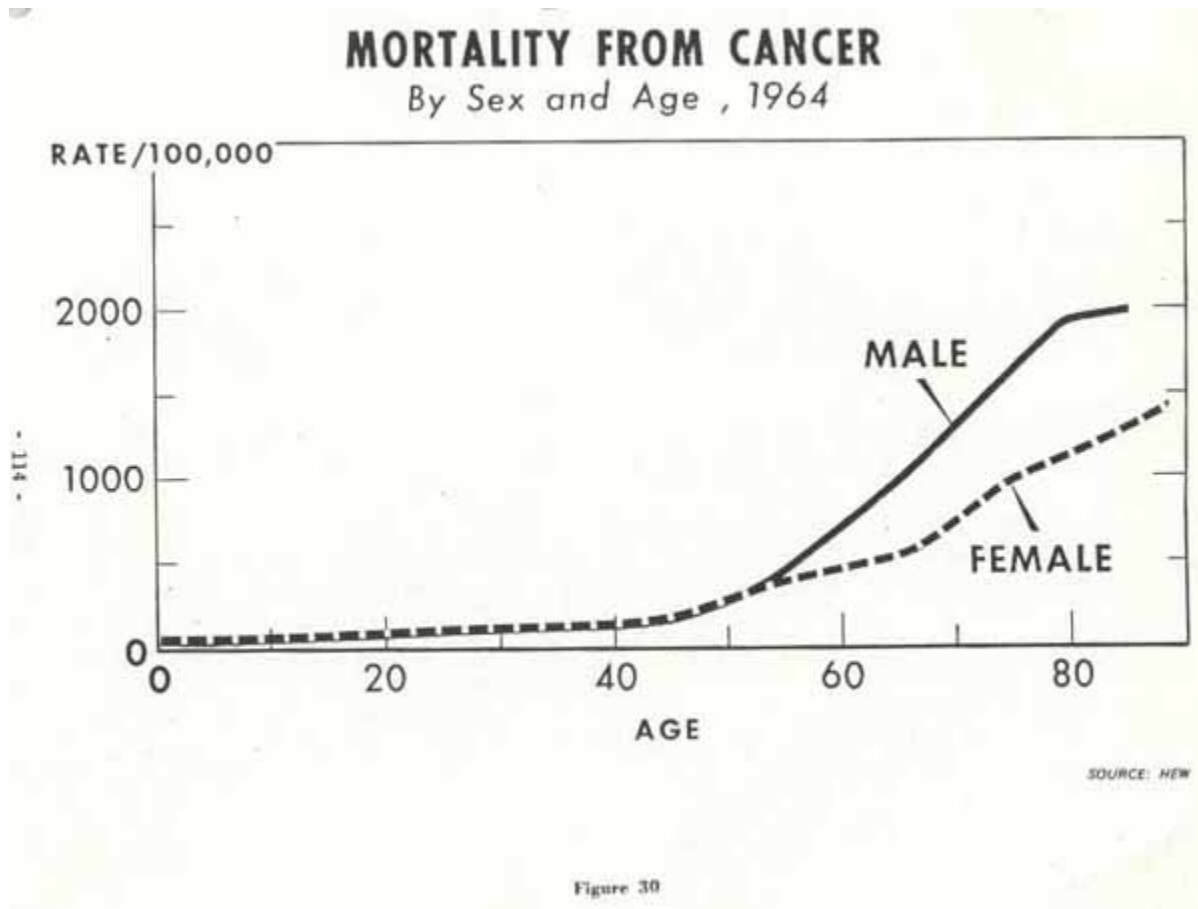


FIGURE 30



IMPROVED GROWTH AND DEVELOPMENT

The close relationship between nutrition, growth rate, and final height has been recognized for years. The potential for future improvement in the U. S. appears to be very small except for those population groups where nutritional stress is great. The National Nutrition Survey of 1968-1969 has shown that for low income families, there is a larger number of children below the average height than expected. Growth retardation was seen in about 3.5 percent of the preschool age children but not in those over five years of age. Early growth retardation, as in the preschool children, is not reversed by improved diet at a later age. Height rather than weight is affected. The cause of the retardation was more likely a nutrient deficiency other than calorie -protein undernutrition. Both vitamins A and C status were below acceptable levels.

The most recent change in population trends has been the earlier age at which physical maturation is reached. Very little is known of the long range implications for man of rapid growth during infancy and childhood. Long-term studies with rats have shown that those which reached their adult weight early had a markedly reduced total lifespan. The findings have not yet been demonstrated in man. The earlier maturation age of children also has raised a number of yet unresolved social and educational problems.

Proper diet is needed to maintain, as well as to develop, each individual's potential for muscular and skeletal growth. Malnutrition as well as undernutrition decreases a worker's productivity. Apathy,

lethargy, and lack of initiative results. Ability to learn new tasks may be reduced. Resistance to disease also is lowered, increasing the rate of absenteeism from the job. This aspect has been discussed in greater detail in RESPIRATORY AND INFECTIOUS DISEASES and DIGESTIVE DISEASES. Thus, in a number of ways, improved diet may increase working efficiency due to feeling better on the job and then lead to economic benefits. A 0.5 percent increase in on-the-job efficiency has been suggested as a possibility from improved nutrition. The benefit when expressed in terms of increased wage and salary disbursements over the 1968 total approximated 2.3 billion dollars. Research findings during the next ten years may permit 20 percent of the benefit to be realized.

Accident rates are high among those who tire quickly due to malnutrition. In the U.S., in 1967, accidents ranked fourth as a cause of death, accounting for over 113,000 deaths (Table 25). In addition, 51.8 million people were injured severely enough to restrict activity or require medical attention. These accounted for 324.5 million days of disability.

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TABLE 25

Incidence of and deaths from injuries and days lost from work and school:
July 1965 to June 1966

Incidence, in thousands	48,357
Deaths, total	113,169
Days lost from work per year in thousands	88,622
per 100 employed persons	121.2
Days lost from school per year in thousands	10,486
per 100 children	24.7

1 Data are based on household interviews of the civilian, noninstitutional populations.

Source: National Center for Health Statistics 1967 PHS publ. 1000, series 10, no. 37. U.S. Dept. of Health, Education, and Welfare.

IMPROVED LEARNING ABILITY

Improved diet may improve learning ability in a number of ways, some of which have already been discussed (MENTAL HEALTH). Some specific nutritional deficiencies limit ability to learn, for example, by causing blindness (EYESIGHT) and by causing apathy and tiredness (ANEMIA AND OTHER DEFICIENCY DISEASES). Improper diet may also affect learning directly through its effect on brain and central nervous system development during the fetal period, infancy, and early childhood. Malnutrition in school age children and adults may handicap learning ability by shortening attention-span and decreasing the ability to work at the same task for any sustained period.

The President's Committee on Mental Retardation is studying the relationship between mental retardation and nutrition and plans to submit a report by June 1, 1970. The Committee has not been

able to establish a causal relationship between nutrition and mental retardation because of the complexity of the problem and lack of basic data. They note, however, that among the poor, severe mental retardation is two or three times the average. They suggest that this greater incidence of mental retardation may be due to poor nutrition, prematurity, poor hygiene, or a combination of the three.

The incidence of mental retardation is high. Over a quarter of a million people were institutionalized in 1967 in the U.S. In addition, there are many thousands in jails and correctional institutions. About three to four percent of the total number of the persons classified as retarded are accounted for by the institutional figures. Over 6.5 million persons may be involved. Improved diet, based on research yet to be done, during the critical years of pregnancy, infancy, and childhood, has a good possibility of increasing the mental performance of about one-half the potential retarders. Benefits would be realized from the savings on institutional costs, improved possibilities for employment and reduced likelihood of civil offenses.

The consequences of malnutrition in terms of impairment of learning ability depends on the time in life when the deprivation occurs as well as its extent and duration. For the brain, the most critical period is the five months prior to birth and about ten months after birth. By the end of the second year, the brain has practically completed its growth. Studies on rats have shown that the brain grows both by increase in the number of cells and by increase in the size of each cell. Severe malnutrition during the period of cell multiplication permanently reduces the total number of cells and cannot be compensated by subsequent proper diet. Malnutrition during the cell phase is reparable by improved diet. Direct application to man is not possible, because similar studies are not possible with infants. However, the brains of infants who died of marasmus were found to have fewer brain cells than those of infants who died from accidents.

Interest in the role of nutrition in mental development and learning ability has been stimulated by problems in developing countries where lack of food and undernutrition have great economic significance. More implications for children from low income families in the U.S. are now being studied. The National Nutrition Survey found evidence that retarded physical growth in about 3.5 percent of children from low income families. It is possible that these children also may suffer lasting damage to mental capacity. Severe deficiency nutrients and undernutrition in general have been shown to reversely affect development of the brain and central nervous system in animals. Studies in developing countries have suggested that findings with animals may be extended to severely undernourished children. There is little or no information concerning the effects of chronic low level nutrient deficiencies found in the U.S. upon permanent mental damage.

A number of studies are in progress on the effects of feeding programs for preschool and school age children upon their mental ability as, implicated by I.Q. grades and learning ability. Preliminary results in New Orleans, Louisiana, study using nonverbal performance tests are shown no differences between normal and anemic children of a young age (4 years, 5 months to 4 years, 9 months). However, children about a year older had slightly lower I.Q.'s than comparable normal children. Follow-up after a year of kindergarten showed that the anemic children receiving a multiple mineral and vitamin supplement had gained as much as ten I.Q. points more than anemic children who didn't get the supplement. While there were differences between the normal and anemic children on short-term attention tests, the performance in the anemic children deteriorated rapidly when the reaction time was longer, and they made more errors on rapid tests. Similar results were found in Philadelphia, Pennsylvania, where the I.Q.'s of anemic children, 4 and 5 years of age, were similar to those of nonanemic children, but their attentiveness was significantly less. Because attentiveness is essential to learning, the potential for learning could be expected to increase when the diet was improved. This is an example of what might be accomplished for children by improving their diet. Conceivably, improved diets from prenatal to school age might increase the learning ability of 50 percent of children sufficiently to increase their I.Q. by ten points.

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IMPROVED EFFICIENCY IN FOOD SELECTION

Efficient food selection is essential to improved nutrition and better diets. It is possible for individuals to select nutritionally inadequate diets from available foods if the necessary information and motivation is provided. The 1965 Household Food Consumption Survey indicated that 22 percent of the diets were below the recommended allowances in 1 nutrient, 13 percent in 2 nutrients, and 15 percent in 3 or more nutrients. Because the majority of households regardless of income level had adequate diets, it is reasonable to conclude that efficient food selection could result in all households having adequate diets.

The effectiveness of food selection in diet improvement is contingent on the availability of nutritious foods which people like to eat, inadequate amounts and at a cost which they can afford.

Fundamental to diet improvement through food selection is the ability to change food habits and to develop new diet patterns. Proper eating habits need to be established early in life. Many food likes and dislikes are set by 3 years of age. Food provides a variety of satisfactions besides its nutritional value, thus changes in food habits are not easy to make or maintain. Very little is known of the role of physiological and emotional factors in developing food habits and how they may be utilized in making and maintaining recommended dietary changes. Better knowledge of these relationships would assist in designing food combinations, selecting and developing foods which would be readily acceptable and make desirable dietary changes possible and easy.

Benefits from improved food selection are reflected in better overall general health and well-being and share in the benefits from the avoidance and modification of health problems. There also are personal satisfactions from the freedom to choose foods that are liked and do not require divergence from established food habits and social customs.

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IMPROVED EFFICIENCY IN FOOD PREPARATION AND MENU PLANNING

Economic and social changes couple with advances in food technology have impelled changes in food preparation practices and menu planning. The result is less time and work spent in preparing food in homes and food service institutions and a wider variety of foods available for menu planning. Rising labor costs in food service institutions and employment of women outside the home have produced an increased demand for partially prepared and ready-to-eat foods.

Changes in the life style of families have affected both food preparation and menu planning. Fewer meals are eaten as a family group, snacks may provide as much as 20 percent of the day's caloric needs, and over one-third of all meals are eaten away from home. Mothers and homemakers are less likely to know what foods have been eaten by individual family members.

Traditionally, knowledge of food preparation and meal planning was handed down from mother to daughter in the home. This means of education is no longer satisfactory. Mothers employed outside the home do not have time for training their daughters, and the information available to them is inadequate. The foods available are increasing in variety and changing in type, so there is constant need to adapt preparation procedures. Processed and fabricated foods are often not comparable nutritionally to the foods they replace. Planning of adequate diets is becoming more complex as nutrition knowledge increases and foods become more refined. The responsibility for good diets now must be shared by all members of the family who eat meals away from home, by food service institutions which provide the meals, and by food processors. Ensuring adequate intakes of essential nutrients is not enough to assure good nutrition. Nutritional problems may also arise from improper selection of dietary fats and carbohydrates.

Better as well as more efficient methods of food preparation are needed if the nutritional value of diets is to be improved. Improved diets can be effective only if the foods recommended or served are eaten. Poorly prepared foods are unappetizing. The desirable eating qualities of some nutritionally important foods such as vegetables are easily lost by improper preparation and handling procedures. Consumption of vegetables, particularly green vegetables, has declined since 1955. The lack of satisfactory ways of ensuring retention of their color, flavor, and texture during preparation and serving may explain why vegetables are among the foods least liked by teenagers and young adults.

Besides improved health, benefits from improved efficiency in food preparation may be expressed in terms of time, labor and cost savings in preparing food in the home and in food service institutions. Mechanization and automation of some aspects of food preparation may be more economically carried out for a large quantity of food. By-products of food preparation which would be considered waste in the home or institution may be transformed to useful products when available in larger quantities in a commercial situation. For example, fat trimmed from meats, bones, outer leaves and peelings from vegetables may be converted to animal feeds or disposed of in a manner which would not add to the pollution, sewage, and garbage disposal systems of communities.

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REDUCED LOSSES OF NUTRIENTS IN FOOD STORAGE, HANDLING AND PREPARATION

Improved food preparation techniques would reduce the loss of some nutrients and increase the availability of others. As a result, the nutritional value of diets could be improved without modification of feeding patterns. The nutrients most likely to benefit are the water soluble vitamins, minerals, and amino acids. Water soluble vitamins and minerals leached into cooking water may be reclaimed. Up to 50 percent of the water soluble vitamins, thiamine, and ascorbic acid may be lost if the cooking water is not used. Even greater losses, up to 90 percent, occur when cooked foods are held for long periods of time or are reheated. One of these procedures and sometimes both are necessary in food service operations and at home when prepared foods are used.

Processors' attention is centered on palatability, not nutritive value, when prepared food products are designed and methods for reheating are recommended. New processing techniques coupled with improved methods of handling and preparing processed foods could ensure vitamin losses no greater than 25 percent. This would mean fewer persons with diets inadequate in vitamin C. Based on findings of the National Nutrition Survey 1968-69, 27 to 41 percent of households now on the poverty level and 20 to 40 percent of those above the poverty level have diets less than adequate in vitamin C. The number of households with inadequate diets may be reduced by one-fourth through use of improved food preparation and handling procedures.

Cooking food has been shown to reduce the availability of amino acids. In meats, as much as 60 percent of methionine and lysine may be made unavailable; in some cereal products, the amount may be higher. The decreased availability of amino acids is often associated with development of desirable flavor. The reduction in available amino acid content of food as a result of cooking is probably insignificant nutritionally in U.S. diets which are generally high in protein. Methionine and lysine are the amino acids likely to be affected and are also those most likely to be deficient in cereal based diets. Preparation procedures designed to minimize the binding of these amino acids would benefit population groups whose protein intake may be marginal for economic or ethical reasons, or individual preferences.

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TABLE 26

Relation of income to dietary adequacy

Income level	Percent of diets below allowances for 1 or more nutrients	Average number of nutrients below allowances
Under \$3,000	63	2.5
\$3,000-\$4,999	57	2.2
\$5,000-\$6,999	47	2.2
\$7,000-\$9,999	44	2.0
\$10,000 and over	37	1.9

Source: Consumer and Food Economics Research Division 1968 Dietary levels of households in the United States, spring 1965. A preliminary report. ARS 62-17, USDA, Washington, D.C.

IMPROVED EFFICIENCY IN FOOD PROGRAMS

Maximum improvement in diets and nutrition through food programs can be achieved only through coordinated Planning by nutritionists, food technologists, economists, and educators. Coordinated subject planning by all of these disciplines is needed to ensure that food programs accomplish the goal of wiping out malnutrition in the shortest possible time and at a minimum cost.

Recent attention to malnutrition in the U.S. is focused on a number of vulnerable population groups. The nutrition of these individuals may be improved through education, economic assistance, or improving the nutritional value of available foods. Most existing Federal food programs are directed to families with low incomes, school age children, infants, and pregnant women. In 1970, approximately 1.6 billion dollars was spent for these programs; about 3.5 billion free and reduced price school lunches and 72 million free school breakfasts were served. Slightly more than 23 million children participated in school lunch programs, and over one-half million in the breakfast program. It was estimated that about 5million of the 7.8 million needy children were reached.

Food consumption surveys show a direct relationship between income and dietary adequacy ([Table 26](#)). In a nationwide survey of household Food Consumption in 1965, 63 percent of households with incomes less than \$3,000 had diets below recommended daily allowances for one or more nutrients. This percentage can be compared with 37 percent of households with incomes over \$10,000. Further, more nutrients were likely to be lacking in the diets of low income groups. Providing nutritionally adequate diets to all persons eligible for food programs would substantially reduce the size of the malnutrition problem. It is estimated that one-fifth of the U.S. diets, or 40,000,000 provide inadequate nutrients. Also, one- fifth to one-fourth of persons have low incomes. These are not always the same but at least half the poor diets occurred among low income persons. Thus, providing better food assistance programs might be expected to improve the health of 20 million people.

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