Hypertension: A Controllable Problem?

An Honors Thesis (ID 499)

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P.A.F.
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CHAPTER I
INTRODUCTION

In the United States more than 24 million people have hypertension, or high blood pressure—and, what makes it worse, fewer than half of them know it (Galton, 1973: p. 1). Hypertension is considered to be one of the most common chronic diseases in persons over 40 years of age, and if untreated, decreases life expectancy by increasing the incidence of heart attack, stroke, and kidney failure.

A person's blood pressure is measured by use of a stethoscope and sphygmomanometer. The sphygmomanometer consists of a cuff, mercury column, and bulb. The cuff is applied to the person's arm and filled with air until pressure is applied to the underlying artery. As air is released from the cuff, pressure is lessened on the arm allowing blood to flow more freely through the artery. The stethoscope is used to listen for the sounds caused by the flow of blood. The sounds, recorded in units of "mm Hg" (millimeters of mercury), are calibrated on the mercury column. The first sound heard represents the greatest pressure of "systolic pressure" while the second sound is the lowest pressure or "diastolic pressure". In an examination, a reading such as 120/80 indicates the systolic pressure is 120 mm Hg and the diastolic pressure is 80 mm Hg. The systolic pressure is caused by the tension in the arteries when the heart contracts to send blood through the blood.
vessels. The diastolic pressure heard indicates the period when the heart is momentarily at rest while filling with blood for the next beat.

The blood pressure reading of 120/80 mm Hg is generally accepted as the baseline pressure from which deviations are determined. The World Health Organization accepts the following definition for hypertension, or an elevation in blood pressure as:

a persistent elevation of the systolic blood pressure above 140 mm Hg and of the diastolic pressure above 90 mm Hg (Luckmann and Sorensen, 1974: p. 677).

The systolic pressure is more variable than the diastolic reading in that it is easily affected by rapid and frequent changes in activity, emotions, and the time of day. Everyone experiences increased alertness and heart rate when jogging, swimming, or experiencing anger. The blood pressure naturally rises to meet the body’s needs and at different times of the day. The blood pressure is generally lower in early morning, rising to peak in the late afternoon, and then declining towards evening. It is when the blood pressure remains elevated even at periods of rest that hypertension may be present.

Dr. J. Stamler, professor and chairman of Northwestern University Medical School’s Department of Community Health and Preventative Medicine, stresses the harsh realities of hypertension in the United States by use of the formula:
of all hypertensives are undetected, 
\( \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \)
of those who are detected go untreated, and only about 
\( \frac{1}{2} \)
of those receiving treatment are getting adequate care
(Merck, Sharp, and Dohme, 1974: p. 21).

Therefore, \( \frac{1}{2} \) of people with hypertension are detected and
adequately controlled showing that out of 2½ million people
with elevated blood pressure, only 2 million are adequately
treated. Frequently, by the time a patient is detected and
under treatment, high blood pressure has been at work ten
years or more, destructively attacking the heart and blood
vessels, paving the way for heart attacks, stroke, and other
consequences. The results of these statistics leads us to
ask why hypertension is not detected more frequently espe-
cially since it is controllable.

The fact that hypertension is not frequently detected
makes it a major health challenge in America today. Total
involvement of society is mandatory to overcome the obstacles
which make detection and control difficult. A few of the
obstacles encountered are:

1) Discovering the millions of unknown persons with
high blood pressure because they feel fine.

2) Persons with elevated blood pressure ignore
referrals from a detection center or clinic to a
doctor because: a) the importance of elevated
blood pressure was not communicated or understood
b) lack of time in the day to spend at the doctor's
office, and/or c) lack of transportation.
This paper is written for the purpose of presenting information about hypertension by answering the following questions: What happens to the body? What increases the risks of it? How can it be prevented and/or managed?
CHAPTER II
WHAT IS HYPERTENSION?

Hypertension is a major disease in the United States which can be controlled. High blood pressure is generally classified as either primary or secondary. Secondary hypertension develops as a complication of diseases affecting the cardiovascular, renal, or neurological systems, and is predominant in childhood or adolescence. Primary or essential hypertension which has no known cause constitutes 90% of all known cases of high blood pressure and thus will be the focus of this paper. The body continuously functions to maintain a state of homeostasis by all organs and tissues in the body working to maintain a constant condition. While the functions of the body necessary to maintain blood pressure occur automatically, an increase in pressure results in an assault on various organs and vessels in the body.

An understanding of the cardiovascular system, i.e. the heart and blood vessels, is essential in order to comprehend the functions of blood pressure. The heart is a muscle about the size of a fist and consists of four chambers. See the following illustration of the heart.
The Heart

Aorta

Pulmonary Arteries

Right Atrium

Right Ventricle

Left Atrium

Left Ventricle

Pulmonary Veins

(Sweetwood, 1976: p. 11)
The right half of the heart receives blood from all parts of the body which appears more blue than red because as the blood passes through the body, oxygen is exchanged for carbon dioxide. The right atrium, or holding chamber, sends blood to the right ventricle, or pumping chamber, which in turn pumps the blood via the pulmonary arteries to the lungs for oxygenation and removal of carbon dioxide. Bright red, oxygenated blood returns from the lungs to the left side of the heart by way of the pulmonary veins. The left atrium receives the blood and sends it to the "power-house" of the body, or left ventricle. The left ventricle has a thicker wall because it must be able to eject blood into the aorta. From the aorta, blood is distributed to all parts of the body. The largest artery in the body, the aorta, has a diameter approximate to that of a garden hose.

Each day the heart goes through 100,000 of these cycles or beats, receiving and promptly pumping out again a total of 1,400 gallons of blood. As a result of this daily function, during an average lifetime of 75 years the heart has to pump well over 35 million gallons of blood in no less than 2.5 billion beats (Friedman, 1974: p. 20). Although the heart is constantly receiving and pumping out this quantity of blood, the heart draws no nourishment from the blood that passes through its chambers. Yet, being a very hardworking muscle, it requires nourishment which is supplied by two coronary arteries that branch off
the aorta. The coronary arteries lie on the surface of the heart which puts them through a great deal of movement as the heart muscle contracts and relaxes. They are twisted and jolted with every beat of the heart, not just occasionally but over 100,000 times a day (Friedman: p. 20).

Another aspect of heart anatomy that deserves attention is the conduction system. The conduction system is half muscle and half nerve and is responsible for the heart's orderly contraction. The conduction mechanism begins with the pacemaker which is located in the right atrium. The mechanism involves sending electrical impulses over the entire heart along a pathway which ensures that every muscle fiber contracts in unison. If the electrical activity should be hindered or blocked, the heart muscle receives no stimulation and cardiac failure ensues. On the other hand, with an effective electrical mechanism, blood is pumped from the heart to the arteries throughout the body.

Five factors involved in the blood flow which play a large part in determining the pressure are:

1. **Pumping action of the heart.** When the heart contracts, blood is pushed into the arteries. If the heart would stop pumping, as in a heart attack, blood would not be sent to the arteries. Blood pressure would be absent, and the cells would starve from lack of oxygen which blood normally delivers to them.
2. **Volume of blood in the arteries.** If a decreased volume of blood is forced through the arteries, the blood pressure decreases because resistance against the vessel walls is decreased and consequently shock may ensue. A volume of blood to reach all tissues is necessary to prevent shock.

3. **Blood viscosity.** Blood is said to be very viscous if it is thick, sticky, gummy, and flows slowly. Viscous blood has an increased resistance to flow requiring the heart to work twice as hard to pump the blood for circulation. This extra expenditure of energy causes the heart to enlarge in order to compensate for the increased workload. The compensation works fine for awhile, but eventually as the heart muscle size increases, so does its demand for blood and oxygen. Untreated, this compensatory state may continue until heart failure occurs. Often doctors will prescribe anticoagulants or blood thinner medication to decrease the blood viscosity before the heart fails.

4. **Elasticity of arteries.** Arteries normally expand when the heart pumps and contract between heart beats. The expansion allows the arteries to accept the blood pumped to them from the heart and the contraction of the arteries smoothes out the blood flow. The loss of elasticity of the arteries may occur prematurely by fat deposits (plagues) and result in a condition known as arteriosclerosis or "hardening of the arteries". Atherosclerosis is the term used to refer to the formation of plaques in the arterial walls.
The effects of atherosclerosis can be compared with a person drinking water through a straw. The drinker corresponds with the heart, straw with blood vessels, and the water with blood. As long as the drinker has water and a normal straw, he has no problems as the heart also has no problems with elastic blood vessels and thin blood. However, if several peas were introduced into the drinker's straw at varying intervals, he would have to suck harder and harder to get water until eventually no water would pass through the straw. The fat deposits of atherosclerosis have the same effect upon the heart and blood vessels. Although fat deposits begin to be laid at an early age, they do not cause total occlusion and blood is able to flow through the vessels. As time passes, fat deposition increases and total occlusion occurs. As a result of the damage to vessels from atherosclerosis and arteriosclerosis, hypertension develops.

3. Resistance to blood flow. The lumens or passage-ways of the smaller arteries, arterioles, and capillaries have a greater resistance than that found in arteries; thus, it takes more pressure to get blood through them. In comparing straws to this, a person drinking out of a very thin straw has to suck harder to get his thirst quenched than the person who has a straw with a large lumen. Consequently the resistance is greater in the smaller straw.

All five factors discussed involve the basic effector organs that determine blood pressure: heart, blood vessels,
and blood. Any one of the five factors may be altered causing a change in the function of the cardiovascular system which affects blood pressure. Whether it be due to the force of the working heart, condition of the arteries, viscosity of the blood, or blood volume, alterations have to be made by the body for compensation in order to maintain homeostasis.

The nervous and hormonal systems also play a semi-independent role in the determination of blood pressure. The nervous system is divided into two networks, the central and autonomic systems. The central nervous system includes the brain and spinal cord and is used for voluntary control of activities. The autonomic system is automatic and controls the heart, blood vessels, gastrointestinal and urinary tracts. The autonomic system is composed of two opposing systems: parasympathetic and sympathetic. The parasympathetic acts to slow the heart rate or dilate the blood vessels, while the sympathetic increases the heart rate or constricts the blood vessels under stressful or demanding situations such as strenuous exercise, laborious work, or excessive emotional states.

Special pressure-sensitive nerve cells, called baroreceptors, located within the walls of arteries detect rises and falls in blood pressure and act to stabilize the pressure. Baroreceptors function similarly to a thermostat in that both are preset to maintain a comfortable environment. The thermostat functions according to alterations in
temperature in the environment. Baroreceptors, on the other hand, are preset to maintain a narrow blood pressure range, and when the pressure rises or falls below appropriate levels, the baroreceptors work to bring it back within the preset range. If baroreceptors are continuously exposed to high blood pressure levels, they become less sensitive and tolerate pressure levels that formerly would have triggered reflexes to reduce arterial pressure. Consequently, the blood pressure remains elevated. When a thermostat does not function, it is fixed or replaced. When baroreceptors lose control, external control of blood pressure is required. Unfortunately dysfunction of a thermostat is more obvious than dysfunction of the body's baroreceptors.

Blood pressure may also be profoundly affected by certain hormones. The first to be considered are the adrenal hormones: adrenalin (epinephrine) and noradrenalin (norepinephrine). Adrenalin (epinephrine) is said to be flowing during emergency situations or when a person accomplishes a feat which under ordinary circumstances he would be unable to achieve. The body's response to these situations by increased adrenalin is referred to as the "fight or flight" reaction. The secretion of adrenalin constricts superficial blood vessels and dilates vessels supplying the brain, heart, and muscles so the individual is more alert and prepared to react. An excess of adrenalin or noradrenalin over an extended period of time
Damages blood vessels by increasing the deposition of clots, or plaques, on the internal surface of arteries. Plaques provide no nourishment to blood vessels, but damage the walls and can accumulate to the point of obstructing the vessel. Consequently symptoms of hypertension arise.

Another important hormone that affects blood pressure is an enzyme or catalyst called renin which is secreted by the kidney. If the blood volume to the adrenal gland decreases, the kidney secretes renin which increases the reabsorption of sodium and water to expand the blood volume. If the blood pressure or blood volume increases, the arterioles of the adrenal gland dilate to accommodate the increase in blood flow which stops the secretion of renin. Consequently the blood pressure will drop. The hormones function independently and interdependently maintaining homeostasis, and therefore may act as a control of hypertension.

Early in the course of essential hypertension, there may be no obvious pathological changes in the blood vessels and organs. Few or no significant symptoms appear aside from an intermittent elevation of blood pressure. Fortunately, the heart, brain, and kidney are able to withstand increased pressure for long periods of time. The constant, insidious impact of hypertension, even when the condition is mild, takes its toll in several ways. A vicious cycle of pathologic changes occur and each new
manifestation complicates other alterations of hypertension. The pathological changes which have been found to occur are:

1) The heart meets increased peripheral resistance because of constricted arterioles, but must continue to work normally so symptoms will not develop.

2) The heart increases its expenditure of energy by stretching muscle fibers to accomplish this work.

3) Stretching of the muscle fibers causes hypertrophy, or enlargement of the heart.

4) Hypertrophy of the heart leads to an insufficient blood supply which results in myocardial infarction, or heart attack, since the heart muscle has outgrown its blood supply.

5) If the hypertrophied heart can maintain sufficient output, a state of compensation exists and left-sided heart failure ensues.

6) As the diastolic pressure rises in the failing left ventricle and atrium, the congestion extends back to the pulmonary system, which in turn affects the vessels of the kidney.

7) The increased pressure in the arteries coupled with arteriosclerosis which weakens the blood vessels causes them to rupture and hemorrhage which is commonly referred to as a stroke.
8) When blood vessels to the kidneys rupture, the area of the kidney supplied by those vessels dies and kidney failure ensues.

The heart is the organ most commonly damaged by high blood pressure. Hypertension makes the heart work harder and faster than normal until it weakens and enlarges. The heart stops pumping effectively and this alone 'kills about 5,000 Americans each year (U.S. Department of Health, Education, and Welfare; Irwin, 1976: p. 3). The narrowing of the blood vessels as a result of loss of elasticity and/or fat deposition results in the death of approximately 600,000 people in the United States each year (U.S. Department of Health, Education, and Welfare, Irwin: p. 3). When a cerebral artery becomes critically narrowed due to atherosclerosis or if increased pressure weakens the blood vessel wall, a blood clot occurs or the artery ruptures producing a brain hemorrhage or stroke. Some 200,000 persons die of stroke each year in this country (U.S. Department of Health, Education, and Welfare, Irwin: p. 3). Hypertension reduces renal function by damaging the arterioles that supply the kidneys with blood. They are eventually unable to rid the body of waste products which result in kidney failure. Eyes are also affected in that changes in blood vessels affect their blood supply. The changes in the vessels to the eyes are one of the first signs of hypertension, and if acted upon, prevent illness.
Regardless of organ involvement, once failure begins, the average survival of the untreated patient is about six years (U.S. Department of Health, Education, and Welfare, Irwin: p. 3). Thus, it is evident that the problem of high blood pressure cannot be avoided and must be detected and controlled through treatment. As mentioned earlier, prevention is preferable to allowing the illness to progress and require treatment. Knowledge of predisposing factors of hypertension may induce individuals to be more involved in seeking routine physical exams, informing physicians of family history, and actively participating in control of elevated blood pressure by altering living habits. Early prevention and control have a strong influence in determining what the future will be for individuals in our society.
CHAPTER III
WHO DEVELOPS HYPERTENSION AND WHY

Identification of potential candidates who will join the 26 million Americans with hypertension requires knowledge of hereditary and environmental factors. There is not only one predisposing factor given for hypertension; instead, a combination of intrinsic and extrinsic factors result in the development of high blood pressure. Intrinsic and extrinsic factors include race, sex, age, diet, excessive stress, and lack of activity.

Family History

The role heredity plays in the development of hypertension was identified by Dr. D. Ayman in 1956. Dr. Ayman, considered to be one of many authorities on hypertension, found that 3 out of every 100 Americans developed hypertension if both parents had normal blood pressure, 28 out of 100 had hypertension if one parent had it, and the rate increased to 45 out of 100 if both parents were hypertensive (Erams, 1956: p. 92). His work shows that the probability of hypertension increases as the number of relatives with hypertension increases. Since individuals receive a genetic predisposition, the risk of hypertension is increased or decreased according to genetic make-up or inherited characteristics.
Sex

The difference in hormonal make-up between males and females contributes to the difference in frequency of occurrence of high blood pressure. Three events which only women experience in relationship to changing estrogen levels have a correlation with an increase in blood pressure: use of oral contraceptives, pregnancy, and menopause.

A positive correlation exists between high blood pressure levels resulting in the development of hypertension and the use of oral contraceptives. Four doctors of the family clinic at the Howard University Medical School, Washington D.C. (Aliuwalla, 1977, p. 627) investigated the difference in blood levels of estrogen in women who developed hypertensive (normal blood pressure) users. The study involved 27 black females between the ages of 20 and 25. No significant difference existed between them in weight, diet, family history, or socioeconomic status. All of the women were oral contraceptive users whose initial blood pressure levels were normal, but then seven developed hypertension. The average blood pressure in the hypertensive group was 157/107 compared with 126/81 in the normotensive group. The hypertensive group had significantly higher blood levels of estrogen as compared to the normotensive group. In this family clinic at Howard University, four percent
of the oral contraceptive users developed hypertension after two years of continuous use. Although the estrogenic content of the oral contraceptives varied among different brands, the results of the study showed that there was a significant decrease in the metabolism of estrogens in the hypertensive group. Therefore, the major adverse effects of oral contraceptives, including hypertension, may be due to the estrogen component. More information on estrogen and the amounts present in different brands of oral contraceptives can be obtained from nurses, physicians, pharmacists, and inserts accompanying the pills.

Pregnant women sometimes have an elevated blood pressure during pregnancy even when normotensive before conception. However, chronic hypertensives are two times more susceptible to elevations during pregnancy than normotensive women ("Pregnancy Under Pressure", 1977: p. 24). Preeclampsia, referred to as "pregnancy under pressure", occurs during the sixth to ninth month of pregnancy with a rise in blood pressure, increased retention of fluids, increased weight gain, and increased excretion of protein in the urine. The higher the blood pressure, the greater the risk of the baby being born prematurely, small, or even dead. Therefore, preeclamptic women are examined carefully through their pregnancy, labor, and delivery. Following childbirth, the mother's hypertension usually disappears within a few days. Unfortunately, as a result
of the pre eclamptic pregnancy, the woman is more prone to have hypertension reappear in later years.

During menopause, the female's hormonal levels undergo changes which account for the physical symptoms such as hot flashes, headaches, and high blood pressure that some women experience. This period may also be emotionally taxing which elevates the blood pressure. During the middle years, ages 40 to 45, women may experience physical changes which have the same effect on the body as seen with the use of oral contraceptives and during pregnancy. These changes often result in hypertension. Although post-menopausal females develop hypertension twice as frequently as males, they are less dramatically affected by a substantial elevation.

Race

Hypertension is the major disease suffered by this country's black population. Before age 50, it is 6 times more frequent in blacks than whites, and after age 65, it is 2 times more prevalent in blacks than whites (Batterson, 1976: p. 56). Therefore, as age increases, the gap between the whites and blacks decreases. In this country, black females are more prone to developing hypertension than any Caucasian person or Negro male. The higher blood pressure of the black population differs from that of the white population in that it develops earlier in their lives, is frequently more severe, and results in a greater number
of deaths especially at an earlier age. Factors which contribute to their higher susceptibility are their lifestyle and kidney system.

A University of Michigan study found evidence that black men and women in relatively "good" Detroit neighborhoods had an eight to nine percentage point advantage over blacks in "high stress" areas where crime rates were high and family incomes low (U.S. Department of Health, Education, and Welfare, Irwin: p. 10).

The investigators suggest that living under constant tension in the inner-city may affect the blood pressure of black residents. In regard to the blacks' kidney system, the blacks with African ancestry have inherited a retention of sodium necessary for the arid climate in Africa and thus a decreased ability to excrete sodium in their urine and perspiration (Schrader, May 1973: p. 1146). Due to this sodium retention, blood pressure is increased. The Negroes susceptibility to hypertension is greatly increased by the addition of the high sodium, or salt, diet of the American lifestyle they acquire.

Age

The best predictor of adult hypertension is the blood pressure level at some earlier date, such as in childhood. Frequently hypertension is mistaken as an "adult only" affliction. It has been found that one half to one percent preadolescent children and three to four percent adolescents are affected by high blood pressure.
Eighty percent of persons with hypertension under age 20 have secondary hypertension or that with a known cause (i.e., congenital heart disease or renal failure). Detection of secondary hypertension is essential as it usually can be controlled with surgery or medication. If untreated, secondary hypertension damages target organs (i.e., kidney and heart) and interferes with normal growth and development. Since an identifiable link exists between high blood pressure readings in infancy and in later years, blood pressure is checked as part of regular pediatric care. A family history is desired to verify the presence of stroke, heart attack, kidney failure, or hypertension because preadolescents and adolescents with borderline high blood pressure have an increased risk of developing pronounced hypertension. According to Ms. Longie (Longie, 1975: p. 36), one third of childhood borderline hypertensive cases return to normal without treatment, and the other two-thirds do not return to normal without treatment. These facts show that control is necessary for the majority of children with borderline hypertension to obtain near normal blood pressure levels. Positive family history of hypertension and obesity in the child are two factors used to distinguish whose blood pressure remains elevated. Early weight control and obtainment of family history helps the child and physician toward prevention of hypertension, and these are only possible with the cooperation and assistance of the child's parents.
An old saying about age and normal blood pressure, "100 plus your age", is no longer accepted as a measurement of normal blood pressure. A 60-year-old man with a blood pressure of 160/90 is no longer considered normoten-
sive. A blood pressure of 140/90 mm Hg or higher is considered to be hypertension regardless if the adult is 25 or 60 years of age. It is a hypertensive state for the individual which requires control.

Diet

The dietary habits of Western man, such as consumption of cholesterol, sugar, and sodium, play a large role in the predisposition to hypertension. Cardiovascular disease in the United States has increased at least five-
fold in the past 50 years (Friedman: p. 123). During these 50 years, emphasis on dietary habits changed from fresh, home-grown food to quick foods from a quick-stop restaurant or the grocery. This change increased the population's intake of cholesterol, sugar, and sodium.

Cholesterol, a fatty substance, is elevated in half of all persons who display symptoms of coronary heart disease (Friedman, p. 131). The incidence of coronary heart disease is high in almost every nation whose average intake of cholesterol is high, and low in nations whose intake of cholesterol is low. The Japanese, for example, ingest far less animal fat, or cholesterol, than inhabitants
of Western countries, and consequently they have a lower incidence of coronary heart disease. On the other hand, the current American diet is high in cholesterol.

The advent of quick food restaurants changed the American lifestyle in more than one way. Not only has quick foods made it possible to eat on the run, but convenience has pushed aside concern for good nutrition. Frequently it is more convenient to drive up and grab a bag of doughnuts for breakfast and a hamburger plus French fries for lunch rather than plan to eat more balanced meals. Quick foods such as hamburger, fish, French fries, and doughnuts are fried and thus extremely high in cholesterol. Increased blood levels of cholesterol lead to increased deposition in the arterial walls which gradually occludes the lumen. As the lumen, or space within the artery, gets smaller, the resistance to blood flow is increased, thus the heart must pump harder to maintain blood flow. These series of events, if not controlled by decreased cholesterol intake, result in the development of hypertension.

In addition to cholesterol, sugar has become a more frequent component of the American diet. Cokes, candy bars, cakes, and canned fruit are loaded with sugar. Sugar not only raises the blood cholesterol level but is responsible for weight gain and dental caries.

Foods that are high in sodium content contribute to hypertension by accelerating the development of arteriosclerosis. To demonstrate the amount of sodium found in
the average American diet, a recent survey of common 
products such as canned goods, dairy products, and frozen 
foods was made in a local grocery. The purpose of the 
survey was to identify the sodium, including salt 
(sodium chloride), content of each food product. Out of 
97 food items checked, only 23 did not contain sodium 
(See Appendix).

According to Dr. Lewis W. Dahl of the Brookhaven National Laboratory's medical research center,

too much salt at a very early age--specifically in 
certain baby foods--could aggravate a predisposition 
(or susceptibility) to hypertension (U.S. Department 

High sodium intake continues as a taste for salty foods 
such as corn chips, potato chips, and fast foods is 
developed. High sodium diets have become a common way of 
life. Several of the salted foods are often salted twice 
again in the home, at the time of preparation, and again 
at the time consumption. The increased sodium in the 
diet takes a toll on our health through dental caries, 
weight gain, increased blood pressure, and renal problems.

Individuals differ in the amounts of cholesterol, 
sugar, and sodium ingested. Bad dietary habits may be 
considered an insidious enemy to man as damage is not appa-
rent until lifetime control of the medical problem created 
becomes the only avenue of treatment.
Obesity

Overweight people have an increased incidence of stroke and coronary disease. A person is considered overweight when he is 10 percent over the ideal weight for his body structure and obese when over 15 percent. Life insurance companies give statistics connecting fatness with hypertension revealing that as weight increases, so does the blood pressure level (Drans: p. 91). In a study involving 81 obese hypertensive patients who received low caloric foods without any salt restriction, all of the patients experienced weight loss and a decrease in the blood pressure (Tobian, 1972: p. 46). This study is significant in that it shows what can be done with weight loss rather than only decreasing intake of salt.

Fad or crash diets are discouraged as the sudden changes they inflict do the body harm and the weight loss is rarely maintained. With conservative weight loss, not only are there no annoying side effects, but it enhances one's sense of well-being, and increases agility. As weight reduction occurs, activity should be increased since it aids in decreasing blood cholesterol and body fat which lowers the blood pressure level and consequently control of blood pressure is maintained.

Cigarette Smoking:

Each year 300,000 Americans die prematurely from the effects of smoking, and millions more live on with
experience hypertension more frequently than those with higher education and better jobs (Stewart, 1967: p. 9).

A survey on the distribution of hypertension in the United States by income and age showed the relationship to be greatest between the 25-39 year old age group with the frequency of hypertension being three times higher in the group whose income was less than $15,000 compared to a group of $15,000 and over (Ferlof, 1977: p. 532).

Hypertension is increased in individuals who have been financially unsuccessful in this material and success-oriented society.

**Stress**

Since stress from the environment has a positive correlation with increased blood sugar levels and constriction of arteries, it is easy to understand that the same is true with hypertension. As a result of stress, body deposits of fat are emptied into the blood, and laid along arterial walls producing atherosclerosis.

This is not to say that all stress is bad—to little stress is just as harmful as too much. An individual constantly under stress and not permitted to rid himself of the pent-up energy develops early physical disturbances such as headaches, insomnia, upset stomachs, or sinus attacks. As the stress continues, the physical disturbances may develop into hypertension. The individual who has learned to cope with stress but suddenly experiences
multiple stressful situations will experience these same problems unless he is able to successfully continue to cope.

Stress is a fundamental fact of life, and each period in life has its own set of stresses. In early life, the child has to cope with his immediate family and the demands of school and peers. As he enters adolescence, he struggles with his physical and emotional changes as well as his strive for independence. The extent to which the adolescent lives in a continuous state of turmoil has long been recognized. As the adolescent finishes high school, he is faced with decisions regarding his future. The college route brings stresses which may involve economic dependence, academic superiority, shifting family relationships, and psychosocial adjustments. The work route encompasses such problems as competitiveness, fear of job loss, trouble with the boss, and socio-economic independence.

Since the majority of society is still pronatalist, they eventually marry and have children. This brings about adjustments such as change in financial status, change in family relationships, as well as difficulties and/or disagreements about child development. Finally the aging process includes stresses among which are children leaving home, grandchildren arriving, retirement, financial adjustments, failing health, and death of spouse. These are some of the possible stressful situations encountered throughout a lifetime.
Our modern, permissive, mobile, industrialized, and affluent urban society, plus the fading of the family concept, are increased environmental stressors. Everyone experiences stress to varying degrees. Without available time, place, or person, an individual may be unable to expel bottled-up energy which ultimately explodes into mental and/or physical disturbances, including hypertension.

**Personality Type**

A particular personality type or behavior pattern gives rise to the abnormalities of hypertension, according to *Type A Behavior and Your Heart* by Dr. Friedman and Dr. Rosenman. The Type A person is one who has a higher incidence of heart problems. A short story from the book gives an excellent beginning understanding of Type A behavior:

An upholsterer had been called to fix the seats of chairs in a doctor's office. After inspecting the chairs, he asked what sort of practice this was. Then he was told cardiologist, he stated "I was just wondering because it's so peculiar that only the front edge of your chairs are worn out" (Friedman: p. 71).

Characteristics of the Type A behavior include sense of time urgency or "hurry sickness", quest for numbers, insecurity of status, and aggression and hostility.

Time urgency or "hurry sickness" is when a person incessantly strives to accomplish too much in the time he
allows. In an attempt to accomplish more, he creates
deadlines for himself that are actually impossible to
achieve. He subconsciously believes that he will somehow
succeed in triumphing over his enemy, time. This push for
haste causes Type A person to continually utilize stereo-
typed thinking. He believes that if he does things in the
same way, it saves time. He substitutes the yearning to
be faster for better and different which decreases his
creativity. As this person meets a new challenge, he
becomes extremely distressed when his usual expedient methods
do not succeed. Prolonged frustration causes blood pressure
to remain elevated, requiring therapeutic control.

Type 1's fascination with numbers and quantity is a
trait which probably begins in childhood. As he experiences
many birthdays and Christmases, he receives more and more
toys and begins to count rather than enjoy which ultimately
develops into an obsession/compulsion with money as he
grows. His money nearly represents tokens to which he has
dedicated himself. After having strived for and obtained a
certain number of dollars, he is disinterested in the utiliza-
tion of the money. He is primarily concerned with the
number of dollars he can obtain which in turn satisfies his
insecurity.

There is probably no one who appears more secure
than the Type A person. He bustles around with confidence
and appears to possess lavish amounts of self-assurance.
He is quick to ask someone about their problem and how he could help, but loathes to ever say he has a problem and needs help. This behavior type measures self-worth by the number of achievements rather than the quality of them. The number of accomplishments must continually increase to satisfy his appetite and to appease his peers, who he feels are always judging him. His innermost security is staked upon the pace of his achievements, and he desires to achieve a maximum number in a minimal amount of time. Unfortunately, if a friend would point out this struggle, he would reject the sympathy as being of no value. His only satisfaction is derived from those moments when he believes his quantity of achievements are increasing at a satisfactory rate.

Aggression and hostility are common traits of the Type A person; however, the individual is usually unaware of this. No man who is as eager to achieve as this man can do so without having an aggressive spirit which frequently evolves into free-floating hostility. The Type A person always has a tendency to compete with others whether for a promotion at work or in a simple game of cards. If this person is not engaged in achieving a maximal number of achievements, he is continuously in a struggle with himself and others. This struggle frequently develops into hostility which is extremely difficult to treat unless the individual is aware of it and willing to undergo treatment.
In the absence of the above mentioned traits or Type A behavior, coronary heart disease almost never occurs before 70 years of age, regardless of fatty foods eaten, cigarettes smoked, or lack of exercise. However, when this behavior pattern is present, hypertension may occur in one's thirties or forties. In the past, Type A traits were particularly on American men; however, now that the American female is becoming more immersed in the commercial and professional environment, they are losing their protection for now they too find themselves short in time reserves. Recent statistics are already beginning to show a narrowing of the margin between sexes.

Inherited factors such as sex and race cannot be changed as genes are fixed and unalterable. What can be changed is the knowledge of what inherited traits predispose an individual to hypertension in order that the individual may deal with or alter these environmental factors which can be manipulated. Environmental factors such as diet, obesity, inactivity, cigarette smoking, stress, education, occupation, and personality type can be controlled or changed if desired. Alterations would control hypertension and prevent the development of complications.
CHAPTER IV

CONTROL OF DIETARY NUTRIENT

Hypertension is a "silent killer" that if controlled will provide for a longer, healthier, and happier life. Control follows detection by measurement of blood pressure levels and/or early recognition of signs and symptoms. Early signs and symptoms include frequent headaches associated with nausea and vomiting, unexplainable anxiety, difficulty with breathing on exertion, unexplainable fatigue, dizziness, sudden weight gain, frequency of urination, and/or swelling of hands and feet. Too often these symptoms go ignored or excused for many different reasons, therefore hindering early detection and control.

Control of hypertension has a dual purpose in that it maintains lower blood pressure levels and avoids the development of possible complications. Some cases can be handled effectively with simple measures and without medication. Successful simple measures include: weight reduction, increased activity, and a decreased intake of sodium, sugar, and cholesterol. Other measures advocated are a decrease in or cessation of smoking, and a decrease in stress. An alternate measure to the latter is to develop an increased ability to handle situations.

**Weight**

Since obesity imposes an increased burden on the heart, a decrease in body weight is important in controlling
hypertension. A pound of fat requires about a mile of capillaries to feed it (Calton: p. 115). Consequently, the heart of an overweight person is forced to pump blood through more blood vessels.

"The association between obesity and hypertension is unequivocal. The single most important factor related to risk of hypertension is overweight—at least the single most important factor amenable to environmental influence," observes Dr. Jeremiah Stamler, professor and chairman of Northwestern University Medical School's Department of Community Health and Preventative Medicine (Calton: p. 115).

Weight reduction sensibly obtained and maintained is the treatment for obesity. It enhances the individual's state of wellness as well as controlling hypertension.

Weight reduction is usually very frustrating as it does not occur quickly and easily. Crash diets that bring down weight with startling suddenness may do more harm than good. Rapid weight loss imposes a strain on the body and often the individual is unable to maintain the loss because there has not been time for the body to adjust.

There may be a danger many people do not realize in crash on-a-mint-off-again dieting. Studies show that increased deposits of cholesterol may be laid down on artery walls during periods of weight gain. No studies indicate that the deposits are melted away during periods of weight loss. To go through repetitive periods of weight loss and weight gain, with increased deposition of cholesterol during the gain periods, may be only to increase the risks of atherosclerotic arteries (Calton: p. 117).
Sensible weight loss is obtained by balancing caloric intake with energy needs. It takes 3,500 calories to make a pound of body fat. A decrease of 100 calories a day would not be demanding and would not create an intolerable situation within which to live. By eliminating 100 calories daily and maintaining the same activity level, a pound of body fat would be lost in 25 days. A pound of body weight lost every 25 days equals a loss of 10 pounds a year! More importantly, a yearly loss of 10 pounds has a better chance of staying lost. Maintenance of weight loss can result in control of hypertension.

Sodium

Removal of sodium, including salt, from the diet causes the blood pressure to fall because sodium restriction decreases the body's retention of fluid. Without excess bodily fluids the heart is able to function more effectively. Several years ago doctors prescribed rigid limitation of salt intake. An example of one such stringent diet is the rice diet in which measured amounts of rice, fresh tomatoes, fruit juices, and vitamins could be ingested. Such a strict restriction in managing hypertension is not used today due to the advent of a drug called a diuretic, "water pill", which helps the body rid itself of fluids. Although medication can be used, a moderate restriction of salt is still desirable in aiding the control of hypertension.
As mentioned earlier, most foods from the grocery or obtained at a quick-stop restaurant contain salt or another form of sodium. This means that society is consuming an unnecessary amount of sodium. People with hypertension cannot consume this amount of sodium, including salt, because it causes their blood pressure to remain elevated. Sodium restriction is necessary for the control of blood pressure. Individuals with hypertension who restrict their sodium intake may complain that their food is bland and tasteless. A solution to this problem is to experiment with the many spices available which do not contain sodium. Examples of flavorings which may be substituted are lemon juice, marjoram, or thyme.

**Cholesterol**

High blood pressure results from increases in the deposition and accumulation of fatty deposits (plaques) in the walls of the arteries. These deposits eventually clog the arteries leading to impaired circulation. Cholesterol is manufactured by the liver and fatty foods add excess fat to the blood stream which causes the formation of plaques. To prevent atherosclerosis, or excessive plaque formation in the arteries, the blood cholesterol level must be kept as low as possible. Ideally, the blood cholesterol should be as low as that in persons of other races who never get coronary heart disease. This is difficult since the American diet is high in cholesterol.
The media has made saturated and polyunsaturated fats household words. Animal fats (saturated fats) increase the blood cholesterol level while vegetable fats (polyunsaturated fats) help to maintain a more constant level of cholesterol as they do not increase nor decrease the blood level of cholesterol. Restricting the intake of cholesterol-rich foods, substituting vegetable fat for animal fat (i.e. corn oil for lard), and restricting intake of "junk foods" (i.e. cheeseburger, French fries, and potato chips) decreases cholesterol intake and thus cholesterol blood levels. A decrease in fatty foods which decreases body weight and blood cholesterol levels will also lower the blood pressure.

Activity

Man has always felt physically and psychologically better after exercising. There is a positive correlation between high blood pressure and a sedentary lifestyle. Exercise lowers blood pressure which keeps arteries healthy. A diseased artery is not "physically fit" and results in circulatory problems such as hypertension. Through exercise an individual can control the development of arterial disease as well as his blood pressure.

Several studies have been conducted demonstrating that exercise does lower blood pressure:
In one experiment at the San Diego State College Exercise Laboratory, 23 hypertensive men were placed on a program of moderate exercise consisting of 15 to 20 minutes of warm-up calisthenics plus no more than 30 minutes of walking, jogging twice a week. After six months of the program, their mean blood pressure had fallen from 159/103 to 142/82 (Falten: pp. 189-189).

In another study with 105 urban men, aged 25 to 60, Dr. George V. Hahn and his associates at Vanderbilt University School of Medicine and the Department of Physical Education of George Peabody College for Teachers, Nashville, Tennessee, sought to find a feasible system of supervised exercise and to measure the effects on heart disease risk factors. The 105 men included professionals, white- and blue-collar workers, and a few laborers. They were asked to attend at least 2 of 3 weekly training sessions, either from 6 a.m. to 7 a.m. or from 5 p.m. to 6 p.m. The training was always carried out in groups led by an instructor and consisted of calisthenics and with alternate periods of walking, jogging, and running. Each man was assigned to one of three levels of exercise intensity according to his medical history, physical examination, and initial fitness. Men were promoted to higher intensity levels as their proficiency increased.

The program lasted six months and 75 per cent of the men stuck with it. At the end, 96 per cent of the men said they would do it again.

There was marked improvement in feelings of fitness, including a significant improvement in weight. Blood cholesterol levels came down, without dietary restrictions. And blood pressures fell significantly (Falten: pp. 123-126).

These studies demonstrate a drop in weight, blood cholesterol, and blood pressure occur when exercise is utilized for the control of high blood pressure.

A well-trained heart muscle becomes more efficient as it can pump more blood with less effort. With exercise, the heart muscle's demand for blood increases, and the
body responds by adding collateral or extra vessels to supply the heart. The collateral circulation comes in handy if the coronary arteries become blocked by disease because they reroute blood around the diseased vessel so the heart still receives nourishment. The collateral circulation aids in the control of blood pressure since it allows the blood to avoid the diseased arteries and still circulate to the heart muscle.

Persons over age 35 or those with hypertension need to exercise, but moderate exercise, not strenuous, is required. Moderate exercise is defined as any form of activity which does not result in panting, excessive acceleration of the heart beat (that is, above 120 beats per minute), or undue fatigue (Friedman: p. 151). Almost any activity can be done moderately if there is no competition involved. An example of a competitive sport done moderately is swimming laps at a moderate pace with frequent rest periods. Strenuous activity places too much stress on the body and may jeopardize an individual's health status. Non activities such as swimming, jogging, skating, or bicycling involve speed and competition, they become strenuous. Moderation in exercise is moderately stressful and is beneficial to the person with hypertension for control.

Persons over 35 years of age who continue to indulge in severe forms of exercise, regardless of how long they...
have been participating in them, should undergo an
electrocardiographic check-up and/or stress test. Approxim-
ately 250,000 American men who never experienced any
effects of coronary heart disease died suddenly last year
after indulging in strenuous activity. In postmortem
studies, each man had coronary artery disease of sufficient
severity that a stress test would have shown its presence.
The stress test can be life-saving and can assist in the
proper control of hypertension (Friedman: p. 102).

Smoking

One of the striking facts from the Framingham
studies is that cigarette smoking is the most impressive
single additive for increasing the risk of stroke and
heart attack for the person with hypertension (March: p. 685).
Cigarette smoking stimulates the adrenal glands to release
excessive amounts of hormones which increase fatty acids
in the blood and accelerate the heart rate which increases
the workload of the heart. At the same time because
cigarette smoke contains carbon monoxide which has a
higher affinity for blood than oxygen, there is less oxygen
available for tissues and the heart muscle. Without enough
oxygen for nourishment, the heart attempts to compensate by
overworking itself which increases the blood pressure.

To addiction is easy to escape. Cigarette smokers
are addicted to the nicotine as well as the emotional
satisfaction derived. Thus, quitting is both physically and psychologically taxing for many individuals. To quit smoking, the individual must have a sincere intent to do so and an incentive to stay with it. People who smoke have tried many various ways to "kick the habit"—chewing gum, sucking candy mints, or nibbling on fruits. Smokers who must continue their habit should choose brands with less tar and nicotine, avoid smoking the entire cigarette, and should inhale less frequently. A change to pipes or cigars does not free individuals from the risk of developing hypertension. Any type of smoking hinders the control of hypertension.

A suggestion for individuals who have been unsuccessful in their attempts to eliminate smoking is a booklet titled "If You Want to Give up Cigarettes" published by the American Cancer Society. The booklet presents practical suggestions from many experimental stop-smoking programs. Whatever is necessary for individuals with elevated blood pressure to stop smoking should be tried because the components of the smoke continue to cause an elevated blood pressure.

Stress

A certain amount of stress is necessary for stimulation of life. Trouble occurs when life's stresses become excessive, prolonged, or no adequate release from them is available. The media emphasizes the many stresses which
occur in our society today. Various attempts are made at labeling stressful situations (i.e., death of a spouse, divorce, or birth of a child) in an attempt to determine the amount of stress any one person experiences at a given time. Society is changing at such a rapid rate that it is not surprising to find that stressful situations are increasing.

In dealing with rapid changes, people lend their ear to those who emphasize relaxation. Methods suggested for relaxation range anywhere from a hot bath, sitting on the bed in silence, or playing some soothing music, to the advent of yoga and transcendental meditation. Basically, the method which works best for each individual is encouraged because the person learns to deal with the stress so that control over blood pressure is maintained.

Behavior

Dealing with Type A behavior is necessary for the control of hypertension because otherwise the behavior pattern continues to impose stress on the individual of which he is usually unaware. "Once a Type A always a Type A" is not a valid statement. A Type A can rid himself of the qualities which cause him the problems leading to hypertension.

Lifetime habits of Type A persons create problems that have to be fought indefinitely. The "hurry sickness"
or incessant flight with time dominates his whole life. It
has kept his life's pace at full speed ahead so that there
is no time to enjoy the meaningful events in life or concone-
trate on self-growth. Friends, hobbies, and visits to
the park just take up time without any profit to his economic
or professional career. It is no wonder that deep-down
inside this person there exists a lack of security.

The Type A individual who is able to see the strain
he imposes on himself and is able to change has a situation
which he will always have to deal with. Habits can be
broken and can also be reformed. The Type A will see that
as more time is taken for relaxation, his blood pressure
can drop to a controlled level.

Medication

Medical treatment is frequently used in the control
of hypertension. Thanks to the discovery of medications
for high blood pressure, less stringent alterations in
lifestyle are required.

Antihypertensive medications generally fall into
categories: those that eliminate excess fluids from
the body, those that block the nerves to blood vessels,
and those that relax blood vessels directly. There are
many different drugs which belong to each of these categories
and often a combination is required; however, no combination
is perfect for each individual. Hypertensive therapy is
individualized and produces various degrees of effectiveness. Vast amounts of information are available on antihypertensive drugs from physicians, nurses, pharmacists, and health agencies.

Diuretics, more frequently called "water pills", promote the excretion of salt and water from the body. Some examples of diuretics include Diuril, Lasix, Dicroin, Aldactone, Hygroton, and Hydrodiuril. These drugs are usually the ones chosen to start medical therapy. For mild hypertension they may be used alone, but they are usually combined with other drugs to increase their effectiveness in controlling blood pressure.

The second group of drugs utilized in the control of high blood pressure are those that block the nerves to blood vessels. These drugs act by impairing the storage of noradrenaline necessary for nerve transmission to the heart to increase its pumping action. Some examples of these drugs are Reserpine, Resulin, Aldomet, and Catapres.

The last group, the vasodilators, relax smooth muscle of the peripheral vessels by decreasing resistance to blood flow. Concurrently they increase cardiac output and renal blood flow. Aproclinal is the most commonly used drug of this group.

As with any medication, antihypertensives have side effects, and they too vary with each individual. When the person with elevated blood pressure is placed on antihypertensive medication, information concerning the name
of the drug, its action in the body, and side effects for which to observe must be clearly understood.

Individuals with hypertension must realize the importance of following and maintaining the therapeutic regimen prescribed by the doctor in order to avoid complications. Once the facts concerning the antihypertensive drugs prescribed are known, then the individual must assume responsibility for control of his blood pressure level. Control is maintained not only by following prescribed treatment, but also by obtaining medical care as designated or needed.
Chapter V
SUMMARY

Statistics show that essential or primary hypertension is a major health problem in society. Since the exact cause is unknown, predisposing factors are relied upon to determine potential victims of hypertension. Extrinsic and intrinsic factors such as sex; race; age; family history of heart disease; obesity; diet high in sodium, cholesterol, and/or sugar; stressful lifestyle; cigarette smoking; education; occupation; and/or Type A behavior pattern have a relationship to an increased incidence of hypertension. Multiplicity of these factors in an individual's life results in an even greater risk of developing hypertension. Intrinsic, or hereditary, factors are unalterable. With knowledge of extrinsic, or environmental, factors, an individual may alter his lifestyle to decrease or at least delay the development of high blood pressure.

Hypertension is a pressing menace in the lives of society, which if captured can be controlled. Once detected, control is required since there is no cure for hypertension. Methods of control are individualized and include: weight reduction; decrease sodium, cholesterol, and/or sugar intake; increase activity; decrease or cessation of smoking; decrease stress; change in Type A behavior pattern; and/or use of medication. Once control is established, it
must be maintained. Emphasis is placed upon maintenance because the asymptomatic individual under therapy is not cured—rather he is controlled. Early detection and control are necessary to prevent a decreased life expectancy and the development of complications such as heart attack, stroke, kidney failure, and blindness.

Since 1972, a wide variety of publications have succeeded in raising to consciousness the prevalence and seriousness of hypertension. Heightened awareness does not seem to have solved the problem (Searle: p. 121). It seems that individuals with elevated blood pressure do not see, or do not want to accept, the need for treatment.

It is up to each individual to be responsible for his health. He alone can decide whether to get annual physical examinations and/or change destructive habits. Examinations are beneficial so that changes in blood pressure can be detected. Too often individuals forego examinations only to suffer consequences that might otherwise have been avoided.

Consideration of many facets of life must be given if man is to control his fate. This is especially true for the individual whose family history indicated that hypertension will develop. Knowledge of hypertension and its manifestations are on the increase. However, knowledge of control of elevated blood pressure levels is of prime importance and must always remain the focal point of hypertension.
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APPENDIX
## APPENDIX

### Table 1. Sodium-Containing Foods

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</tr>
<tr>
<td>Jif peanut butter</td>
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</tr>
<tr>
<td>Snicker's grape jelly</td>
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</tr>
<tr>
<td>Strawberry jam</td>
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<tr>
<td>Wishbone French dressing*</td>
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</tr>
<tr>
<td>Laces*</td>
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</tr>
<tr>
<td>Mayonnaise*</td>
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<td>Delmonte catsup*</td>
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<tr>
<td>White bread*</td>
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<td>Wheat bread*</td>
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</tr>
<tr>
<td>Eye bread*</td>
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<tr>
<td>Hostess cupcakes*</td>
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<td>x</td>
</tr>
<tr>
<td>Idahoan instant potatoes</td>
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<td>x</td>
</tr>
<tr>
<td>7-Up*</td>
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</tr>
<tr>
<td>Coca-Cola</td>
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<td>Potato chips*</td>
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<td>Sunshine sugar wafers</td>
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<tr>
<td>Chicken &amp; dumplings</td>
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<td>Ortega taco sauce</td>
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<td>Kraft dinners</td>
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<td>Delmonte Pineapple juice</td>
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<tr>
<td>Van Camp's Pot &amp; Beans</td>
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<td>Beer</td>
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<td>Delmonte raisins</td>
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<td>Jiffy cake mix</td>
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<td>Betty Crocker blueberry muffin mix</td>
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<td>Nestle brownie mix</td>
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<tr>
<td>Thank you pie filler</td>
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<td>Log Cabin syrup</td>
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<td>Aunt Jemima pancake mix</td>
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<td>Nabisco shredded wheat</td>
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<td>Instant quick oats</td>
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<td>Figurine</td>
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<td>Carnation instant breakfast</td>
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<tr>
<td>Grape nuts</td>
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<tr>
<td>Cream of wheat</td>
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<td>Baby food</td>
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<td>Similac</td>
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<tr>
<td>Lipton cup-a-soup</td>
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TABLE 1. (Continued)

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<th>Foods</th>
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<tbody>
<tr>
<td>&quot;Mayers bouillon&quot;*</td>
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<td>Campbell's can soup*</td>
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<td>Fish sticks*</td>
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<td>Velveeta cheese*</td>
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<td>Butter*</td>
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</tbody>
</table>

* Foods containing salt or sodium chloride (NaCl)