1982

A Study Of Physiological Variables In Black Children Of Reported Hypertensive And Non Hypertensive Parents.

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The University of Alabama in Birmingham D.S.N. 1982

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106

A STUDY OF PHYSIOLOGICAL VARIABLES IN BLACK CHILDREN OF REPORTED HYPERTENSIVE AND NON HYPERTENSIVE PARENTS

by

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A DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of Doctor of Science in Nursing, School of Nursing in The Graduate School, University of Alabama in Birmingham

BIRMINGHAM, ALABAMA

1982

ABSTRACT OF DISSERTATION

GRADUATE SCHOOL, UNIVERSITY OF ALABAMA IN BIRMINGHAM

Degree D.S.N. Major Subject Nursing

Name of Candidate Billie Rayburn Rozell

Title A Study of Physiological Variables in Black Children of Reported Hypertensive and Non Hypertensive Parents

Significant physiological differences in variables commonly associated with increased blood pressure in middle childhood have not been documented between children whose parents do and do not have essential hypertension. This study was implemented to compare specific physiological and demographic variables in a two-group design utilizing 9, 10 and 11 year old black children in a school setting. Physiological variables measured in a one day screening included blood pressure, height, weight, skinfold thickness, sexual maturity, heart rate, presence or absence of murmur and grade if present, as well as overnight urine sodium and potassium excretion. Demographic variables of the children's biological parents such as age, educational level, occupation and number of relatives to the third generation who had hypertension were obtained through questionnaire.

The sample consisted of 41 children whose parent(s) reported hypertensive status (Group 1) and 59 children whose parents reported non hypertensive status (Group 2). Age and sex distribution between the groups was similar.

Statistical hypotheses, subhypotheses and research questions generated by the research hypotheses were tested utilizing the two-tailed *t*-test, analysis of covariance and discriminant analysis. The first hypothesis, that there would be no difference in the physiological variables between the groups, failed to be rejected. Subhypotheses related to age and sex were rejected. Eleven year old males in Group 2 were more mature sexually (p = 0.02) than those in Group 1 and female subjects whose parent(s) reported hypertension had significantly higher blood pressures (systolic and diastolic) than those whose parents reported no hypertension. In addition, females in Group 2 had higher overnight urine sodium excretion (p = 0.03) than those in Group 2.

The second hypothesis, that there were no differences in demographic variables reported between the two groups, failed to be rejected as parent age was significantly greater (p = 0.02) for Group 1 subjects than for Group 2. Recommendations for further study were made.

Abstract Approved by: Commitee Chairman Carl N. Miller

Program Director [signature]

Date: 6/4/82 Dean of Graduate School Kenneth Bozen

ACKNOWLEDGEMENTS

I wish to thank the members of my committee, Dr. Carl Miller, Chairman, Dr. Milly Cowles, Dr. Kathryn Barchard, Dr. Katharine Kirk, and Dr. Albert Oberman, for their support and guidance in my studies and this research endeavor.

Appreciation is extended to Mr. Robert Byrd, superintendent of education, and Mr. Horace Dobbins, principal of the school system described in this paper, for their continuing interest in and concern for school health. I appreciate, also, the enthusiastic participation of the children, their parents, and the teachers.

For their encouragement and participation in this effort I am indebted to Pam Daugherty, Wendy DiMicco, Grace Holman, Frances Lange, Gloria McGhee, and Becky Wright. In addition, for their support, my thanks are given to the faculty members of Level II.

I am proud of my children, Patricia and Jonathan, for their willingness to sacrifice time and activities for my studies.

Finally, this study is dedicated to the memory of my mother, Ruby Daniel Herrell.

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CHAPTER I

INTRODUCTION

Hypertension is a major public health problem of epidemic proportion in the United States (Henson, 1981). It affects over 23 million people, an estimated 10-20% of the adult and 1-2% of the pediatric and adolescent population. More than 1/5 of all deaths are directly or indirectly due to the results of hypertension. In terms of disability, in the 65 and older age group it is the fourth leading cause and it is the seventh leading cause of disability between the ages of 24 and 65. Thus, as blood pressure rises so do the risks of illness and death (Swartz & Leitch, 1975; Voors, Webber, & Berenson, 1979). In addition, for over 90% of those who have hypertension, they have primary or "essential" hypertension--an hereditary type whose etiology is unknown (Guyton, 1968).

Hypertension is especially devastating to blacks who constitute the largest minority in this country (Hill, 1978). They usually develop it earlier (frequently as teenagers) and it is usually more severe in blacks than in whites. Hypertension kills more than 13,500 blacks each year as compared to sickle cell's 340 deaths per year (Botwin, 1976). In addition, while other genetic and environmental variables have been associated with hypertension, it has long been observed that the most consistent risk factor for development of hypertension as an adult is a family history of the disease (Biron, Mongeau, & Bertrand, 1975; Zinner, Levy, & Kass, 1971).

It is difficult to be precise in estimating the prevalence of hypertension in children because of the lack of longitudinal data, disagreement on the definition of hypertension, and lack of standardized technique for blood pressure measurement. In the past, too, it was commonly believed that hypertension was extremely rare in children, but beginning in the mid 1960's this belief has been soundly challenged by researchers and Voors, Webber & Berenson (1979) noted the likelihood that primary hypertension begins in childhood. It has been postulated that given better identification of genetic and/or environmental risk factors in childhood progression or even prevention of the disease state could be the direction of intervention (Blumenthol & Kamisar, 1977; Chenoweth, 1973).

Statement of the Problem

Many children do not have yearly blood pressure or other assessments routinely to detect presence of hypertension or its associated manifestations (Mitchell, 1977). For these children, school health programs with routine blood pressure screening can be of great importance in identification of children with hypertension as well as continuing assessments of children identified at risk for development of the disease (Granico, 1981). In addition, while studies with large samples have been implemented in the recent past yielding racial comparisons and describing the samples studied, comparisons of multiple physiological variables in selected age groups of black children of hypertensive and non hypertensive parents are lacking (Berenson, Foster, Frank, Frerichs, Srinivasan, Voors & Webber, 1978; Harlan, Cornoni-Huntley & Leaverton, 1979; Voors, Foster, Frerichs and Berenson, 1976).

Pertinent questions related to investigation of blood pressure among such children include: (a) Do physiological variables noted to be associated with blood pressure levels in school aged children vary between groups of children with and without parent history of hypertension? (b) Are those variables for which the nurse has screening capabilities discrete enough using nonintrusive procedures to note possible group differences? (c) Are other (demographic) variables associated with the groups? These questions and nursing's traditional and extensive involvement in providing school health care with identification of existing or potential health problems provided the impetus for the present comparative study.

Statement of Purpose

The purpose of this study was to determine if black children of hypertensive parents had different physiological characteristics than children of non hypertensive parents.

Research Hypotheses

The following were research hypotheses for this study:

Hypothesis 1: There are differences in physiological variables measured between children of reported hypertensive and non hypertensive parents.

Subhypothesis 1:

There are differences in the physiological variables measured between children of reported hypertensive and non hypertensive parents by specific age.

Subhypothesis 2:

There are differences in the physiological variables measured between children of reported hypertensive and non hypertensive parents by specific sex.

Hypothesis 2: There are differences in demographic variables between children of reported hypertensive and non hypertensive parents.

Subhypothesis 1:

There are differences in demographic variables between children of reported hypertensive and non hypertensive parents by specific age.

Subhypothesis 2:

There are differences in demographic variables between children of reported hypertensive and non hypertensive parents by specific sex.

Hypothesis 3: The physiological and demographic variables can classify the children into hypertensive and non hypertensive parent groups with at least 75% accuracy.

Assumptions

The following were assumptions for this study:

1. The risk factor of familial hypertension connotes risk for the child's development of hypertension at some point in the child's life.

2. Physiological indications of development of hypertension in a child are measurable and indicate physiological adaptation to the disease process.

3. Reports of hypertensive or non hypertensive status by a parent denotes hypertension or non hypertension among the parents.

4. Nursing intervention in health screening activities contributes to promotion and maintenance of health.

Limitations

The following was a limitation for this study:

All biological parents could not be contacted by the researcher for a variety of reasons and reports of existing hypertensive state were made by a spouse or parent.

Definition of Terms

The following were definitions of terms for this study:

Children at risk: children of hypertensive parent(s).

Children not at risk: children of non hypertensive parent(s).

Criteria for Referral: a blood pressure in a child of 140 mm Hg. or above systolic and/or 90 mm Hg diastolic for any of the blood pressure measurements taken during screening.

Demographic data: personal information about the child and parents relative to age, sex, education level, occupation, and number of relatives with hypertension.

Heart murmur: abnormal heart sounds of a vibratory nature detected through auscultation and graded according to protocol (Appendix F).

Heart rate: the number of contractions of the heart recorded in beats per minute following protocol (Appendix F).

Hypertension: refers to primary or "essential" hypertension.

Hypertensive parent(s): statements by parent(s), spouse, either verbal or in written form, that parent(s) has high blood pressure or hypertension for which parent(s) is receiving medical treatment and for which no secondary cause has been identified.

Non hypertensive parents: statement by parent(s), spouse, either verbal or in written form, that parents do not have high blood pressure or hypertension or have ever been informed that parents have this disease and that blood pressure has been taken and determined within normal range within 6 months of inquiry by the investigator.

Parent: biological mother and father.

Primary or "essential" hypertension: a term used to describe sustained elevated arterial blood pressure for which no etiological factor(s) can be identified.

Secondary hypertension: a term used to describe a variety of conditions in which elevated arterial blood pressure is caused by some known disease state.

Systolic blood pressure: corresponds to Korotkoff's Phase I as the first appearance of faint, clear tapping sounds and measured according to protocol (Appendix E).

Diastolic blood pressure: corresponds to Korotkoff's Phase IV, at the appearance of a distinct, abrupt muffling of sound and measured according to protocol (Appendix E).

Need for the Study

While nursing and medical literature is replete with articles related to hypertension detection and control in the adult, it is only within the past decade that much emphasis has been placed on this disorder in children and, further, in efforts to evaluate its relationship to the growing child. According to Blumenthol and Kamisar (1977):

> Advances have been made in the understanding and management of hypertension. Much more needs to be learned.... The ultimate goal must be prevention. The ability to achieve this goal will rest upon advances made in understanding the interplay of a variety of mechanisms for blood pressure control in children. The relative role of genetics and environment require elucidation. (p. 101)

Hypertension figures prominently as a factor in heart attacks and strokes in the adult population (Swartz & Leitch, 1975) and, in economic terms, it and related cardiovascular diseases cost an estimated $40 billion in 1977 alone, including 26.7 million work days lost (Fink, 1982). Thus, unless detected earlier and preventive measures and/or earlier treatment is implemented, at least 10-12% of today's children are certain to become among those with hypertension as adults, especially if they are black and have family histories of hypertension. With this condition they will contribute significantly to this country's morbidity and mortality statistics.

Loggie (1978) noted Page's contention that hypertension is likely multifactoral in origin. With an onset prior to adulthood, the natural history of hypertension is not clear, but to date there exists no reason for optimism that it is any better than in the adult. It then remains a challenge to try to develop means of identifying particular children at risk for developing hypertension as well as those who are already hypertensive. According to Johnson, Cornoni, Cassel, Tyroler, Heyden, & Hames (1975), it would be important to understand the development of blood pressure levels in childhood and youth and to identify at what age the influence of some factors known to be associated with increased blood pressure such as sex, age and weight become apparent.

While a genetic aggregation in blood pressure has been well documented (Zinner, Martin, Sacks, Rosner & Kass, 1975), the meaning and magnitude of familial aggregation remains a source of controversy. Granted that children of parents who have hypertension are at greater risk for developing the disease as adults, no reliable way of identifying these children prior to the development of the disorder has yet been established (Rose, Miller, Grim, & Christian, 1979). In addition to race and family history, various factors, both demographic and physiological, have been studied and those associated with high blood pressure levels include obesity (Voors, Webber, Frerichs, & Berenson, 1977), height (de Castro, Biesbroeck, Erickson, Farrell, Leong, Murphy, & Green, 1976; Voors et al., 1979), body mass (Harlan, Cornoni-Huntley, & Leaverton, 1979; Zach, Harlan, Leaverton & Cornoni-Huntley, 1979), sodium intake (Tobian, 1979; Tuthill & Calabrese, 1981), sexual maturity level for both males and females (Cornoni-Huntley, Harlan & Leaverton, 1979), increased fat and carbohydrate intake (Leiberman, 1974), and serum uric acid levels (Prebis, 1979). In addition, there have been studies which suggest a possible relationship between low potassium intake and high blood pressure in blacks (Fries, 1976; Hall, 1977). Harlan et al. (1979) noted previous studies of children and young adults that found a consistent, direct relationship between increased pulse rate and systolic blood pressure as well as an association between cardiac murmurs and blood pressure levels. Although not found to be significant in the adult, Katz (1979) reported an association between skeletal age and systolic blood pressure during puberty in a group of adolescent hypertensives.

In addition to these physiological variables, Kagan (1974) cited several studies that suggested a direct relationship between accumulated, unfavorable psychoemotional factors in the life environment and the origin of hypertension. However, physiological variables seem to be more important in studying hypertension than do demographic (Harlan et al., 1979).

Loggie (1978) described the challenge in this essentially new field of interest as to try to develop means for identifying children at high risk for later sustained hypertension as well as to try to prevent its development into the hypertension of adulthood. Heredity as well as constitutional and familial factors have been implicated as determinants of high blood pressure (Klein, Hennekens & Jesse, 1975). It is apparent that these determinants operate from a very early age and, if recognized in childhood, they could lead to identification of the child among his peers at greater risk for developing hypertension (Higgins, Keller, Metzner, Moore & Ostrander, 1980). During growth and physiological maturation associated with childhood and adolescence, blood pressure rises. According to Harlan et al. (1979) in reporting findings of The National Health Examination Survey in which 7,119 children 6-11 years of age participated, despite the generally held belief that primary hypertension may have its roots in the early years, it is not yet possible to define with any accuracy whether the blood pressure changes that occur with growth are an indication of later development of hypertension.

Identification of attributes that place a child at increased risk of hypertension can have important implications toward developing interventions for prevention, early detection, and early treatment. This becomes especially important when considering findings that indicate blood pressure tends to retain the same position in relation to others of the same sex and age throughout life; thus, a child or teenager with a relatively high blood pressure will become an adult with a relatively high blood pressure (Buck, 1970; Miall & Lovell, 1967). This is particularly ominous for children in regard to Wolf's (1973) estimate that the average duration of life following the appearance of diastolic hypertension (sustained diastolic blood pressure above 89 mm Hg) is about 20 years.

Despite information related to hypertension in apparently normal children noted by Londe, Johanson, Kronemer and Goldring (1975), Levine, Hennekens, Duncan, Robertson, Gourley, Cassady and Gelband (1980), reported that most practicing pediatricians, unless faced with clinical problems known to be associated with hypertension (such as cardiac murmurs and cases of suspected renal diseases), have not been in the habit of taking routine blood pressure measurements on children below age 7 and frequently not until adolescence. The Report of the The Task Force on Blood Pressure Control in Children (1977) suggested that all children aged 3 and above have yearly blood pressure determinations. Heavenrich and Cinque (1977) strongly supported this recommendation and also noted the problem of detection and surveillance. They suggested that the primary care physician's office, maternal and child health programs, and school health programs provide the mechanism for such detection and surveillance. Mitchell (1977) called attention to the fact, as did Heavenrich and Cinque, that many children do not have the opportunity to visit a pediatricians's office on a routine basis. This is true especially of children in minority and/or lower socioeconomic groups who may also be at greater risk for undetected hypertension. Therefore, even if blood pressure screening were available routinely in the pediatrician's office, many at risk children would still be missed. However, not only is screening for hypertension needed for populations at risk but, according to Kotchen and Havlik (1980),

> Traditional approaches to the study of hypertension have relied upon experimental models and patients with established hypertensive disease to delineate both mechanisms of increased arterial pressure and the impact of therapeutic interventions. For both the scientist and the clinician, perspectives obtained from the study of blood pressure (BP) in younger populations may provide an added dimension to our understanding and treatment of hypertension. (p. 1)

There is a need for nurses in all settings to be aware of the importance of blood pressure screening and referral of children as a legitimate nursing function (Botwin, 1976). Wood, Barrow, Freis, Gifford, Kirkendall, Lee and Williams (1970) also suggested early screening as economically more sound than later caring for the disabled hypertensive adult. According to Granico (1981), nurses should also facilitate and support the development of community-based plans for hypertension control that go beyond screening as the goals of community-based programs involve both detection and intervention with not only the child diagnosed as having hypertension but also intervention with those at risk for developing it when identified. It is appropriate that nurses intervene in screening children and participate in the subsequent management of the children. According to the Report of the Task Force on Blood Pressure Control in Children (1977), skills of teaching, guiding, and supporting are vital tools in management of children with hypertension and because nurses use these tools, they can be valuable in planning, administration and systematic follow-up of children.

Nurses, as health care providers in all settings, are in a unique position, through contact with children and other family members, to examine factors that place a child at risk for developing hypertension. It has become increasingly common for nurses to engage in screening programs within both traditional as well as community-based settings where children are found and to provide follow-up care. The areas of follow-up care include assisting with life style changes and observing for alterations that may indicate disease progression or complications. The nurse of today and the future must be capable of assessing not only psychosocial but also physiological variables that may give rise to pathology and for which there may be methods of detection and intervention well within the scope of nursing practice. Given the fact that hypertension in children is not now believed to be a rarity, but may be a prominent problem, nursing must confront the challenge of dealing with it. Nurses can no longer explain away the responsibility for seeking ways to detect and prevent this disease in children. Instead, they must persist and find methods suited to the needs of particular children and then consistently and routinely implement these methods (Botwin, 1976).

In view of the emphasis currently being placed on the fact that hypertension may originate and be detected in childhood, it is crucial to health care providers to try to identify factors that may be operative in the development of hypertension. It is absolutely essential that efforts be made to identify with a high degree of probability the prehypertensive state in human development in order to be aware of those persons who are at long term risk for developing this disease (Loggie, 1978).

Screening in a school setting for some specific physiological variables thought to be related to development of hypertension in childhood and making a comparison of these variables between a group of black children whose parent(s) report hypertension and those whose parents report absence of hypertension offers many opportunities for nursing. Information that will lead to the development of more specific screening procedures, earlier recognition of subtle changes needing follow-up on an ongoing basis within school systems and in families is necessary to nursing in planning detection and follow up programs of intervention with identified children and their families.

CHAPTER II

REVIEW OF LITERATURE

Conceptual Framework

Essential hypertension may be viewed as an insidious disease with at least a familial risk factor and several other associated parameters. In those children "at risk" (having parent[s] with hypertension) for developing essential hypertension, physiological predictors may be discrete enough to be identified early in the course of the disease and, thus, direct intervention to forestall the disease process. These predictors of disease could be seen as the body's response to stimuli and the body's adaptation to such stimuli.

Roy (1976) described individuals as being bombarded with stimuli to which they must adapt. The term "adapt" is a derivative of "adaptare," a word of Latin origin which means "to adjust" (Helson, 1964). The concept of adaptation--that is, everchanging man in an everchanging environment--lends itself to describing physiological or biological as well as psychosocial behavior of the human being. This adaptation theory was described by Helson (1964) and later utilized and expanded upon by Roy (1976) as a basis for the development of a model for nursing. According to Roy and Helson, if man does not adapt positively to bombardment by stimuli, disease may be the outcome. An adaptive response to stimuli is behavior which maintains the integrity of the individual; a maladaptive response is one which does not maintain integrity and is disruptive to the individual.

Adaptation, then, is viewed by Roy (1976) as a dynamic process with changing levels consisting of both sensitizing and desensitizing aspects and which involve external and internal energy initiation. According to Helson (1964) the adaptation level is the pooled effect of all stimuli. These stimuli are seen as being focal, contextual, or residual in origin. Focal stimuli are those immediately confronting the individual, contextual stimuli are background or all other stimuli in the environment, and residual stimuli include beliefs, attitudes, traits, and other factors from past experience which are relevant to the present situation (Roy, 1976).

Adaptation begins with a stimulus which demands an adaptive response. Any impulsion to respond comes from the disparity between the stimulation and the adaptation level. This disparity sets up a gradient which determines the strength of the response. The steeper the gradient, the greater the impact of the stimulus on the person and the greater will be his response to it. The strength of the response, however, depends not only on the strength of the stimulation but also on the adaptation level. Adaptation levels are viewed as a range or zone (rather than being fixed), and stimulation within this zone leads to a positive (adaptive) response and stimuli falling outside the zone lead to a negative (maladaptive) response (Riehl & Roy, 1974).

Roy's adaptation model has eight basic assumptions which includes the nature of man, health, illness, coping mechanisms, types of stimuli and adaptive modes. These assumptions are:

1. Man is a biopsychosocial being.

2. Man is in constant interaction with a changing environment.

3. To cope with a changing world, man uses both innate and acquired mechanisms, which are biological, psychologic, and social in origin.

4. Health and illness are one inevitable dimension of man's life.

5. To respond positively to environmental changes, man must adapt.

6. Man's adaptation is a function of the stimulus he is exposed to and his adaptation level. Man's adaptation level is determined by the combined effect of three classes of stimuli: focal, contextual, and residual.

7. Man's adaptation level is such that it comprises a zone which indicates the range of stimulation that will lead to a positive response. If the stimulus is within the zone, the person responds positively. However, if the stimulus is outside the zone, the person cannot make a positive response.

8. Man is conceptualized as having four modes of adaptation: physiologic needs, self-concept, role function, interdependent relations.

(Riehl & Roy, 1974, pp. 136-138)

The identified adaptive modes have basic needs as a focus. Needs are requirements within the individual which stimulate behaviors (responses) to maintain the physiologic, psychologic, or social intergrity of the individual. The physiologic adaptive mode relates to man's need for physiological integrity. For example, as the oxygen tension decreases at higher altitudes, the hemoglobin content of the blood increases in order to supply adequate amounts of oxygen to the individual. The individual has adapted physiologically to the stimulus of decreased oxygen tension in order to maintain physiological integity. Similar mechanisms operate on the psychosocial level (Riehl & Roy, 1974).

Regulator and cognator mechanisms have been identified by Roy as the two major types of adaptive mechanisms in this mode. The regulator mechanism readies the individual to cope with stimuli through approach, attack and flight. The cognator mechanism activities are manifested through thoughts, decisions and defense mechanisms. Man is seen as a total, unified being and stimuli may have an effect on more than one mode at any given time.

In this study the physiological mode was the focal point. This mode is based on the individual's need for physiological integrity and was assessed by measurement of the physiological variables described. Deviations from established norms were assessed as being maladaptive in nature. Physiological growth is a continuous period of changes and adjustments. Physiological integrity requires that the individual adapt to these changes. If predisposition to develop a physiological disease process is present, the individual, given appropriate intervention and/or adaptation, could not manifest the disease at all, or have well controlled disease state (adaptation), or could become symptomatic of the disease and have poor management or uncontrolled disease state (maladaptation). In order to relate physiological adaptation to hypertension, some review of the physiology of blood pressure is necessary and is included as follows:

Physiology of Blood Pressure

The level of arterial blood pressure is determined by a complex interaction of many physiological mechanisms acting simultaneously. It results from the interaction of physiologic systems contributing to the quantity and distribution of the vascular volume and cardiac output and the systems implicated in regulation of the vascular tone or elasticity. In physiological terms blood pressure is essentially a reflection of cardiac output and the vascular resistance which it meets, i.e.,

Blood Pressure = CO x R or Blood Pressure = (SV) (HR) (R)

when:

CO = Cardiac Output

R = Vascular Resistance

SV = Stroke Volume

HR = Heart Rate

(Hiner & Gruskin, 1977)

From a clinical viewpoint the above formula can be further modified to state that blood pressure is proportional to the volume times the degree of vasoconstriction (Laragh, 1975). Because the blood moves in waves through the arteries, there are two blood pressure measures:

1. Systolic pressure--the pressure the blood has as a result of contraction of the ventricles of the heart as it forces the blood into the arteries. This pressure is at the height of the blood wave.

2. Diastolic pressure--the pressure when the ventricles of the heart are at rest. This pressure is the pressure present at all times within the arteries.

Many factors influence both the vascular blood volume, cardiac output and the degree of resistance or vasoconstriction. Thus, factors related to cardiac output such as pulse rate, blood volume, presence of cardiac flow-impairing anomalies, or structural abnormalities can affect blood pressure. Increased vasoconstriction results from increased activity of the sympathetic nervous system. Angiotensen II (the end product of the renin-angiotensen-aldosterone system) is a very potent vasoconstrictor. Factors contributing to changes in volume include the activity of circulating mineralocorticoid hormones, the level of cardiac output and the renal modulation of fluid volume (Hiner & Gruskin, 1977).

Basically, arterial blood pressure in humans is regulated by the following mechanisms:

1. Carotid sinus reflex: pressure receptors located in the walls of the aorta and carotid arteries mediate the carotid sinus

reflex. If the pressure increases, these walls are stretched sending impulses to the medulla of the brain which, in turn, inhibits the sympathetic nervous system and excites the parasympathetic which leads to a decrease in heart activity and dilitation of peripheral arteries. Further, there is depression of cardiac activity and reduction of blood pressure. The reverse occurs if blood pressure falls.

2. Central nervous system and ischemic response: this response is only initiated if the blood pressure falls to approximately 20 mm of mercury (Hg) and is mediated by lack of circulating oxygenated blood to the central nervous system.

3. Arterial and venous blood volume: this mechanism is related to the ability of smooth muscles of veins and arteries to relax or contract depending on the volume they enclose. If arterial pressure increases through increased blood volume, the veins and arteries may stretch over a few minutes in order to accommodate new volume.

4. Tissue fluid: the capillary's ability to shift fluid in and out of the tissues permitting more adequate adjustment to larger volume increase or decrease is responsible for this mechanism.

5. Hormonal activity: this mechanism alters renal arterial pressure regulations through release of the hormone glomerulotropin from the brain cells and, through this mechanism, affects the secretion of aldosterone which acts on the renal tubulo-epithelium and causes absorption of sodium and retention of water.

6. <u>Hemodynamic response of the kidneys</u>: this relates to the response of the kidneys to change the arterial pressure dependent upon the renal blood flow and pressures with excretion or retention of fluids and salts as well as by reflexive action in the kidney and blood vessels (Keith, Rowe, & Vlad, 1978). Basically, the kidneys perform two major functions, that is, they excrete the end products of body metabolism and they control the concentrations of most of the constituents of the body's fluids. One such constituent associated with blood pressure levels is sodium; another is potasium. An increase in arterial pressure greatly increases the rate of urine formation and sodium loss into the urine. It has been postulated that when the arterial blood pressure rises too high, the renal output of sodium automatically increases (Guyton, 1968). While the physiological mechanism for elevations in blood pressure are not well understood, hemodynamic studies suggest that the development of hypertension may be a "homeostatic response to sodium-induced expansion of the extracellular fluid volume" (Tuthill & Calabrese, 1981, p. 72). The mechanism for regulation of potassium is less well known than that for sodium. Potassium ions, like sodium, are continually being excreted or reabsorbed by the renal tubules, but when aldosterone increases with sodium reabsorption in the distal tubules of the kidneys, potassium excretion increases. Thus, sodium and potassium are involved in an exchange reaction, the mechanism of which is not now known (Guyton, 1968).

In summary, the exact physiology of blood pressure and its regulation is not well known at the present time, but it does include a highly complex mechanism involving many bodily systems interacting simultaneously.

Pertinent Clinical Studies

In reviewing pertinent clinical studies, family history of hypertension, sex, race, anthrophological measurement, blood pressure measurement, cardiac status, sexual maturity level, urine sodium and potassium excretion levels as well as certain pertinent findings in terms of demographic factors related to blood pressure are included.

Family History of Hypertension

According to the Report of the Task Force on Blood Pressure Control in Children (1977), the best predictor of later hypertension is the level of blood pressure at an earlier date in the person's life or its presence in a child's parent(s). Heller, Robinson and Peart (1980) noted the value in assessing relatives of known hypertensives and Klien, McCrory and Engle (1981) reported excess concordance in monozygotic twins when compared with dizygotic twins in adulthood. Biron et al. (1975) found significant correlation between blood pressures of parents and their biological children but not between parents and adoptive children who lived in the same household. Havlik, Garrison, Katz, Ellison, Feinleib and Myrianthopoulos (1979) reported on a study of 197 pairs of like- sexed twins aged 7 years in which they found significant genetic variability for diastolic blood pressure with a heritability estimate of 0.53. In their study, while systolic blood pressure levels tended in the same direction as diastolic pressures, they were not statistically significant. However, the trends were comparable for both sexes and races. In discussing their findings, they suggested that even at 7 years of age there are substantial genetic influences on diastolic blood pressure levels.

Londe et al. (1975) studied 46 hypertensive children under the age of 15 years and followed them for at least 3 years. They found that although parental hypertension was more common among the hypertensive children than among normotensive children, over half of the children studied did not have hypertensive parents. In a study of 721 children, Zinner, Levy and Kass (1971) found that the variance of blood pressures within families was significantly less than among all children in the age group studied ($\underline{p} < 0.01$). This study was followed by a study of 837 newborn infants (age 1-6 days) and their mothers in which Zinner, Lee, Rosner, Oh, and Kass (1980) noted that while the blood pressure increased significantly with age in days, birth weight, weight on the day of measurement, arm circumference and ponderal index (height/weight ratio), no relationship was found with sex, race, pulse rate, type of feeding, or Apgar score. They did find a significant correlation ($r = .196$ for systolic and .157 for diastolic blood pressure, $\underline{p} < .001$) between maternal and infant blood pressure.

Finally, in the Tecumseh, Michigan, study (Higgins et al., 1980) of 2,400 persons under the age of 20 with a follow-up assessment after an average interval of 13 years, it was found that predictors of high systolic blood pressure for males who were 6-19 years of age at the beginning of the study were initial blood pressure levels, change of body fatness and the mother's blood pressure. For females in the same age range, predictors were the same as for males but also included the father's blood pressure level.

Sex

In a study by Swartz and Leitch (1975) of 496 adolescents, there was a significant difference between sex and systolic blood pressures with male adolescents having higher systolic pressure levels generally, but no significant difference was reported between sex and diastolic blood pressure. Swartz and Leitch also noted that the systolic blood pressure rises steeply in males 6-17 years of age and slightly from 17-19 years of age, whereas in females the peak of systolic pressure is at 12 years of age following which there is a decline in diastolic pressure. Kilcoyne (1975), in a study of 3,537 children aged 14-19 years, reported that systolic blood pressure levels were lower in females than in males.

Race

In adults hypertension is more prevalent in blacks than whites and is generally more severe. Vital statistics indicate that the mortality risk in blacks with hypertension is about two to six times greater than in whites and is a prognostic index. The racial difference applies more importantly to blacks under 50 years of age (Kochar & Daniels, 1978). Whaley and Wong (1979) supported this finding and noted that hypertension usually develops earlier in blacks than in whites and results in mortality at an earlier age.

Although several studies have indicated that blacks (male adolescents) are more vulnerable to the development of hypertension than are whites, Swartz and Leitch (1975) found a significant difference between systolic blood pressure and race but demonstrated no significant difference between diastolic blood pressure and race. In fact, in their study the highest mean blood pressure was found in whites. However, Londe et al. (1975) noted that generally blacks have higher blood pressures than do whites. More recently Goldring, Londe, Sivakoff, Hernandez, Britton, and Choi (1977) in a study of girls and boys found significantly higher mean blood pressures in white boys and the same or higher in white girls when compared with black children. This study was designed to provide contrasts in socioeconomic levels and racial origin and utilized high school students.

Harlan et al. (1979) found that the mean systolic blood pressure reported in the National Health Examination Survey in which there were 6,100 whites and 987 blacks was lower for blacks than for whites, but that the diastolic blood pressure was highest in blacks. A recent study by Voors et al. (1979) in which children were studied indicated that race is not consistently related to blood pressure in children. This study supported Kilcoyne's (1975) finding regarding race and blood pressure in adolescents.

Anthropologic Meansures

Harlan, Oberman, Mitchell and Graybiel (1973) noted a relationship between weight or body size and blood pressure in a cohort of adults. In assessing the parameters of height and weight on 3,524 children ages 5-14 years, Voors et al. (1977) cautioned that practical criteria for evaluating abnormal blood pressure levels in children should be based on normative values derived from body weight and body height rather than from chronological age. In a follow-up study they chose a ponderosity index (weight/height^3) instead of the use of body weight as an independent variable in order to avoid artifacts resulting from the highly positive correlation between height and weight. In addition, they measured skinfold thickness to determine adiposity in the child.

In a study of 1,692 black children in an elementary school setting, Lynds, Selyer and Morgan (1980) found that elevated blood pressure (systolic or diastolic blood pressure above the 90th percentile for age) whether in males or females was three times as likely to be found in obese children. The Tecumseh, Michigan, study reported by Higgins et al. (1980) noted that in 2,400 persons under 20 years of age changes in body fatness in both sexes were predictors of elevated systolic blood pressure levels.

The positive correlation between blood pressure and ponderosity is well established and is higher in younger than in older age groups. This phenomenen was described in studies by Lauer, Connor, Leaverton, Reiter, and Clarke (1975) and Voors et al. (1977). The importance of obesity and elevated blood poressure in adolescents for the development of hypertension in adults is suggested by the data from Paffenbarger, Thorne, and Wing (1968). Correlation between blood pressure and weight in young populations were demonstrated by Londe et al. (1975), as well as by Paffenbarger et al. (1968). In a study of males between 11 and 15 years of age, de Castro et al. (1976) reported a significant correlation with weight in each category of age. Children who were heavy for age tended to show higher blood pressures. In a group of both males and females, Kotchen, Kotchen, Schwertman and Kuller (1974) reported highly significant correlations between weight and blood pressure. Londe (1966) reported finding that in females there was a significant relationship between systolic and diastolic blood pressure and weight. Swartz and Leitch (1975) noted that of height and weight, weight had the greatest effect on blood pressure. Harlan et al. (1979), in describing results of the National Health Examination Survey, noted that weight was consistently correlated with blood pressure but stated that in growing children this factor reflected growth and adiposity.

Londe (1966) found that in females there was a significant relationship between systolic blood pressure and height. In a study of adolescent males aged 11-15 years, significant correlations were reported by de Castro et al. (1976) for height in each year of age. In this study children who were tall for age tended to have higher blood pressures. This held true for both sexes. Voors et al. (1977), in a study of 3,524 children found a strong association between height and blood pressure and, in fact, found height to be a more important correlate of blood pressure in growing children than age. Harlan et al. (1979), in comparative analysis using the Health Examination Survey data, reported that height was predictive of blood pressure levels only when skeletal age was not included in the analysis. Appendices L & M reflect weight and height ranges for males and female measurements (Whaley & Wong, 1979).

Voors et al. (1977), in the Bogalusa Heart Study, measured multiple risk factor variables for coronary heart disease in a total biracial community study of 3,524 children aged 5-14 years. Their findings suggested a strong influence of height and an additional influence of a weight/height index on blood pressure levels in the children studied. They concluded that the blood pressures "measured under basal conditions increases as the child grows and is proportional to lean body mass and total body mass" (p. 101). According to Harlan et al. (1979) the relationship between blood pressure and body mass is complex. They noted that indices of body mass are indirect measurements which include several body components. In addition, the inclusion of height with other measurements provides some correction for growth and, thus, indices of body mass whose computation includes height are fairly accurate. Johnston, Hamill and Lemeshaw (1972) reported that the average percent of body fat for boys was 21.61 and 20.14 for girls. Table 1 shows body composition for the 10 year old child.

Table 1

Body Composition - 10 Year Olds

Age	Height	Weight	Body Fat Percent
10	140 cm	31 Kg	15%

Tanner & Whitehouse, 1976.

In a longitudinal study of body fatness in childhood and adolescence Zach et al. (1979) emphasized the relationship of obesity to blood pressure in the child as did Siervogel, Frey, Kezdi, Roche and Stanley (1980). They noted that past studies have consistently indicated that the degree of adiposity in infancy is predictive of fatness in childhood and adolescence as well as adulthood. They also noted that the preadolescent period between 7 and 11 years (middle childhood) is a good time to study children because it is a period of accelerated growth and may indicate the beginning of obesity. The authors cautioned that during this period assessment of adiposity, especially through the use of weight/height ratios, is subject to error since skeletal growth and changes in lean body mass are related to adiposity and weight/height ratios continue to be ambiguous measures of body fatness. They supported the use of skinfold thickness which is a measure not dependent upon weight and height in assessing adiposity.

Harlan et al. (1979) supported the relationship of skinfold thickness to blood pressure in children and observed that the relationship persisted even when controlling for age (skeletal or chronological) and when controlling for height. As in Voors et al. (1977) study, skinfold thickness was highly correlated with weight/height ratio (Harlan used Quetelet Index and Voors used a ponderosity index) and the two variables were interchangeable in their ability to predict blood pressure. A similar finding was reported by Harlan et al. (1979) which held also for adolescents and adults. They noted, in addition, that the skinfold thickness measurement could be an important prognostic measure especially since it is known that relative body fatness persists through adolescence.

Advances in instrumentation recently have meant that there are currently a large number of anthropometric instruments available which purport to give fairly accurate measurements. Most of these instruments have been derived from physical anthropology. One such instrument is the Harpenden anthropometer which has low frictional forces and, in addition, has an easy to read digital display (Falkner & Tanner, 1978).

Very often poor reliabilities and standard errors are apparent in reports of studies involving skinfold measurement. Edwards, Hammond, Healy, Tanner and Whitehouse (1955) described their standard deviation of the differences between duplicate measurements taken by a single observer as being 0.3-0.6 MM at a jaw opening of 7 MM. The equivalent figures of different observers were roughly twice these values. An accuracy of 0.3-0.6 MM was described as being "sufficient for any presently conceivable purpose" (Falkner & Tanner, 1978, p. 70). Only proper training, experience, and practice as well as repeated consistency tests will provide the efficiency needed to have fairly accurate measurements.

If a large number of measurements are taken from different subjects, they do not follow a normal distribution except in the young or malnourished. Killeen, Vanderburg and Harlan (1977) noted that in the Health Examination Survey Quetelet Index had the strongest correlation with skinfold thickness and the "ponderosity" index ($weight/height^3$) had the weakest coefficient. Correlation as high as 0.8294 were found between Quetelet Index and skinfold thickness.

Cardiac Function

Harlan et al. (1979) noted past studies of children and young adults that found a consistent, direct relationship between pulse rate and systolic blood pressure. However, the relationship of pulse rate to diastolic pressure was not found in previous studies but was found to be of significance as reported by Harlan et al. They suggested that increased cardiac output is an important hemodynamic alteration in early hypertension and the increased cardiac output has been attributed to higher pulse rate and increased stroke volume. Their report of the study of 7,119 children in the Health Examination Survey (NHS) (aged 6-11 years) which was representative in regard to age, sex, race, and geographic region, found pulse rate to be related to blood pressure levels. The relationship of pulse rate and cardiac murmurs to blood pressure was independent of the other factors studied.

In the NHS study, murmurs were recorded by a pediatrician who noted whether or not the murmurs were associated with cardiovascular disease. Systolic murmurs were found in 27% of the children and diastolic murmurs in less than 1%. Only 3.5% of the murmurs were classified as "significant" and possibly related to cardiovascular disease. Their findings supported those of Paffenbarger et al. (1968). They concluded that the murmurs may be transient and the relationship "evanescent", with no prognostic significance. However, they did reassert the importance of the heart in blood pressure regulation. Marienfield, Telles, Silvera, and Nordsieck (1962) reported on a 20 year follow-up of "innocent" heart murmurs and confirmed the impression that low frequency vibratory murmurs of childhood are innocuous. Appendix O shows the normal heart rate ranges for children adapted from Whaley and Wong (1979).

Sexual Maturity

Katz, Hediger, Schall, Bowers, Barker, Aurand, Eveleth, Gruskin and Parks (1980) conducted a study of two samples of black adolescents (n = 562) stratified by sex and age (11-15 years) and a sample (n = 256) whose supine blood pressure was over one standard deviation above the mean at 7 years of age and who were followed for 3 years. They reported that the large variability of blood pressure that occurs at adolescence involves two phenomena: (a) increased weight for age is associated with high systolic blood pressure for age in childhood and (b) increased weight for age in childhood is associated with earlier maturity whether measured by skeletal age or onset of puberty. These findings were supported by Londe et al. (1975) as well as Voors et al. (1979) who used Tanner staging for sexual maturity levels in the Bogalusa Heart Study. In addition, Cornoni-Huntley et al. (1979), in a follow-up to the Health Examination Survey including children 12-17 years of age, found that sexual maturation was a significant predictor of blood pressure if weight and skeletal age were not included in analysis.

Sodium and Potassium Excretion

Many studies over the years have confirmed that there is a strong relationship between blood pressure and level of salt intake (Dahl, 1964, Dahl & Love, 1954). That is, societies with high salt intake have higher mean blood pressure levels, a high prevalence of hypertension and a pattern of blood pressure rise with age as contrasted with societies with low salt intake. Such societies have low mean blood pressures, low prevalence of hypertension and lack of blood pressure rise with age in adults (Tobion, 1979). Dahl (1964) noted a higher prevalence of hypertension in both obese and non-obese patients who had a history of high salt intake.

According to Tuthill and Calabrese (1981), based on studies by Dahl (1964) and Weinser (1976), among western nations the higher the dietary salt intake the higher the rate of hypertension. Further, the average daily dietary intake of sodium in the United States of 2.8 to 6.0 grams is greatly in excess of the requirements estimated to be 0.4 to 0.8 grams per day. Their study of 100 third grade students (50 males and 50 females) in which the children from a high drinking water source of sodium were compared with the same number of children from a low drinking water source found that the mean of three blood pressure measurements taken for each child showed a clear upshift in the blood pressure distributions of the high sodium community subjects when compared to the children in the low sodium community. The upshift was consistent for systolic blood pressure in both sexes. In addition, Siervogel and Glueck (1980), in a study of 154 white children (aged 8-18 years), found that, while not strongly supporting a relationship between sodium excretion and blood pressure levels in children, their findings did not rule out such a relationship, especially in families with a history of hypertension.

There are some exceptions to the many studies confirming the high salt intake-hypertension relationship (Grim, Luft, Miller, Rose, Christian & Weinberger 1980; Swaye, Gifford, & Berrettoni, 1972). Grim et al. (1980) compared urinary sodium excretion between blacks and whites in which no significant difference was found between the groups despite a higher prevalence of hypertension in the black group.

The correlation between salt intake and blood pressure also must take into consideration potassium intake. Weinser (1976) postulated that sodium/potassium ratio may act synergistically with the low salt intake. In addition, Watson, Langford, Abernethy, Barnes and Watson (1980), in a study of electrolytes and blood pressure in a sample of adolescent females (n = 662), noted an association between potassium excretion and systolic blood pressure which was a negative coefficient for potassium and a positive coefficient for the sodium/potassium ratio.

Quantative urine measurements of sodium and potassium are valid indicators of their intake under steady state conditions. That overnight versus 24 hour specimens are practical estimates of intake has been validated recently by a number of studies (Pietinen, Findley, Clausen, Finnerty & Altschul, 1976; Watson & Langford, 1970). Pietinen et al. (1976) demonstrated that the mean sodium excretion of three 10:00 p.m. - 7:00 a.m. urine collections correlated highly (r = 0.72 - 0.91) with mean 24 hour excretions of sodium. In addition, Liu, Coopert, Soltero and Stamler (1979) demonstrated the utility of overnight versus 24 hour specimens in children. Dahl (1958) also reported a close relationship between sodium excretion and consecutive 6-38 day urine collections (186 meq to 178 meq), and Liu, Coopert, McKeever, McKeever, Byington, Soltero, Stamler, Gosch, Stevens and Stamler (1979) recommended this procedure especially for children.

Demographic Variables

Harlan et al. (1979), in analyzing data from the Health Examination Survey, found no relationship between blood pressure and the following variables: (a) population density, (b) family income level, (c) educational attainment of parents, (d) intelligence quotient of subjects, (e) reported history of renal disease and (f) hearing levels measured by audiometry. In fact, analysis revealed only one significant relationship with blood pressure--systolic blood pressure was slightly (approximately 1 mm Hg) higher in the Southern region and diastolic pressure was slightly higher in the middle Western region for each sex-race group ($p < .01$) .

CHAPTER III

METHODOLOGY

Preliminary Study

A preliminary study utilizing three outpatient clinics for adult hypertensives was implemented the last two weeks of August, 1980, and included six children of parents receiving treatment for essential (primary) hypertension in hypertension clinics. The first clinic provided two children, the second clinic three children, and the third clinic one child. Of the six hypertensive parents who agreed to participate, data regarding their disease process, family history of hypertension, and other pertinent data were obtained in the clinic setting following established protocol during interview. At this interview parents were given an appointment to return with their child to the University of Alabama School of Nursing at a mutually agreed upon time for the child to be screened. Also, instructions for obtaining a urine specimen were given following protocol. Participants were paid $5.00 each in appreciation for the time involved.

Of the six parents who agreed to participate in the study and to allow their children to participate, only three returned to the screening area with their children for assessment. Upon inquiry by telephone, two reported they had forgotten the date and one reported he was unable to find the screening location. In addition, of the three children assessed, only two provided overnight urine specimens. The remaining child said her mother forgot to tell her to collect the specimen.

During the child screening, even though privacy was insured by following established protocol, all three children verbally expressed embarrassment at disrobing to underwear and one child refused to do so, although she allowed the researcher to arrange her clothing in such a way as to be able to determine breast maturity while assessing cardiac status and to view genital maturity while obtaining suprailiac skinfold measurement.

In follow-up to obtain non hypertensive neighbors who had children in the 9-11 year age range, telephone calls to those identified by the clinic patients participating in the study revealed that all neighbors identified reported that they were or had been hypertensive. Three reported they were currently under treatment with antihypertensive drugs on a daily basis, one reported she was hypertensive when taking oral contraceptives, and two reported periods of hypertension requiring medication during pregnancy.

Based upon these difficulties in obtaining an adequate sample within a reasonable period of time, the following changes were made with committee and the University of Alabama in Birmingham Institutional Review Board approval and consent from the Board of Education and a local elementary school principal:

1. The sample of children was drawn from 9-11 year old students attending an elementary school with 100% black population whose parent/guardian consented to participate through completion of parent information tool and its return to the school (Appendix A) and who gave written permission for the child to participate (Appendix B).

2. The sample of children was grouped according to whether or not parent(s) reported hypertension.

3. The sample of children was screened at the school during their scheduled physical education period during a one day screening session requested by the school.

4. Protocol for screening the children was adapted to decrease embarrassment by not removing children's outer clothing in order to assess physical maturity (Appendices D, E, & F).

5. The school maintained up-to-date health records for all students. Data regarding presence or absence of specific diseases or conditions which might influence blood pressure and whether or not the child was taking any medication on a regular basis were available within the school system and such information was relayed to the investigator by the school principal.

6. Follow-up blood pressure screening of all parents reporting non-hypertensive status was planned to validate reported status.

Protection of Human Rights

Prior to implementation of the study measures for the protection of human rights were specified and presented to the Institutional Review Board of the University of Alabama in Birmingham. The Institutional Reveiw Board determined that the subjects chosen for inclusion in this study were not at risk. However, during the course of the study, there was adherence to procedures specified for the protection of human rights.

At the time of the initial meeting between the investigator and the school board superintendent as well as the school principal, information related to the duration of the study, types of screening activities planned, and the type of information and assistance required from the school was reviewed. Upon principal and school board agreement to participate in the study the investigator met with all eligible students in the school and demonstrated the entire screening procedure on her son. Letters seeking consent of parent/guardian for parent and child participation in the study were sent to the parent under a letter of explanation and endorsement by the school principal (Appendix B).

The parent was asked to complete a data collection tool in writing regarding the child's biological parents to elicit information about individual and family health status and such demographic data as age, sex, educational level and level of employment (Appendix A). In addition to the parent consent, each child was asked to give written consent to participate in the study. Any child who had previously given written consent, but who upon the screening date verbally refused to participate, was withdrawn from the study.

Information regarding the child's past and present health status (i.e., report of existing disorders) was obtained from the child's school health record by the school principal and verbally related to the investigator.

All children whose letters of consent were signed and returned were given a numerical code. The master list containing the children's names and code numbers was retained in a locked file in the investigator's office. Urine collection containers bearing the children's names, once volume and a specimen for freezing (coded by name & number) were obtained, were taken by the investigator in large sealed opaque bags to a nearby sanitation department for burial in the city's landfill site on the day they were delivered. The investigator, after lengthy instruction and practice, performed all urine analyses for sodium and potassium levels using a flame photometer housed in the laboratory of a research center in a large metropolitan medical center and following recommended procedures (Operator's Manual, 1978).

The parent was sent a report of available screening data by the child on the date of screening (Appendix J). Any child deemed to have a blood pressure measurement 140/90 or above was given a report that the investigator would contact the parent by telephone that afternoon. All such parents were contacted by the investigator and referred to the child's private physician for further diagnostic evaluation.

No costs were incurred by the participants during the study. In gratitude for participation, all children asked to participate whether or not the parent gave approval were presented with McDonald's coupons. To provide anonymity for school and student participants, neither individual student names nor the school name appear in this report or any other reports of this study.

Setting

The study was conducted in an all black elementary school in the South. The elementary school was located in a suburban city whose population was approximately 15,000 and was adjacent to a large metropolitan area with a population of more than 700,000. The racial distribution within the suburban area was 52% white and 48% black. Of the black population in the work force, almost half were reported to be laborers, service workers or private household workers. Another 25% was made up of skilled workers. Approximately 29% of black families in this area were reported to have incomes below the poverty level. In addition, over 26% had a female listed as head of the household. In terms of education, the mean educational level for all blacks in this location was 9.3 years of school completed (U.S. Bureau of the Census, 1970). The setting for the child data collection was in the school health room designated by the school.

Sample

All children in the elementary school, ages 9-11, who met specific criteria were eligible for participation in the study. Excluded from participation were children with identified physiological and/or functional conditions known to influence blood pressure as well as conditions identified during screening which could influence the blood pressure. In addition, children who were the recipients of any treatment which could temporarily influence blood pressure were excluded from the study. Specific criteria included that the child: (a) provide written consent from parent/guardian to participate, (b) agree to participate, (c) be able to cooperate with the study procedure, and (d) have no school health record of sickle cell or other known blood or clotting disease, heart disease, kidney disease, asthma or severe allergies, or prescribed medication that might influence blood pressure such as mood elevators or tranquilizers.

Data Collection Procedure

The study consisted of two major areas of data collection - demographic data primarily of parents and physiological data of the children in the study. Included in demographic data was whether or not biological parents had hypertension, educational level and age of parents, parents' employment status and occupation as well as number of relatives to the third generation who had hypertension (Appendix A). Age and sex of the child were also obtained. Despite efforts to screen blood pressure on all parents reporting non-hypertension, it was impossible to do so because some lived out of the area and some in the area refused such screening. In an effort to try to identify any parent with hypertension, the investigator contacted by telephone at least one biological parent who gave information related to biological parents regarding whether blood pressure had been assessed within the past six months, if medication had been prescribed and if they had ever been told that their blood pressure was high. Physiological data on the children consisted of height, weight, blood pressure, heart rate, presence or absence of cardiac murmur and (if present) its grade along with skinfold measurements, sexual maturity assessment and overnight urine sodium and potassium levels (Appendix K). A discussion of the data collection procedure included those items discussed in the previous sections as well as the following: The investigator met with the teachers of all participating children and explained the overnight urine collection procedure and, after they verbally agreed to assist, gave each teacher a specimen container for each child participating in the study. On the day before the children were screened, the teachers verbally explained the urine collection procedure, answered any questions the children had, and gave each child a urine collection container with written directions of collection (Appendix G).

The day of the screening all teachers collected the labeled urine specimens, tightened the container lids, and placed them in plastic bags with containers of ice to keep the specimens cool.

The specimens were measured for volume and two 10 cc specimens were frozen until flame photometry could be done. All specimens were labeled with the childs' name and identification number. After giving the urine specimens to the investigator, the teachers kept all children in the regular classrooms until the investigator notified the teacher the child could be screened.

The sequence of the data collection procedure was the same for all participants (Appendix C). The approximately 1 hour data collection procedure consisted of the child moving through six stations where data were collected. At Station One the participant was identified as having consent form signed and parent data form completed. The child was then given a coded identification number which was placed on the Child Screening Tool (Appendix K). The child was then weighed and measured (Appendix D) by the same nurse. The child, along with his data collection tool, then progressed to Station Two where his blood pressure was taken following established protocol (Appendix E). Five nurses participated in collecting the blood pressure data. Inter-rater reliability for blood pressure measurement was determined by a two-tailed _t_-test. For the variables systolic and diastolic blood pressure, correlations of .98 for systolic and .90 for diastolic blood pressure were obtained.

These findings indicate a very high internal consistency between the nurses taking simultaneous blood pressure measurements on a subject, with better consistency in taking systolic pressure than in taking diastolic. Table 39 (Appendix CC) shows the results of the *t*-test.

Once blood pressure data were obtained and recorded the child progressed to Station Three where body fat measurements were obtained (Appendix H) and genital maturity (Appendix I) assessed according to established protocol. These data were obtained in a screened area with only the nurse and the child present. One nurse collected these data on all participating children. Once data were recorded the child progressed to Station Four where heart rate, presence or absence of heart murmur and female breast maturity were assessed following established protocol (Appendix F). These data were collected by one nurse on all children who participated in the screening. The screening area was isolated from the rest of the room and only the nurse and the child were present. Once these data were recorded the child progressed to Station Five where the data collection tool was collected. A nurse reviewed the tool to ascertain that all data were obtained and the child was then sent to the appropriate classroom with a completed Report to Parent form (Appendix J).

At all stations the nurses verbally interacted with the children in an effort to decrease anxiety and procedures were explained to the children as they progressed through the screening area. At Station Two, four students were screened for blood pressure levels at the same time and children were permitted to verbally interact with their peers during this time.

All nurses collecting data were registered nurses who had clinical experiences working with children. Three of the nurses held a master's degree in nursing and one a doctoral degree in nursing. All were instructors of beginning nursing skills, including blood pressure measurement, in a university school of nursing. One nurse held a master's degree in nursing and worked as a nurse practitioner in Medicaid screening of children in the local county hospital. The investigator screened all participants for body fat measurements and genital maturity. The nurse who screened the children for heart rate, presence or absence of heart murmur and murmur grade as well as female breast maturity held a bachelor of science in nursing and certificate of nurse practitioner in the area of cardiovascular nursing. Her work experience included evaluating heart rate and heart murmurs in infants and children. All nurses were blind to the child's group placement.

Data Analysis

Demographic and physiological data obtained on each subject were tabulated and analyzed with statistical tests to answer the null hypotheses derived from the research hypotheses. These hypotheses were:

HO_1: There are no statistically significant differences in physiological variables measured between children of reported hypertensive and non hypertensive parents.

Subhypothesis 1:

There are no statistically significant differences in physiological variables measured between children of reported hypertensive and non hypertensive parents by specific age.

Subhypothesis 2:

There are no statistically significant differences in physiological variables measured between children of reported hypertensive and non hypertensive parents by specific sex.

HO_2: There are no statistically significant differences in demographic variables between children of reported hypertensive and non hypertensive parents.

Subhypothesis 1:

There are no statistically significant differences in demographic variables between children of reported hypertensive and non hypertensive parents by specific age.

Subhypothesis 2:

There are no statistically significant differences in demographic variables between children of reported hypertensive and non hypertensive parents by specific sex.

HO_3: Hypothesis 3 generated 2 research questions as follows:

1. Which physiological and demographic variables best descriminate between the children of reported hypertensive and non hypertensive parents?

2. With what accuracy (%) can subjects be classified as children of reported hypertensive or non hypertensive parents?

The Statistical Analysis System (SAS) was used for data analysis.

The data were treated with a two-tailed t-test which compared group to group means to determine significant differences. In addition, the two-tailed t-test was utilized to compare means of the variables obtained for specific age and sex. Analysis of Covariance was utilized to determine if significant differences remained with specific variables held constant.

Confidence level was placed at .05. While this level of confidence may allow greater possibility of a Type 1 error, for the purposes of this study, rejection of a true null hypothesis was considered an acceptable risk.

To answer the two research questions regarding which variables could more accurately classify the subjects into their group as well as determining with what accuracy the subjects could be classified, discriminant analysis was the method utilized.

CHAPTER IV

FINDINGS

Description of the Sample

Of 43 parents reporting presence of hypertension in parent(s) (Group 1) and 77 reporting no hypertension in either parent (Group 2), 100 children met sample criteria for inclusion in the study. There were 41 in Group 1 and 59 in Group 2. In Group 1, 30 reported hypertension in the mother only, 13 in the father only and 9 reported hypertension present in both parents.

After preliminary tabulation, few differences were found between the small number (15) of 9 year olds and the 10 year olds. Further, since all 9 year olds were past their ninth birthday by at least three months, they were combined with the 10 years olds to facilitate data analysis. Table 2 gives the age and sex distribution of the two groups.

Table 2

Group and Sex Distribution of Children by Age

	Age 9, 10 years	Age 11 years
Group 1		
Female	10	11
Male	12	8
Group 2		
Female	16	9
Male	15	19
Total	53	47

Physiological Variables

The purpose of this study was to determine if black children of hypertensive parent(s) had different characteristics than children of non hypertensive parents. Null hypotheses and subhypotheses tested were:

HO_1: There are no statistically significant differences in physiological variables measured between children of reported hypertensive and non hypertensive parents.

The two tailed *t*-test revealed no statistically significant differences between the groups in regard to the physiological parameters measured. Tables 3, 4, and 5 (Appendix P) describe these findings. The null hypothesis failed to be rejected.

HO_1:

Subhypothesis 1:

There are no statistically significant differences in physiological variables measured between children of reported hypertensive and non hypertensive parents by specific age. There was a statistically significant difference between genital maturity stage in the 11 year olds (males) between the groups ($p = 0.02$). Table 10 (Appendix R) shows this finding. The null subhypothesis 1 for HO_1 was rejected.

It is of interest to note that cardiac murmurs were determined to be present in 25 of the 100 children screened. Eleven were in Group 1 (9 were 9, 10 year olds and 8 were males) and 14 in Group 2 which consisted of 10 eleven year olds, 9 of which were females. Twelve were classified as Grade 2 and the remainder as Grade 1. All were systolic murmurs with no radiation to carotid arteries. None of the children assessed as having cardiac murmurs had unusual pallor, shortness of breath, cyanosis or chest heaves or lifts. None, upon questioning, verbalized shortness of breath or excessive fatigue or fainting. In addition, according to school health records, none was currently receiving medication or followup for cardiac or other health problems.

The two tailed t-test revealed a statistically significant difference between the groups in regard to cardiac murmur grade in both the 9, 10 year olds ($p = 0.04$) and the 11 years olds ($p = 0.04$). Tables 6 and 7 (Appendix Q) give these results. In addition, Tables 8 through 11 (Appendix R) list all physiological variables and results of the t-test for age.

HO_1:

Subhypothesis 2:

There are no statistically significant differences in physiological variables measured between children of reported hypertensive and non hypertensive parents by specific sex.

The two tailed t-test revealed a statistically significant difference in blood pressure measurement for females as follows:

1. Supine diastolic blood pressure - second measurement (DBP_2) was significantly higher for females in Group 1 ($p = 0.004$) than for females in Group 2.
2. Supine systolic blood pressue - third measurement (SBP_3) was significantly higher for females in Group 1 ($p = 0.04$) than for females in Group 2.
3. Supine diastolic blood pressure - third measurement (DBP_3) was significantly higher for females in Group 1 ($p = 0.01$) than for females in Group 2.
4. Average supine systolic blood pressure (SBP_4) was significantly higher for females in Group 1 ($p = 0.04$) than for females in Group 2.
5. Average supine diastolic blood pressure (DBP_4) was significantly higher for females in Group 1 ($p = 0.005$) than for females in Group 2.

6. Sitting diastolic blood pressure (DBPS) was significantly higher for females in Group 1 ($p = 0.01$) than for females in Group 2.

Tables 12 through 17 (Appendix S) give the t-test results by sex.

Upon removal of the female subject in Group 1 whose blood pressure met criteria for referral to physician, all blood pressure measurements between the groups remained significantly different with the exception of average supine systolic blood pressure (SBP_4): Group 1 $\bar{X} = 111.95$ and Group 2 $\bar{X} = 106.82$ ($t = 1.73$, df = 50 $p = 0.08$). The null hypothesis was rejected.

In addition to differences between the groups in specific blood pressure measurements, for females, there was a significant difference in sodium levels (meq/L) between the groups: Group 1 $\bar{X} = 19.034$ and Group 2 $\bar{X} = 26.094$ ($t = -2.155$, $p = 0.036$, df = 48). Females in Group 2 had significantly higher levels of urine sodium excretion than those in Group 1 and there was also a significant difference in potassium levels (meq/L) between the groups: Group 1 $\bar{X} = 4.482$ and Group 2 $\bar{X} = 6.685$ ($t = -1.980$, $p = 0.05$, df = 48). Again, females in Group 2 had significantly higher levels of potassium excretion than those in Group 1. Table 18 (Appendix T) gives the urine sodium and potassium excretion levels for group, age and sex. The null hypothesis was rejected.

It is of interest to note that 92% of the subjects returned overnight urine specimens for analysis. The mean sodium level for combined age, sex and group was 145.47 meq. The mean potassium level was 37.48 meq. Urine volume was 198.67 ml. and ranged from 25-500 ml. The mean number of hours was 9.6 with a range of 8-12 hours reported.

In terms of other physiological variables measured, the following results were obtained:

Blood Pressure: Table 19 (Appendix U) shows the blood pressure measurements obtained for combined age, sex and group. For systolic blood pressure range was 80-156 mmHg and 42-94 mmHg for diastolic. Table 20 (Appendix U) gives the mean blood pressure levels by group. One child, an 11 year old female in Group 1 had a systolic blood pressure of 152 supine, 152 sitting and 148 standing. One 10 year old had supine systolic blood pressure of 129 and another 130 mmHg to place them in the 90th percentile for age and sex; one was from each of the two groups. In addition, females had higher blood pressures, both systolic and diastolic, than did males regardless of group. Appendix V Tables 21 through 24 gives the percentile distribution of blood pressure by age and sex for group.

Height: The range for all subjects was 130-173 cm. with a mean of 145.47 and a standard deviation of 8.89. Tables 25 and 26 (Appendix V) give mean height by sex for age and group and shows little differences in height for the subjects in the study.

Weight: The range for all subjects was 24-103 Kg with a mean of 40.5 and a standard deviation of 13.38. Table 27 (Appendix W) gives mean height, weight and Quetelet index for sex, age and group. For group, age and sex, females were generally heavier than males.

Heart Rate: Twelve children of the 98 children whose heart rates were recorded had heart rates above 90/minute - none exceeding 108/min. No child had a heart rate below 62/min. Mean heart rate for both groups and sexes was 83.99/minute with a standard deviation of 11.18.

Skinfold Thickness: Skinfold measurements of the children are summarized in Tables 15 and 16. While thicknesses for biceps, triceps, subscapular and supra iliac skinfolds were readily measurable in children who were overweight for height, calf thickness was difficult to measure, and was not obtained in 20 subjects because of this problem. Tables 28, 29, and 30 (Appendix X) show skinfold measurements for combined age, sex and group as well as giving the measurements by sex and age for group.

Sexual Maturity Level: For combined groups and ages, female breast maturity stage ($\bar{X}$) was 2.96. Pubic hair distribution for males was staged at 2.0 for Group 1 and 1.96 for Group 2. Male genital development was similar for both groups (2.81 for Group 1 and 2.60 for Group 2). Combined sexes, group, and age sexual maturity levels were as follows:

Genital and breast development = 2.79 (Stage)

Pubic hair distribution = 2.48 (Stage)

Table 31 (Appendix Y) shows these findings.

Demographic Variables

The statistical hypotheses related to demographic variables are as follows:

HO_2: There are no statistically significant differences in demographic variables between children of reported hypertensive and non hypertensive parents.

The two tailed *t*-test revealed signficant differences in the groups for mothers' age (*p* = 0.03) and for fathers' age (*p* = 0.01) with both parents in Group 1 being older than those in Group 2. Table 32 (Appendix Z) gives the results of the *t* test for all demographic variables with group to group comparison. The null hypothesis was rejected.

HO_2:

Subhypothesis 1:

There are no statistically significant differences in demographic variables between children of reported hypertensive and non hypertensive parents by specific age.

The two tailed *t*-test revealed no statistically significant difference between the groups in regard to subjects age. Tables 33 and 34 (Appendix Z) give the results of this test. The null hypothesis failed to be rejected.

Subhypothesis 2: There are no statistically significant differences in demographic variables between children of reported hypertensive and non hypertensive parents by specific sex.

The two tailed t-test revealed that for male subjects, father's age was signficantly greater for Group 1 than for Group 2 ($p = 0.02$). Tables 35 and 36 (Appendix Z) show the results of the t-test for demographic variables by subjects sex. The null hypothesis was rejected.

In order to examine group differences while controlling for parent age, analysis of covariance was employed for the physiological variables measured. Table 37 (Appendix AA) gives the results of the analysis. With the exception of potassium excretion (meq/L) in which $p = 0.057$, none of the F values was significant for the variables measured.

For the demographic variables obtained, a summary follows: In terms of employment, 58% of the mothers and 18% of the fathers were reported as being unemployed. As to type of employment 36% of the mothers and 24% of the fathers reported employment in essentially unskilled areas.

All participants reported number of hypertensive relatives to the third generation. The mean for Group 1 was 1.317 and for Group 2 was 0.779. No indication of family size was obtained.

Hypothesis 3 generated the following research questions:

1. Which physiological and demographic variables best descriminate between the children of reported hypertensive and non hypertensive parents?

2. With what accuracy (%) can subjects be classified as children of reported hypertensive or non hypertensive parents?

In order to answer these questions, backward stepwise discriminant analysis was employed. Because of difficulties with retaining cases with missing data, the following variables were used as they were without significant missing values and, therefore, could enter the analysis: height, weight, sex, age, average supine systolic and diastolic blood pressure (SBP_4, DBP_4), systolic and diastolic blood pressure sitting (SBPS, DBPS) and standing (SBPST & DBPST), Quetelet index, heart rate, presence of cardiac murmur, murmur grade, sexual maturity stage (combined) and urine sodium and potassium levels. Thirty-two of the 100 subjects (cases) were not included due to missing data. Of the 68 observations (subjects) included in the analysis, 27 were from Group 1 and 41 from Group 2.

To answer the question of which variables studied best discriminated between the children of reported hypertensive and non hypertensive parents, discriminant analysis finding Wilk's Lambda was used. The smaller the Wilk's Lambda value, the higher the F-ratio (univariate F), the more differences there are in the groups. In this case, Table 20 summarizes these values in the backward stepwise discriminant analysis employed to show that, while none is at a statistically signficiant level ($p = 0.05$), the variables best discriminating the groups were systolic blood pressure sitting (SBPS) and average supine systolic blood pressure (SBP_4) along with urine potassium (meq/L). Those with higher Wilk's Lambda values (and lower F-ratios) giving least discrimination between the groups were measures of sexual maturity, heart rate, age and diastolic blood pressure sitting (DBPS). With all variables to meet the significance level to remain in the analysis (0.10) Wilk's Lambda was 0.91603 and F (18.73) was 0.372.

To answer the question "with what accuracy can the subjects be classified as children of reported hypertensive or non hypertensive parents" backward stepwise discriminant analysis, through the use of variables listed on Table 38 (Appendix BB), revealed the percent of "grouped" cases correctly classified was 73.5% ($p = 0.002$). This means that less than 26% of the children were misclassified through the use of these variables when compared to their actual group placement. Therefore, in this study the use of the variables included permitted fairly accurate classification of the children into their respective groups while not meeting the level anticipated (75%). Table 33 (Appendix AA) gives results of this analysis.

CHAPTER V

DISCUSSION AND CONCLUSIONS,
IMPLICATIONS, RECOMMENDATIONS

Discussion and Conclusions

Review of the literature revealed the need for community-based studies of variables associated with blood pressure in "at risk" groups of children. Black children with first degree family history of hypertension constituted significant risk for later development of hypertension. The present study was conducted to determine if differences exist between 9, 10 and 11 year old black school children of reported hypertensive (Group 1) and non hypertensive (Group 2) parents in regard to physiological variables commonly associated with increased blood pressure as well as such demographic variables as parent's age, educational level, occupation and number of family members who reportedly have hypertension.

To examine differences in the two groups, 3 major and 4 subhypotheses were tested. In addition, two research questions were explored. The data collected from a small (n=100) sample of black school children offered interesting comparisons with National Health Examination Survey (NHS) data as well as with findings from the Bogalusa Heart Study.

In terms of the hypotheses posed, statistically significant differences were not found in the physiological variables measured between the groups when discounting age and sex of the participants. However, there were significant differences between ages and sexes from group to group for several of the variables. For example, the third supine systolic blood pressure measurement (SBP_3) and average supine systolic blood pressure (SBP_4) were significantly higher for females in Group 1 than for females in Group 2. This held true for diastolic blood pressure measurements (DBP_2, DBP_3, DBP_4 and DBPS). These differences were influenced to some extent by an outlier - a female subject in Group 1 whose blood pressure (both systolic and diastolic) was much higher than others found in the study. However, significant differences between the groups at the $p = 0.05$ level of significance were still present for both average systolic and diastolic blood pressure (SBP_4 & DBP_4) when not considering this subject, although not in the remainder of the blood pressure measurements. When comparing data from this study with NHS data, males were generally below national levels for blood pressures, while females (of both groups) were generally higher in all of the percentiles. Like national data, females in this study had higher blood pressure levels than males and 11 year olds for both sexes had higher blood pressures than did 9, 10 year olds. For age and sex by group, the values in percentiles were compared with those for the same race, age and sex from the National Health Survey data (Appendix DD).

For systolic blood pressure, 9 and 10 year old females in both groups (Table 21 Appendix V) were higher than NHS percentiles (Table 40 Appendix DD). In addition, Group 1 11 year olds were consistently higher and the 75th, 90th and 95th percentiles showed a wide disparity in the systolic blood pressure. One child, an 11 year old female in Group 1, had a systolic blood pressure of 152 supine, 152 sitting and 148 standing. One 10 year old had a supine systolic pressure of 129 and another 130 to place them in the 90th percentile for age and sex; one was from each of the two groups. Group 2 females (except for slightly higher levels in the 90th and 95th percentiles) had levels below NHS values in all percentile distributions with as much as 7 mmHg differences in the values. The means for average systolic and diastolic blood pressure by age were across the board higher than those reported by Voors et al. (1976) in the Bogalusa Heart Study.

For males, up to the 75th percentile group and NHS data were consistently close for both ages. Past the 75th percentile 9, 10 year olds are higher for the groups and for 11 year olds and the 75th and 90th percentiles show higher levels (up to 5.8 mmHg) for males in both groups than those reported for NHS data (Table 41 Appendix DD).

For diastolic blood pressure Group 2 ages 9, 10 and 11 year old females had percentiles close to or lower than the NHS Data. Group 1 ages 9, 10 and 11 were consistently higher than that found in the NHS data. One 11 year old in Group 1 had a diastolic pressure of 90 supine, 94 sitting and 94 standing. One other female in Group 1 had a diastolic pressure at 89. No other child in the study had a diastolic pressure above 89 mmHg. Thus, the only children having diastolic blood pressure levels in the 90th percentile were both members of group 1.

While Group 1 9, 10 year olds were closer to those reported in the NHS data, 9 and 10 year old males in Group 2 consistently had higher percentiles than did 9, 10 year olds in the NHS data. For 11 year olds, both groups were consistently higher than the NHS data, in some cases close to 10 mmHg separated the findings. However, for males in both groups only one child had diastolic blood pressure in the 90th and 95th percentile. Table 41 (Appendix DD) reflects diastolic percentile for males and NHS data are reflected in Table 40 (Appendix CC).

In terms of blood pressure, physiological adaptation to the familial influence of hypertension may be manifested earlier in females and detected by both systolic and diastolic blood pressure levels, and may be especially noted when averaging several blood pressure measurements. While Harlan et al. (1979) noted the biological inference that growth and increased body size are associated with adaptation of the cardiovascular system and include increased blood pressure, in this study other factors related to physiological maturation such as height, weight and skinfold thickness demonstrated no significant differences between the groups. There were differences in these variables between males and females and between 10 and 11 year olds which indicates growth and development, but not within sexes or ages between the groups. Thus, females comprising Group 1 may be at greater risk for developing adolescent or adult hypertension than those females in Group 2 when considering Oberman, Lane, Harlan, Graybiel and Mitchel (1967) findings of tracking of blood pressure over time.

Another physiological variable which was found to be significantly different between groups was the presence of cardiac murmur and their grade. Nine of the 11 children in Group 1 who were found to have cardiac murmur were 10 year olds, but only 5 of the 14 in Group 2 were 10 year olds. In addition, for 10 year olds in Group 1 murmurs were graded higher than for Group 2 and the opposite was true for 11 year olds. However, since only 25 of the 100 subjects had cardiac murmurs, given a larger sample of more evenly distributed ages in groups, the differences may not have been significant. As noted by Harlan et al. (1979), murmurs can be highly transient with little prognostic significance. While factors such as lack of standardization of grading, chest wall thickness and rapid pulse rate in children in this age range make grading murmurs difficult, findings in this study are comparable with findings of the National Health Examination Survey in which systolic murmurs were detected in 27% of the children, but only 3.5% were classified other than "innocent." Of the innocent murmurs detected prevalence was 26.0% for black children.

For heart rate, 11 year olds for both groups had a slightly higher rate than did 10 year olds. Females had a slightly higher rate ($\bar{X}$ = 86.39) than did males in Group 1 ($\bar{X}$ = 79.21), but rates were similar for both males and females in Group 2.

In terms of sexual maturity, significant differences were found between the groups in 11 year old males as to staging of genital development. Group 2 males were consistently staged higher than Group 1 males. Staging of male genital maturity across the groups and ages in the present study was higher than those reported in the Bogalusa Heart Study even though both studies used the Tanner Scale (pictoral and written description). In the present study, it was extremely difficult to differentiate visually between the stages - especially in uncircumcised males as were the majority of these children. In addition, the very short time available for inspection (while measuring the suprailiac skinfold) was inadequate and often had to be repeated. The children, too, verbally expressed embarrassment at this observation because of necessary clothing adjustment and sometimes would not permit close observation. For pubic hair distribution across the groups and ages, females were more advanced than were males. The Bogalusa Heart Study (Voors et al., 1979) reported that black children of both sexes progressed through each Tanner Stage at an earlier age than did white children and found that staging between 2 and 3 was found in black males at the following age levels:

Pubic Hair - 11.72 ± 0.25

Genitalia - 11.16 ± 0.27

(50% transition - Kärber's method)

In the present study males were staged considerably higher than in the Bogalusa Study for both groups and ages. For females, the findings were similar for those in this study and those participating in the Bogalusa Heart Study.

For the variables of sodium and potassium overnight excretion levels, there were significant differences between the groups in females. However, unlike studies noted in the literature regarding high sodium/low potassium or low sodium/high potassium ratios, Group 2 showed high sodium and high potassium excretions for females. Based on previous studies of Tuthill and Calabrese (1981) and Grim et al. (1970) it would be likely that, since females in Group 1 had higher blood pressure levels than did females in Group 2, high sodium and low potassium outputs would characterize females in Group 1 - not Group 2. In the present study this did not hold true, and with no attempt to determine or control dietary sodium and potassium intake and with only one overnight urine specimen for analysis, this finding (in isolation) may have little relevance.

The variables of height, weight, Quetelet index, heart rate, breast development in females and skinfold thickness showed no significant differences between the groups by sex and age; however, there were differences between the sexes and ages for the variables related to maturation as has been found in various other studies. In Group 1 9, 10 year old females were slightly taller than their male counterparts, but the difference was minimal for 11 year olds. In Group 2 there was very little difference between the sexes for age.

For height, comparing these data with NHS data, all values were at or below the 50th percentile for both groups, sexes and ages, and in comparing these data with findings of the Bogalusa Heart Study (Voors et al., 1976), 9, 10 and 11 year old females in both groups were near the mean for the Bogalusa Heart Study. Table 41 (Appendix DD) shows findings from the Bogalusa Study for height.

In Group 1 9, 10 and 11 year old females were heavier than were 9, 10 and 11 year old boys. This was true also for 11 year olds but not 9, 10 year olds in Group 2. It was not possible to compare weight and height percentiles for this sample with national data in a precise manner as the methodology for grouping by age differed, but the mean for 9, 10 year olds in Group 1 (42.17 Kg) was extremely close to the 90th percentile for national data which was 43.16 Kg (n=1977). In addition, the data from the National Survey are not broken down by race.

Percentiles for 11 year old females also reflected that they were heavier than those in the National Survey ($\bar{X}$ for group 1 = 47.25 Kg and national data 90th percentile = 47.72). Group 2 females who were 9, 10 years old were near the 50th and 11 year olds were near the 90th percentile when compared with the national data. However, males in Group 1 for both 9, 10 and 11 year olds were near the 50th percentile when compared to national data while those aged 9, 10 in Group 2 were slightly lower and 11 year olds slightly higher (n=4100). None of the males in either group approached the 90th percentile for national data.

Males in both groups were near the means found for black children in the Bogalusa Heart Study, while females were heavier than those reported in the Bogalusa Study. Quetelet index demonstrated higher relative weight for females across ages and groups than for males.

Also, in terms of the demographic variables reported (parents age, education, occupation and number of relatives to the third generation with hypertension) when parents age was adjusted for group, no significant differences were found between the groups except for potassium meq/liter. These findings support those of the National Health Examination Survey. In addition, except for a higher mean educational level in the present study, the demographic variables reported were similar to report of the US Bureau of the Census (1970) for the area studied.

The attempt to classify the subjects into groups reflecting presence or absence of hypertension in their parent(s) resulted in a high percentage of discrimination accuracy (73.5%, $p = 0.002$) in this study although none of the variables used in the analysis approached the 0.05 level of significance. The variables best able to discriminate were blood pressure, urine potassium and the variables associated with growth (height, weight and Quetelet index). Whether this indicates normal rise of blood pressure with growth as suggested in the literature or a significant parameter to be considered in determining "at risk" children for later development of hypertension is open to speculation.

While group to group differences were noted in this study for several of the physiological variables studied and there was fairly accurate classification of subjects into their respective groups through discriminant analysis, reporting by parent of hypertensive status was of questionable reliability. Follow-up on the questionnaire by telephone interview and attempts to screen parents who reported non hypertensive status were fraught with difficulties. Some parents could not be contacted by any means available for validation of reported status. Thus, more positive identification of parents actual hypertensive or non hypertensive status would have strengthened those findings of group to group differences.

Implications

This study has implications for both research and clinical nursing practice especially in the area of school and community health as follows:

1. Actions and comments of the children during screening indicated that having these essentially routine assessments was a new experience for many of them. In addition, the screening was geared to a fairly constant flow of children to meet the school's constraint in terms of time for screening activities and provided little time to assist the participants in learning about the activities and their own health status. More time during the actual screening was needed in order to provide health education to the children involved in the study. Nursing activities within a

school system such as this could have a very positive effect on school children in terms of their knowledge about their own health in an ongoing program of health assessment with emphasis on self-care from an early age. In addition, because of their lack of familiarity with these essentially routine procedures, need for other types of health screening such as anemia or scoliosis screening seem indicated in this setting where large numbers could be evaluated and results assessed in terms of identifying areas of health care deficits for groups of children with common needs.

2. There was much support for the research project within the school system studied - probably generated from their participation in a longitudinal blood pressure study in adolescence conducted in a local high school, but also influenced by one of the school children (aged 13) in the community who had a stroke associated with undetected hypertension some months prior to implementation of the present study. The community itself, in the wake of those events, is potentially more receptive to vigorous screening activities as well as research efforts in the area of hypertension. Indeed, of the parents who returned questionnaires regarding whether or not they had hypertension (regardless of whether the children participated in the study), over 28% of all those polled reported hypertension present. The community is all black in composition, and the residents are in a lower-socioeconomic strata which implies less frequent routine checkups and thus, increased likelihood of undetected hypertension. This is a community that could benefit greatly from nursing activities

related to early detection of hypertension, referral and follow-up care and offers much challenge in the area of research since positive responses to the query of whether or not hypertension was present were far greater than that found in the general population.

3. The current school record contained information concerning disorders that would have excluded them from the study. Since these are kept up to date through the efforts of volunteer nurses in the community, screening results would be of potential future benefit to the children if maintained on the school health record as a possible resource for nurses already in the school system to use as baseline data. This would be of continuing usefulness in identification of and planning for areas of school health needs.

4. Although adequate privacy was provided, genital assessment (especially of males since not only pubic hair distribution but also genital size was assessed) was hurried. As a result, data obtained are of limited usefulness. In addition, one nurse doing five skinfold measurements and, at the same time, observing genital maturity in uncircumcised males was a very complex task better suited to two observers. Not only was more time needed for observation purposes, but also to provide verbal interaction with the children in order to decrease their embarrassment about this procedure.

5. In terms of group placement, there was questionable reliability of group membership. Although screening of parents' blood pressure when they reported non hypertensive status was part

of the planned methodology, the reality of the situation was such that it was impossible to contact both biological parents of each child and to obtain a blood pressure measurement for them. Alternate methods of verifying group membership with more accuracy are needed in future research endeavors.

In addition, all children meeting the criteria for inclusion in the study were screened with no effort to control numbers for age and sex. Thus, there were very few 9 year olds who were then, for purposes of analysis, grouped with the 10 year olds. Since the study was limited to one elementary school, no other 9 year olds were available for inclusion. Some possible important findings may have been undetected due to grouping in this small sample.

6. Adaptation to familial risk of hypertension may be more easily identified in female's blood pressure levels in the age groups studied than in males. There were significant differences in blood pressure measurement with females whose parent(s) reported hypertension than those who reported no hypertension in either parent. In addition all females studied had generally higher blood pressures than those found in the NHS study and higher than their male counterparts of the same ages in this study. Possibly confounding the significance of this finding could be normal increases in blood pressure in females associated with earlier maturity. Harlan et al. (1979) noted that since females experience a pubescent growth spurt at 10 to 11 years of age which is delayed in males, this may account for the higher readings in females.

However, there were no significant differences in females between groups for other variables that indicate maturation such as height, weight and sexual maturity stage. In addition, while only one subject had a blood pressure meeting the criteria for referral to physician (a female), several children, notably females, were above the 75th percentile for group, sex and age in blood pressure measurement. The current trend to consider children who fall into the 80th or 90th percentile as needing follow-up care and intervention in such areas as weight control, dietary restriction of cholesterol and sodium restriction as well as routine monitoring of blood pressure has implications for clinical nursing and follow-up studies of children falling into these percentiles as these are unique areas of care provided for in nursing practice.

7. Having one overnight urine specimen from which to draw conclusions was inadequate. Results of high sodium/high potassium ratios conflict with previous findings noted in the literature. More valid results could have been obtained by using a series of urine specimens from which average volume and average sodium and potassium levels could have been determined. In addition, the collection, measuring and storage of the specimens on the same date of screening was difficult methodologically and, as a result, some spillage occurred in transporting inadequately sealed containers. The association of sodium and potassium levels with blood pressure is well documented in the literature and, with better control over the sample obtained and dietary intake measured or restricted, in group to group comparisons was potentially valuable information.

8. While variables included in this study had fairly accurate ability to discriminate subjects into correct groups, results failed to demonstrate anticipated discrimination. It is resasonable to conclude that factors other than those examined in this study function to influence discrimination between the two groups. Of those factors responsible for the level of discrimination achieved, physiological factors were of significant usefulness while demographic factors were not. Efforts to identify other factors might be best served to focus on other physiological rather than demographic factors.

9. When doing telephone interviews, many parents and other family members had questions regarding hypertension. These questions were not limited to those reporting non hypertensive status. Those with hypertension posed questions related to drugs, sodium restriction and weight control while those reporting non hypertensive status asked questions primarily related to the nature of the disease and symptoms related to its presence. There was an indication of need for health teaching within the community contacted.

10. Considering questionable group membership, finding of between groups differences in blood pressure and the number of children whose blood pressure fell in the upper percentiles, there is support for more studies in school settings as well as follow up to parents and family members in the community. The screening skills utilized in this study are part of every nurse's repertoire of skills and are easily used in school settings. Follow up in the

community is more difficult and time consuming, but the nurse who works in schools and communities on a continuing basis could be instrumental in research efforts, health teaching, assessement of risk and intervention with schools, children, families and communities related to detection, control and possibly prevention of hypertension.

In summary, this screening procedure could be very useful to the practicing nurse in non-traditional settings such as school and home in:

1. establishing baseline data for assessment of risk to specific children or groups of children and their families
2. being aware of perhaps subtle physiological changes taking place over time reflected in longitudinal data
3. providing direction for intervention with children, families, school personnel and other health care professionals in such areas as health education and life style changes necessary to promote good health.

Recommendations

As a result of the findings of the present study the following recommendations are made for nursing research and practice:

Nursing Research

The findings of the study indicate the need for further research of the variables known to have some association with blood pressure in childhood. Suggestions for future studies include:

1. Replicate the present study with the following changes:

a. insure, prior to screening, that both biological parents of each subject included in the study are available for interview and screening for those reporting non hypertensive status.

b. for parents reporting hypertension, validate essential hypertension through communication with physician or having access to health records.

c. include more schools in similar communities to increase sample size.

d. utilize several days to conduct screening in order to provide more interaction with the children and decrease likelihood of hurried assessments and decrease anxiety.

e. provide the nurse assessing sexual maturity practice in observation or, perferably, use two nurses and if staging is different between the nurses average the stages.

f. obtain at least three overnight urine specimens from each child and obtain average sodium and potassium excretion levels over time.

g. impose some dietary control over or assessment of sodium and potassium intake as baseline data.

2. Implement a study similar to the present one but excluding males.

3. Implement a longitudinal study of children whose blood pressures were in the upper percentiles with larger samples in assessing long range relationship between presence of hypertension and development in childhood or adolescence

4. With a large sample, study the effect of nursing intervention with families in areas of health teaching, dietary intervention and other life style alterations in children whose blood pressure levels are in the upper percentiles.

5. Implement a study to determine the relationship of cardiac murmur to blood pressure.

Nursing Practice

Findings of this study indicate the need for nursing intervention in health teaching, early detection and referral and intervention with children, families, school personnel and other health professionals. Specific recommendations include:

1. Establish more structure to the present school health programs. There are sufficient volunteer nurses in the school system, but their efforts are largely uncoordinated. Health records, for example, do contain pertinent up-to-date information about major health problems in the children. However, basic and routine assessment data are excluded to the point that one child in this community suffered a stroke from undetected hypertension and one child in the present study had previously undetected extremely high blood pressure measurements. It is reasonable to conclude that other areas of screening are also needed. The nurses working

in school health could be extremely valuable in needs assessment and early detection programs.

2. Many children at ages 9,10 and 11 verbalized unfamiliarity with the screening procedures, thus, health teaching and involvement of the children and families in their own health care would be of enormous benefit, health-wise, for the entire community.

3. In this study only one child met the criteria for referral; however, several children had blood pressures in the upper percentiles. Nurses working in screening programs dealing with children need to be aware of such children and the implications of a child's blood pressure falling in percentiles higher than their peers within the community and nationally as well. Measures for weight control, careful monitoring and manipulation of those variables associated with increasing blood pressure are well within the scope of nursing practice and should be instituted in school and home settings. In addition alerting family physician or pediatrician of children whose blood pressures are in the upper percentiles would enhance the likelihood of collaborative efforts toward decreasing the risk of undetected and uncontrolled hypertension.

4. There is a need for health teaching and counseling within the community validated though the telephone interview and not limited to people who have not been diagnosed as having hypertension. A major function of the nurse is health teaching. With the school as a base of operation, nurses working within the

system could provide such needed teaching and counseling to large numbers of people within the community, and provide for more informed self care and detection of problems related to hypertension.

REFERENCES

Berenson, G. S., Foster, T. A., Frank, G. C., Frerichs, R. R., Srinivasan, S. R., Voors, A. W., & Webber, L. S. Cardiovascular disease risk factor variables at the preschool age. The Bogalusa heart study. Circulation, 1978, 57(3), 603-612.

Biron, P., Mongeau, J., & Bertrand, D. Familial aggregation of blood pressure in adopted and natural children. In O. Paul (Ed.), Epidemiology and control of hypertension. Miami: Symposia Specialists, 1975, 397-405.

Blood pressure levels of persons 6-74 years, United States 1971-1974 (Publication No. (HRA) 78-1648). Hyattsville, Md.: U.S. Department of Health, Education, and Welfare, Public Health Service, 1977.

Blumenthal, S., & Kamisar, S. The National Heart, Lung, and Blood Institute: Its commitment to hypertension. Pediatric Annals, 1977, 6(6), 101-102.

Botwin, D. Should children be screened for hypertension? American Journal of Maternal Child Nursing, May/June 1976, 152-158.

Buck, C. W. The persistence of elevated blood pressure first observed at age 5. Journal of Chronic Diseases, 1970, 26, 101-104.

Burch, G. E., & Shewey, L. Sphygmomanometerec cuff size and blood pressure recording. Journal of the American Medical Association, 1973, 225(10), 1215-1218.

Chenoweth, A. B. High blood pressure: A national concern. Journal of School Health, 1973, XLIII(5), 307-308.

Conn, R. Maintenance of blood pressure equipment. American Journal of Nursing, 1976, 76, 776-777.

Cornoni-Huntley, J., Harlan, W. R., & Leaverton, P. E. Blood pressure in adolescence: The United States health examination survey. Hypertension, 1979, 1(6), 568-571.

Dahl, L. K. Sodium intake of the American male: Implications on the etiology of essential hypertension. American Journal of Clinical Nutrition, 1958, 6, 1-7.

Dahl, L. K. Studies on the role of salt and genetics in hypertension. Academy of Medicine of New Jersey Bulletin, 1964, 10, 269.

Dahl, L. K., & Love, R. A. Evidence for relationship between sodium (chloride) intake and human essential hypertension. Archives of Internal Medicine, 1954, 94, 525-531.

Dahl, L. K., & Love, R. A. Etiological role of sodium chloride intake in essential hypertension in humans. Journal of the American Medical Association, 1957, 164(4), 397-400.

de Castro, F. J., Biesbroeck, R., Erikson, C., Farrell, P., Leong, W., Murphy, D., & Green, R. Hypertension in adolescents. Clinical Pediatrics, 1976, 15(1), 24-30.

Edwards, D. A. W., Hammond, W. H., Healy, M. J. R., Tanner, J. M., & Whitehouse, R. H. Design and accuracy of calipers for measuring subcutaneous tissue thickness. British Journal of Nutrition, 1955, 9(2), 133-142.

Falkner, F., & Tanner, J. M. (Eds.). Human growth-postnatal growth. New York: Plenum Press, 1978.

Fink, J. W. The challenge of high blood pressure control. Nursing Clinics of North America, 1982, 16(2), 301-308.

Freis, E. D. Salt, volume, and the prevention of hypertension. Circulation, 1976, 53(4), 589-595.

Garn, S. M., & Gorman, E. L. Comparison of pinch-caliper and teleroentgenogrammetric measurements of subcutaneous fat. Human Biology, 1956, 28, 4.

Goldring, D., Londe, S., Sivakoff, M., Hernandez, A., Britton, C., & Choi, S. Blood pressure in a high school population. Journal of Pediatrics, 1977, 91, 884-889.

Granico, S. D. Opportunities for nurses in high blood pressure control. Nursing Clinics of North America, 1981, 16(2), 309-320.

Grim, C. M., Luft, F. C., Miller, J. Z., Rose, R. J., Christian, J. C., & Weinberger, M. H. An approach to the evaluation of genetic influences on factors that regulate arterial blood pressure in man. Hypertension, 1980, 2(4), 34-42.

Guyton, A. C. Textbook of medical physiology (3rd ed.). Philadelphia: W.B. Saunders Company, 1968.

Hall, W. D. Twenty-four hour sodium (NA) and potassium (K) excretion in hypertensive blacks. Clinical Research, 1977, 25, 41A.

Harlan, W. R., Cornoni-Huntley, J., & Leaverton, P. E. Blood pressure in childhood. The National Health Examination Survey. Hypertension, 1979, 1(6), 559-565.

Harlan, W. R., Oberman, A., Mitchell, R. E., & Graybiel, A. A 30 year study of blood pressure in a white male cohort. In O.G. Kwam & J.N. Moyer (Eds.), Hypertension: Mechanisms and management. New York: Grune & Stratton, 1973.

Havlik, R. J., Garrison, R. J., Katz, S. H., Ellison, M. F., Feinleib, M., & Myrianthopoulos, N. C. Detection of genetic variables in blood pressure of seven year-old twins. American Journal of Epidemiology, 1979, 109(2), 512-515.

Heavenrich, R. M., & Cinque, T. J. Childhood high blood pressure: A new emphasis. Pediatric Annals, 1977, 6(6), 7-13.

Heller, R. F., Robinson, N., & Peart, W. S. Value of blood pressure measurement in relatives of hypertensive patients. Lancet, June 1980, 1(8180), 1206-1208.

Helson, H. Adaptation level theory. New York: Harper and Row, 1964.

Henson, M. A. Long term control of hypertension. Nursing Clinics of North America, 1981, 16(2), 343-347.

Higgins, M. W., Keller, J. B., Metzner, H. L., Moore, F. E., & Ostrander, L. D. Studies of blood pressure in Tecumseh, Michigan. II. Antecedents in childhood of high blood pressure in young adults. Hypertension, Suppl. I, 1980, 2(4), 117-123.

Hill, M. N. What can go wrong when you measure blood pressure. American Journal of Nursing, 1980, 80, 942-946.

Hill, R. A demographic profile of the black elderly. Aging, 1978, (287), 2-9.

Hiner, L. B., & Gruskin, A. B. The physiology of blood pressure regulation--normal and abnormal. Pediatric Annals, 1977, 6(6), 19-32.

Johnson, A. L., Cornoni, J. C., Cassel, J. C., Tyroler, H. A., Heyden, S., & Hames, C. G. Influence of race, sex and weight on blood pressure behavior in young adults. American Journal of Cardiology, 1975, 35(4), 523-530.

Johnston, F. E., Hamill, P. V. V., & Lemeshaw, S. Skinfold thickness in a national probability sample of U.S. males and females aged 6 through 17 years. American Journal of Physical Anthropology, 1972, 40, 321-324.

Jones, M. Accuracy of pulse rates counted for fifteen, thirty, and sixty seconds by graduate nurses and basic nursing students. Unpublished master's thesis, University of Seattle, 1967.

Kagan, A. Health and environment--psychosocial stimuli--a review. Social Science and Medicine, 1974, (8), 225-241.

Katz, S. H. Association between skeletal age and systolic blood pressure during puberty (Abstract). Preventive Medicine, 1979, 8(2), 177.

Katz, S., Hediger, M. L., Schall, J. I., Bowers, E. J., Barker, W. F., Aurand, S., Eveleth, P. B., Gruskin, A. B., & Parks, J. S. Blood pressure growth and maturation from childhood through adolescence. Hypertension, 1980, 2(4), 55-69.

Keith, J. D., Rowe, R. D., & Vlad, P. Heart disease in infancy and childhood (3rd ed). New York: McMillan Publishing Company, Inc., 1978.

Kilcoyne, M. M. Adolescent hypertension. American Journal of Medicine, 1975, 58(6), 735-739.

Killeen, J., Vanderburg, D., & Harlan, W. R. Application of weight-height ratios and body indices to juvenile populations--the National Health Examination Survey Data. Journal of Chronic Disease, 1978, 31, 529-537.

Kirkendall, W. M., Burton, A. C., Epstein, F. H., & Freis, E. D. Recommendations for human blood pressure determination by sphygmomanometers. Circulation, 1967, 36(XXXVI), 980-988.

Klein, B. E., Hennekens, C. H., & Jesse, M. J. Longitudinal studies of blood pressure in offspring of hypertensive mothers. In O. Paul (Ed.), Epidemiology and control of hypertension. Miami: Symposia Specialists, 1975, 387-395.

Klein, A. A., McCrory, W. W., & Engle, M. A. Hypertension in children. Cardiovascular Clinician, 1981, 11(2), 11-33.

Kochar, M., & Daniels, L. Hypertension control for nurses and other health professionals. St. Louis: The C.V. Mosby Company, 1978.

Kotchen, T. A., & Havlik, R. J. High blood pressure in the young symposium. Hypertension, Suppl. I, 1980, 2(4), 1.

Kotchen, J. M., Kotchen, T. A., Schwertman, N. C., & Kuller, L. H. Blood pressure distributions of urban adolescents. American Journal of Epidemiology, 1974, 9, 315-324.

Kozier, B., & Erb, G. L. Fundamentals of nursing: Concepts and procedures. Menlo Park, Calif.: Addison-Wesley Publishing Company, Inc., 1979.

Krogman, W. M. A handbook of the measurement and interpretation of height and weight in the growing child. Child Development Monograph, 1950, 13, 3.

Laragh, J. H. The renin-angiotensin-aldosterone system in relation to type of hypertension. In P. Oglesby (Ed.), Epidemiology and control of hypertension. New York: Stratton Intercontinental Medical Book Corporation, 1975, 221-232.

Lauer, R. M., Connor, W.E., Leaverton, P.E., Reiter, M.A., & Clarke, W.F. Coronary heart disease risk factors in school children: Muscatine study. Journal of Pediatrics, 1975, 86(6), 697-706.

Levine, R. S., Hennekens, C. H., Duncan, R. C., Robertson, E. G., Gourley, J. E., Cassady, J. C., & Gelband, H. Blood pressure in infant twins--birth to 6 months of age. Hypertension, 1980, 2(4), 29-33.

Lieberman, E. Essential hypertension in children and youth: A pediatric perspective. Journal of Pediatrics, 1974, 85(1), 1-9.

Liu, K., Coopert, R., McKeever, J., McKeever, P., Byington, R., Soltero, I., Stamler, R., Gosch, F., Stevens, E., & Stamler, J. Assessement of the association between habitual salt intake and high blood pressure: Methodological problems. American Journal of Epidemiology, 1979, 110(2), 219-226.

Liu, K., Coopert, R., Soltero, I., & Stamler, J. Variability in 24 hours sodium excretion in children. Hypertension, 1979, 1, 631-636.

Loggie, J. (Ed.). Hypertension in childhood and adolescence. Pediatric Clinics of North America, 1978, 25(1), 1.

Londe, S. Blood pressure in children as determined under office conditions. Clinical Pediatrics, February 1966, 71-78.

Londe, S., Johanson, A., Kronemer, N. S., & Goldring, D. Blood pressure and puberty. Journal of Pediatrics, 1975, 87(6), 896-900.

Lynds, B. G., Selyer, S. K., & Morgan, B. M. The relationship between elevated blood pressure and obesity in black children. American Journal of Public Health, 1980, 70(2), 171-173.

Marienfield, C. J., Telles, N., Silvera, J., & Nordsieck, M. A 20 year follow-up study of "innocent" murmurs. Pediatrics, 1962, 30(1), 42-47.

Miall, W. E., & Lovell, H. G. Relation between change of blood pressure and age. British Medical Journal, 1967, 2, 660-664.

Mitchell, S. C. The challenges of pediatric hypertension. Pediatric Annals, 1977, 6(6), 14-15.

Oberman, A., Lane, N. E., Harlan, W. R., Graybiel, A., & Mitchell, R. E. Trends in systolic blood pressure in the thousand aviator cohort over a twenty-four-year period. Circulation, 1967, 32, 812-822.

Operator's manual IL 643 digital flame photometer. Lexington, Ky.: Instrumentation Laboratory, Inc., 1978.

Paffenbarger, R. S., Thorne, M. C., & Wing, A. C. Chronic disease in former college students: VIII. Characteristics in youth predisposing to hypertension in later years. American Journal of Epidemiology, 1968, 88, 25-32.

Pietinen, P. I., Findley, T. W., Clausen, J. D., Finnerty, F. A., & Altschul, A. M. Studies in community nutrition: Estimation of sodium output. Preventive Medicine, 1976, 5(3), 400-407.

Prebis, J. W. Uric acid in childhood hypertension (Abstract). Preventive Medicine, 1979, 8(2), 211.

Prineas, R. J., Gillum, R. F., Horibe, H., & Hannan, P. J. The Minneapolis children's blood pressure study: Part I. Standards of measurements for children's blood pressure. Hypertension, 1980, 2(4), 24-28.

Riehl, J., & Roy, C. Conceptual models for nursing practice. New York: Appleton-Century-Crofts, 1974.

Report of the Task Force on Blood Pressure Control in Children. Pediatrics, Suppl. 59, 1977, 797-820.

Rose, R. J., Miller, J. Z., Grim, C. E., & Christian, J. C. Aggregation in blood pressure in the families of identical twins. American Journal of Epidemiology, 1979, 241(1), 503-511.

Roy, S. C. Introduction to nursing: An adaptation model. Englewood Cliffs, N.J.: Prentice-Hall, 1976.

Siervogel, R. M., Frey, M. A., Kezdi, P., Roche, A. F., & Stanley, E. L. Blood pressure, electrolytes, and body size: Their relationships in young relatives of men with essential hypertension. Hypertension, 1980, 2,(4), 83-91.

Siervogel, R. M., & Glueck, C. J. Interrelationships between lipids, lipoproteins and blood pressure in children from kindreds with essential hypertension. Preventive Medicine, 1980, 9(6), 760-772.

Swartz, H., & Leitch, C. Differences in mean adolescent blood pressure by age, sex, ethnic origin, obesity, and familial tendency. Journal of School Health, 1975, 65(2), 76-81.

Swaye, P. S., Gifford, R. W., Jr., & Berrettoni, J. N. Dietary salt and essential hypertension. American Journal of Cardiology, 1972, 29(1), 33-38.

Tanner, J. M., & Whitehouse, R. H. Clinical longitudinal standards for height, weight, height velocity, weight velocity, and stages of puberty. Archives of Diseases in Childhood, 1976, 51(3), 170-179.

Tobian, L. The relationship of salt to hypertension. American Journal of Clinical Nutrition, 1979, 32(12), 2739-2748.

Tuthill, R. W., & Calabrese, E. J. Drinking water sodium and blood pressure in children: A second look. American Journal of Public Health, 1981, 71(7), 722-728.

U.S. Bureau of the Census. Census of population and housing: 1970, census tracts (Final Report PHC (1) - 26 Birmingham, AL). Washington, D.C.: U.S. Government Printing Office, 1972.

van den Berg, B. J. Comparisons of blood pressure measurements by auscultation and physiometrics infrasonde recording techniques. Hypertension, 1980, 2(4), 8-17.

von Behren, P. A., & Lauer, R. M. Blood pressure measurement in children. Pediatric Annals, 1977, 6(6), 33-40.

Vaughn, V. C. & McKay, R. J. (Eds). Nelson's textbook of pediatrics. Philadelphia: W. B. Saunders Company, 1975.

Voors, A. W., Foster, T. A., Frerichs, R. R., & Berenson, G. S. Studies of blood pressure in children, ages 5-14 years in a biracial community--the Bogalusa heart study. Circulation, Suppl. 2, 1976, 319-327.

Voors, A., Webber, L. S., & Berenson, G. S. Time course studies of blood pressure in children. The Bogalusa heart study. American Journal of Epidemiology, 1979, 109(3), 320-333.

Voors, A. W., Webber, L. S., Frerichs, R. R., & Berenson, G. S. Body height and body mass as determinants of basal blood pressures in children--the Bogalusa heart study. American Journal of Epidemiology, 1977, 106(2), 101-108.

Watson, R. L., & Langford, H. E. Usefulness of overnight urines in population groups: Pilot studies of sodium, potassium, and calcium excretion. American Journal of Clinical Nutrition, 1970, 23, 290-304.

Watson, R. L., Langford, H. G., Abernethy, J., Barnes, T. Y., & Watson, M. J. Urinary electrolytes, body weight, and blood pressure: Pooled cross-sectional results among four groups of adolescent females. Hypertension, 1980, 2(4), 93-98.

Weinser, R. L. Salt and the development of essential hypertension. Preventive Medicine, 1976, 5, 7-14.

Whaley, L. F., & Wong, D. L. Nursing care of infants and children. St. Louis: The C.V. Mosby Company, 1979.

Wolf, G. Adolescent hypertension and cardiovascular disease prevention. Journal of the American College Health Association, 1973, 22, 113-119.

Wood, J. E., Barrow, J. G., Freis, E. D., Gifford, R. W., Kirkendall, W. M., Lee, R., & Williams, H. Primary prevention of hypertension: Hypertension study group. Circulation, 1970, XLII, 39-42.

Zack, P. M., Harlan, W. R., Leaverton, P. E., & Cornoni-Huntley, J. A longitudinal study of body fatness in childhood and adolescence. Journal of Pediatrics, 1979, 95(1), 126-129.

Zinner, S. H., Lee, Y. H., Rosner, B., Oh, W., & Kass, E. H. Factors affecting blood pressures in newborn infants. Hypertension, 1980, 2,(4), 99-101.

Zinner, S. H., Levy, P. S., & Kass, E. H. Familial aggregation of blood pressure in childhood. New England Journal of Medicine, 1971, 284(8), 401-404.

Zinner, S. H., Martin, L. F., Sacks, F., Rosner, B. & Kass, E. H. A longitudinal study of blood pressure in childhood. American Journal of Epidemiology, 1975, 6, 437-442.

APPENDICES

APPENDIX A

PARENT DATA INVENTORY

Please Complete this Form and Return it Tomorrow

Child's Name ______________________________

Telephone Number__________________________

I. Child's Mother

1. Is this child's mother living? Yes____ No____
2. If yes, what is her age? ________ Years
3. Has this child's mother ever been told that she has high blood or high blood pressure?
   (Check one) Yes____ No____
   If yes, what kind?______________________________________
4. How many years of school did this child's mother finish? _________Years
5. Does the child's mother work? Yes____ No____
   If yes, what is his job?______________________________

II. Child's Father

1. Is this child's father living? Yes____ No____
2. If yes, what is his age? ________ Years
3. Has this child's father ever been told that he has high blood or high blood pressure?
   (Check one) Yes____ No____
   If yes, what kind?______________________________________
4. How many years of school did this child's father finish? _________Years
5. Does the child's father work? Yes____ No____
   If yes, what is his job?______________________________

III. How many relatives of the child's father and mother (father mother, brothers or sisters) have had high blood pressure?

____

Thank you very much for taking the time to answer these questions.

____

Billie Rozell, R.N.

APPENDIX B

LETTER OF INVITATION FOR STUDY PARTICIPATION

Dear Parent:

As you may be aware, having high blood pressure can lead to heart disease, stroke, and heart failure. There is a possibility that heart problems in adults may begin in childhood and adolescence. For this reason I am conducting a study of children who are nine and ten years old. These children are divided into two groups--those children whose parent(s) do not have high blood pressure and those children whose parent(s) are being treated for high blood pressure. Your child's school principal and superintendent are supportive of this project related to child health.

If you agree to participate, information about you and your child will be obtained from you, I will take your blood pressure, and you will be asked to send your child and his/her overnight urine specimen to the school on a specified date where he/she will:

1. have his/her blood pressure taken while sitting, lying down, and standing by using a blood pressure cuff on the upper arm;
2. be weighed and measured;
3. have his/her upper arm, under the arm, shoulder, hip, and leg measured for body fate;
4. have his/her heart rate measured by listening to the heart using a stethoscope; and,
5. have his/her level of physical maturity assessed by observation.

All of the above procedures will be done by me and other registered nurses at your child's school.

Names of participants (children and parents) will be recorded on a master list available only to me and records will be maintained in my possession. For data identification purposes, each participant will be assigned a number but at no time will either number or name be used in published or unpublished reports of the study. As follow-up studies are anticipated, the master list will remain in my possession until such follow-up is completed.

The total amount of time you and your child will spend being assessed will be approximately one hour. Provision will be made for privacy during body fat measurement, assessment of maturity, and heart rate measurement by using a room with outside doors closed and only your child and the nurse will be present.

While your child may be slightly embarrassed to being examined for body fat level and physical maturity level, he/she will be allowed to wear regular clothing with a short sleeved or sleeveless shirt or dress during the remainder of the examination. Other than this, there are no known risks associated with any of the procedures as all are commonly carried out in physicians' offices or clinics. In addition, you will gain information about your child which may give some satisfaction in knowning something about his/her health status.

You will not be expected to pay for these examination and, in appreciation for your time and willingness to participate, your child will have the opportunity to receive from me a gift certificate from McDonald's.

Information about your blood pressure, your child's blood pressure, weight, height, body fat distribution, physical maturity level, pulse, and urine test will be made available to you upon request. In the event that your blood pressure is above 160/90 or your child's blood pressure is outside the normal range for a child, you will be informed so that you may seek further evaluation. Should you have need of any information about health care resources, such information will be made available to you.

If you decide to participate and to permit your child to participate, you will be free to withdraw from the study at any time prior to data collection. The University of Alabama in Birmingham has made no provision for monetary compensation to you in the event of physical injury resulting from the research procedure. Should physical injury occur, additional treatment is available but treatment is not provided free of charge. If you have any questions, please feel free to call me, Billie Rozell, R.N., at 934-3695.

Your signature below and completion of the attached form indicates that you have read and understood this consent form and that you agree that you and your child will participate in the study.

Signature of Researcher

Date

Signature of Parent

Time AM/PM

Signature of Witness

Child's Names

Child's Signature

APPENDIX C

SCHEMATIC FOR FLOW THROUGH SCREENING AREA

Station I

1. Child arrives from school room.
2. Check File (A) to be sure consent form signed.
3. Place child's name on master sheet.
4. Complete Sections 1, 2, 3, 4, & 5 on Appendix K.
5. Send child & Appendix K to Station II.

Station II

1. Weigh & measure child following Protocol.
2. I will translate to metric later.
3. Complete Section 6 & 7 on Appendix K.
4. Send child & Appendix K to Station III.

Station III

1. Take B/P following Protocol.
2. Record on Appendix K 11 A-F omitting D Section (I will do D Section later).
3. Establish interrater reliability using double stethoscope & initiating readings (this is described in Protocol).
4. Send child & Appendix K to Station IV.

Station IV

1. Measure skinfolds.
2. Unobtrusively measure physical maturity of genitals (using Protocol).
3. Complete Sections 15 & 16 (genital) on Appendix K.
4. Send child to Station V.

Station V

1. Measure heart rate following Protocol.
2. Assess for M.
3. Complete Sections 13, 14, & 16 (Breast only) on Appendix K.
4. Let me know if m present.
5. Send child & Appendix K to Station Vi.

Station VI

1. Collect Appendix K from child.
2. Be sure all data included (Section 1, 2, 3, 4, 5, 6, 7, 11 (A-F), 13, 14 15 & 16.
3. Be sure all Appendix K forms have child's name & ID number.
4. Complete "Report to Parent."
5. Give "Report to Parent" to child & ask him to return it to his teacher.
6. Send child back to class-room.

APPENDIX D

HEIGHT AND WEIGHT MEASUREMENT PROTOCOL

1. Have child face nurse on Toledo Balance scales wearing school clothing (without shoes and outercoats, sweaters, or jackets and socks).

2. Child should stand straight, with arms relaxed and at sides and child¯ankles and knees together.

3. Encourage him/her to stand as tall as possible.

4. Read the weight to the pound and nearest ounce; i.e. 60lb. 8oz.

5. Be sure scale is balanced to "zero" between each child.

6. Read the height by:

   Moving the blade of the measuring device down on the top of the head with the right hand insuring that the blade passes above the saggital plane of the head and the measurement to the nearest completed unit.

7. Assist the child off the scale.

8. Praise the child for doing his best.

9. Record measurements on Appendix, K, give to child and have child go to Station III.

Note: From Falkner & Tanner, 1978; Krogman, 1950.

APPENDIX E

BLOOD PRESSURE PROTOCOL

1. Have child lie on cot supine at least 3 minutes prior to taking blood pressure. (Inform researcher of any blood pressure 140/90 or above).

2. To establish interrater reliability, initial all reading and use double stethoscope.

3. Obtain blood pressure by following method (A-P).

   A. Use right arm with child supine on bed.
   B. Use 9 or 13 cm wide cuff--whichever closely approximates 2/3 diameter of the arm.
   C. Use aneroid manometer.
   D. Palpate pulse and place cuff with arrow pointing to pulse site.
   E. Place cuff approximately 2 cm above antecubital area.
   F. Cuff should be tight enough to allow entrance of no more than two fingers beneath its edge.
   G. Inflate cuff using steady pressure--inflate to 120 mm of Hg and place stethoscope over antecubital area.
   H. If no beat heard at 109 mm, inflate 10 mm and listen again. Continue in this manner until no beat is heard. If the time of inflation exceeds two minutes, deflate cuff, take cuff off arm, and wait two minutes before reinflating.
   J. Deflate cuff in a steady manner.
   K. Systolic blood pressure is recorded as the point at which the first consistent beat is heard.
   L. Diastolic blood pressure is recorded as the "muffled" sound. If not confident of muffled sound, record last beat heard and indicate this is not the muffled sound. Also record last beat heard if "muffled" sound also audible.
   M. Allow two minutes between the three blood pressure readings--remove cuff after each reading.

N. Have child stand upright, adjust level of sphygmomanometer to midaxillary area and take blood pressure in right arm following procedure D through L as before.

O. Allow two minutes and take blood pressure in right arm with child seated and sphygmomanometer adjusted to midaxillary area.

P. Record each blood pressure reading after it has been obtained. Average blood pressure on supine after the child has left the testing area (2nd and 3rd supine measurements).

4. If the child complains of arm discomfort, an additional two to five minutes rest between measurements will be permitted; if discomfort persists, the left arm may be used. Please advise if discomfort occurs.

5. Disregard first blood pressure reading when tabulating for data analysis.

Note: From van den Berg, 1980; von Behren & Lauer, 1977; Burch & Shewey, 1973; Conn 1976; Hill, 1980; Kirkendall, Burton & Epstein, 1967.

APPENDIX F

HEART AND BREAST ASSESSMENT PROTOCOL

1. Have child rest supine on cot at least 2 minutes prior to taking heart rate. Ascertain rate over apex for 1 minute.

2. Arrange upper clothing so PMI can be visualized if present.

3. If PMI cannot be visualized, palpate to locate beginning at L midclavicular area at 4-5th intercostal space.

4. Place stethoscope over PMI. Count heart rate 60 seconds and record rate on Appendix K.

5. Assess valve areas for presence or absence of murmur (mitral, tricuspid, aortic, pulmonic).

6. If murmur present, tell researcher to validate presence/grade as follows.

   Grade 1--barely audible; very faint; heard only with effort.
   Grade 2-- quiet but clearly audible.
   Grade 3--moderately loud.
   Grade 4--loud.
   Grade 5--very loud, can be heard with stethoscope partly off chest.
   Grade 6--loudest possible; audible with stethoscope just removed from the chest wall.

7. While locating PMI, unobtrusively assess breast maturity on girls using Tanner Scale Pictures and written description as follows:

   Assessment of maturity for girls as follows:
   <u>Breasts</u>:
   Stage 1--The infantile stage which persists from the immediate postnatal period until puberty.
   Stage 2--The "bud" stage. The breast and papilla are elevated as a small mound, and the diameter of the areola is increased. The development of this appearance is the first indication of pubertal development of the breast.
   Stage3--The breast and areola are further enlarged and present an appearance rather like that of a small adult mammary gland with a continuous rounded contour.

8. Record all findings on Appendix K

9. Send child and Appendix K to Station V.

   Note: From Falkner & Tanner, 1978; Jones, 1967; Kozier & Erb, 1979; Vaughn & McKay, 1975.

APPENDIX G

OVERNIGHT URINE COLLECTION

Take this to your parent/guardian so they can help you to remember to get the specimen.

Child's Name____

Date of Collection__________________________________

Please follow these guidelines for the overnight urine specimen:

1. Before going to bed Thursday night, October 30, go to the bathroom. Put down the time that you go to the bathroom here ________ p.m. When your kidneys have acted, flush the toilet. Do not save this urine.

2. Friday morning when you get up, instead of going to the toilet for your kidneys to act empty your bladder into the plastic jug. Put down the time here ________ a.m. Put the cap on the jug and bring it to your teacher when you get to school.

   If you get up during the night to go to the bathroom for your kidneys to act, use the plastic jug, but again empty your bladder in the plastic jug when you get up to stay.

Everyone who brings his urine specimen to school Friday morining will get a special Halloween treat.

Thank you,

Billie Rozell
923-2088

APPENDIX H

MALE GENITAL MATURITY AND PUBIC HAIR DISTRIBUTION ASSESSMENT PROTOCOL

1. While clothing is displaced for suprailiac measurement, unobtrusively assess male genital maturity using Tanner Scale picture and written discription as follows:

   Stage 1--Infantile stage from birth until puberty begins.
   Stage 2--The scrotum has begun to enlarge, and there is some reddening and change in texture of the scrotal skin.
   Stage 3--The penis is increased in length and there is a smaller increase in breadth with further scrotal growth.
   Stage 4--The length and breadth of the penis have increased further and the glands have developed. The scrotum is further enlarged and the scrotal skin has become darker.
   Stage 5--The genitalia are adult in size and shape.

2. Observe pubic hair distribution stage for males and females as follows:

   Stage 1--No true pubic hair is visible, although there may be a fine velus over the pubic area similar to that over other parts of the abdomen.
   Stage 2--Sparse growth of lightly pigmented hair which is usually straight or only slightly curled. In boys this usually begins at either side of the base of the penis. In girls the site at which hair is first seen is usually the labia and sometimes the mons pubis.
   Stage 3--The hair spreads over the pubic symphysis and is considerably darker and coarser and usually more curled.
   Stage4--The hair is adult in character but covers an area smaller than in most adults. There is no spread to the medial surface of the thighs.
   Stage5--The hair is distributed in an inverse triangle for both sexes. It has spread to the medial aspects of the thighs but not up the linea alba or elsewhere above the base of the triangle.

3. Record findings on Appendix K and send child and Appendix K to Station VI.

<u>Note</u>: From Falkner & Tanner, 1978.

APPENDIX I

BODY FAT (SKINFOLD MEASUREMENT) ASSESSMENT PROTOCOL

1. Ask the child to stand at the measurer's side with arms relaxed at his/her sides with ankles and knees together.

2. Explain the procedure and assist the child in adjusting clothing to expose each site as it is to be measured

3. Use Harpenden Caliper - calibrate prior to each measurement

4. For each site sweep the index or middle finger and thumb together over the surface of the skin from about 6-8 cm apart and collect the subcutaneous tissue pushed away from the underlying muscle fascia. Take 2 measurements at each site. If difference above 0.3mm occur, take a third measurement and if not more than 0.3mm difference between the third measurement and one of the 2 previous measurements exist, average the two closet measurements for the reported measurement.

5. All measurements are taken on the left side of the body.

6. Utilize the following sites.

   Triceps skinfold. The subject stands with his back to the measurer and his arm relaxed with the palm facing the lateral thigh. The tips of the acromial process and blecranon are palpated, and a point halfway between is marked. The skinfold is picked up over the posterior surface of the triceps muscle 1 cm above the mark, on a vertical line passing upwards from the olecranon to the acromion, and the caliper jaws are applied at the marked level. The fingers of the right hand relax their grip to allow the caliper to exert its full pressure of $10g/MM^2$. The left hand maintains the pinch throughout the measurement. It is advisable to have the subject bend the arm before taking the skinfold and straighten it before applying the caliper since any muscle which may have been picked up by the measurer to be pulled out from the skinfold by the contracting action of the triceps at arm extension.

   Biceps skinfold. The subject stands facing the measurer with the arm relaxed at his side and the palm facing forward. The skin is picked up over the belly of the biceps and 1 cm above the line marked for the triceps skinfold on a vertical line, joining the center of the antecubital fossa to the head of the humerus. The caliper jaws are applied to the marked level as described above.

Subscapular skinfold. The subject stands with his back to the measurer with his shoulders and arms relaxed. Determine the inferior angle of the scapula by palpation of the medial border of the scapula and run the fingers of the left hand downward along its full length until the inferior angle is located. The skinfold is picked up immediately below the inferior angle of the scapula with the fold either the vertical line or slightly inclined downwards and laterally, in the natural cleavage of the skin.
Suprailiac skinfold. The subject stands sideways with his arms folded and the skinfold is picked up vertically about 1 cm above and 2 cm medial to the anterior suprailiac spine. The caliper is applied just below the fingers.
Calf skinfold. The subject stands with his back to the measurer. The skinfold is picked up on the vertical line at the posterior position at the level of largest circumference with the leg relaxed and slightly bent at the knee.

7. Record data on Appendix K and send child to Station V.

Note: From Falkner & Tanner, 1973; Garn & Gorman, 1956; Tanner & Whitehouse, 1976.

APPENDIX J

REPORT TO PARENT

DATE ______________________

YOUR CHILD ____ HAS BEEN INVOLVED IN THE HEALTH SCREENING YOU WERE INFORMED ABOUT LAST WEEK. OUR FINDINGS INCLUDE:

1. BLOOD PRESSURE TODAY____________________
2. WEIGHT _______________

   HEIGHT _______________

THESE FINDINGS ARE WITHIN THE NORMAL RANGE FOR A CHILD IN HIS/HER AGE GROUP. THE URINE SPECIMEN REPORT WILL NOT BE AVAILABLE FOR SEVERAL WEEKS AND IF ANY ABNORMALITY IS FOUND WHEN THE REPORT IS RETURNED, I WILL NOTIFY YOU.

THANK YOU AGAIN FOR ALLOWING YOUR CHILD TO PARTICIPATE IN THIS PROJECT. IF YOU HAVE ANY QUESTIONS, PLEASE FEEL FREE TO CALL ME.

BILLIE ROZELL, R.N.
934-3695 or 923-2088

APPENDIX K

CHILD SCREENING FORM

	DO NOT WRITE IN THIS COLUMN
1. Child's name ____________________	
2. Identification number of child ________	______ 1 - 3
3. Date ____________________	______ 4 - 9
4. Birthdate ____________________	______ 10 - 15
5. Sex: Male ______ Female ______	______ 16
6. Height: ________ cm	______ 17 - 20
7. Weight: ______ lb ______ KG	______ 21 - 24
8. Biological age ______ years ______ months	______ 29 - 32
9. Height % tile ______	______ 33 - 34
10. Weight % tile ______	______ 35 - 36
Relative weight ______	______ 37 - 39
Ponderal index ______	______ 40 - 42
Body mass index ______	______ 43 - 45
11. Blood pressure (Supine)	
A. First blood pressure reading:	
Systolic ________	XXX 46 - 48
Diastolic ________	XXX 49 - 51
Last sound ________	XXX 52 - 54
B. Second blood pressure reading:	
Systolic ________	______ 55 - 57
Diastolic ________	______ 58 - 60
Last sound ________	______ 61 - 63

C. Third blood pressure reading:
Systolic ________ ________ 64 - 66

Diastolic ________ ________ 67 - 69

Last sound ________ ________ 70 - 72

D. Average of second and third blood pressure reading:
Systolic ________ ________ 4 - 6

Diastolic ________ ________ 7 - 9

Last sound ________ ________ 10 - 12

E. Blood pressure (Sitting):
Systolic ________ ________ 13 - 15

Diastolic ________ ________ 16 - 19

Last sound ________ ________ 20 - 22

F. Blood pressure (Standing):
Systolic ________ ________ 23 - 25

Diastolic ________ ________ 26 - 28

Last sound ________ ________ 29 - 31

13. Apical pulse rate ________________/min ________ 32 - 34

14. Murmur present ________ Yes ________ No ________ 35
If yes - murmur grade ________

15. Skinfold measurement (left side of body):
A. Biceps ________________ cm ________ 37 - 39

B. Triceps ________________ cm ________ 40 - 42

C. Subscapular ________________ cm ________ 43 - 45

D. Suprailiac ________________ cm ________ 46 - 48

E. Calf ________________ cm ________ 49 - 51

16. Maturity level:
A. Female: Breast ________ stage ________ 52

Pubic hair ________ stage ________ 53

A. Male: Penis ________ stage ________ 54

Pubic hair __________ stage ________ 55

17. Urine screening:

A. Sodium ______________ mg ________ 56 - 58

B. Potassium ____________ mg ________ 59 - 62

Total volume ______________ cc ________ 63 - 65

18. Has this child had any health problems in the past?

Yes______ No______ ________ 67 - 70

19. Does this child now have any health problem?

Yes______ No______ ________ 71

If yes, what kind?______________ ________ 72 - 75

20. Is this child now supposed to be taking any medications other than vitamins?

Yes______ No______ ________ 76

If yes, what kind?______________ ________ 76 - 80

APPENDIX L

WEIGHT AND HEIGHT DISTRIBUTION BY PERCENTILES FOR FEMALES

	Weight Distribution by Percentile+						Height Distribution by Percentile+					
	3+		50+		97+		3+		50+		97+	
Age*	lb	kg	lb	kg	lb	kg	inches	cm	inches	cm	inches	cm
9	49.1	22.27	63.8	28.94	89.9	40.78	48.7	123.6	52.3	132.9	56.5	143.4
10	53.2	24.13	70.3	31.89	101.9	46.22	50.3	127.7	54.6	138.6	58.8	149.3
11	57.9	26.26	78.8	35.74	112.9	51.21	52.1	132.3	57.0	144.7	62.0	157.4

Adapted from studies by Howard V. Meredith, Iowa Child Welfare Research Station, The State University of Iowa. In V.C. Vaughan, & R.J. McKay (Eds.), Nelson's textbook of pediatrics. Philadelphia: W.B. Saunders Company, 1975.

Years unless otherwise indicated.

APPENDIX M

WEIGHT AND HEIGHT DISTRIBUTION BY PERCENTIES FOR MALES

	Weight Distribution by Percentile+						Height Distribution by Percentile+					
	3+		50+		97+		3+		50+		97+	
Age*	lb	kg	lb	kg	lb	kg	inches	cm	inches	cm	inches	cm
9	52.5	23.81	66.0	29.94	89.8	40.73	48.9	124.2	53.3	135.5	57.2	145.3
10	56.8	25.76	71.9	32.61	100.0	45.36	50.7	128.7	55.2	140.3	59.2	150.3
11	61.8	28.03	77.6	35.20	11.7	50.67	52.5	133.4	56.8	144.2	60.8	154.4

Adapted from studies by Howard V. Meredith, Iowa Child Welfare Research Station, The State University of Iowa. In V.C. Vaughan, & R.J. McKay (Eds.), Nelson's textbook of pediatrics. Philadelphia: W.B. Saunders Company, 1975.

Years unless otherwise indicated.

APPENDIX N

SYSTOLIC AND DIASTOLIC BLOOD PRESSURE RANGES BY AGE

Age (years)	Systolic		Diastolic	
	Mean	Range	Mean	Range
½ - 1	90	65 - 115	61	42 - 80
1 - 2	96	69 - 123	65	38 - 92
2 - 3	95	71 - 119	61	37 - 85
3 - 4	99	76 - 122	65	46 - 84
4 - 5	99	78 - 112	65	50 - 80
5	94	80 - 108	55	46 - 64
6	100	85 - 115	56	48 - 64
7	102	87 - 117	56	48 - 64
8	105	89 - 121	57	48 - 66
9	107	91 - 123	57	48 - 66
10	109	93 - 125	58	48 - 68
11	111	94 - 128	59	49 - 69
12	113	95 - 131	59	49 - 69
13	115	96 - 134	60	50 - 70
14	118	99 - 137	61	51 - 71
15	121	102 - 140	61	51 - 71

Adapted from Whaley, L.F., & Wong, D.L. Nursing care of infants and children. Saint Louis: The C.V. Mosby Company, 1979.

APPENDIX O

HEART RATE* RANGES FOR CHILDREN BY AGE

Age	Lower limits of normal	Average	Upper limits of normal
Newborn	70	120	170
1 - 11 months	80	120	160
2 years	80	110	130
4 years	80	100	120
6 years	75	100	115
8 years	70	90	110
10 years	70	90	110
12 years			
Girls	70	90	110
Boys	60	80	100
14 years			
Girls	65	85	105
Boys	60	80	100
16 years			
Girls	60	80	100
Boys	55	75	95
18 years			
Girls	55	75	95
Boys	50	70	90

*Rate given in beats/minute.

Adapted from Whaley, L.F., & Wong, D.L. <u>Nursing care of infants and children</u>. Saint Louis: The C.V. Mosby Company, 1979.

APPENDIX P

TABLE 3

t test - Blood Pressure, Heart Rate and Cardiac Murmur Grade (Combined Ages, Sexes)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
SBP_2	100	108.97	108.71	.10	98	0.91
DBP_2	94	72.05	70.10	1.10	92	0.27
SBP_3	100	109.21	107.21	.71	98	0.47
DBP_3	93	73.17	71.33	1.08	91	0.27
SBP_4	91	72.39	70.77	1.00	89	0.31
SBPS	100	106.26	105.49	.29	98	0.76
DBPS	100	72.87	70.81	1.10	98	0.27
DBPST	100	103.17	102.16	.37	98	0.71
DBPST	100	69.75	69.59	.06	98	0.95
Heart rate	98	84.85	83.36	.64	96	0.52
Murmur grade	100	0.39	0.37	.12	98	0.90

TABLE 4

$\underline{t}$ test - Height, Weight, and Skinfold Measurements
(Combined Ages, Sexes)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	$\underline{t}$	df	$\underline{p}$
Height	100	145.43	145.49	-.03	98	0.97
Weight	100	40.82	39.67	.43	98	0.66
Biceps Skinfold	100	6.95	6.63	.36	98	0.71
Triceps Skinfold	100	10.19	9.42	.70	98	0.48
Subscapular Skinfold	100	11.34	9.97	.77	98	0.43
Suprailiac Skinfold	100	9.93	8.42	.92	98	0.35
Calf Skinfold	80	11.54	11.27	.25	78	0.79

TABLE 5

t test - Sexual Maturity Stage and Urine
Sodium and Potassium Levels
(Combined Ages, Sexes)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	*t*	df	*p*
Female Breast	54	3.10	2.82	.84	52	0.40
Female Pubic Hair	54	2.80	3.05	-.56	52	0.57
Male Genital	46	2.80	2.60	.52	44	0.59
Male Pubic Hair	46	2.00	1.96	.11	44	0.90
Sodium (meq)	92	143.94	146.53	-.19	90	0.84
Sodium (meq/liter	92	25.00	28.32	-1.09	90	0.27
Potassium (meq)	92	38.59	36.70	.41	90	0.68
Potassium (meq/liter)	92	6.31	7.25	-.92	90	0.35

APPENDIX Q

TABLE 6

t test - Blood Pressure, Heart Rate and Cardiac Murmur Grade by Age 9, 10

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	*t*	df	*p*
SBP_2	53	104.63	105.93	-.40	51	0.68
DBP_2	47	69.36	70.71	-.55	45	0.57
SBP_3	53	104.81	103.87	.31	51	0.75
DBP_3	49	71.60	70.55	.44	47	0.65
SBP_4	53	104.77	105.03	-.08	51	0.93
DBP_4	47	70.31	70.57	-.65	51	0.51
SBPS	53	101.13	103.03	-.65	51	0.51
DBPS	47	70.90	70.74	.06	45	0.95
SBPST	53	98.18	98.96	-.23	51	0.81
DBPST	46	67.89	66.88	.32	44	0.74
Heart Rate	51	80.13	77.37	1.13	49	0.26
Murmur Grade	53	.59	.19	2.08	51	0.04*

*Significant at p = .05.

TABLE 7

t test - Height, Weight, and Skinfold Measurement by Age 9, 10

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	*t*	df	*p*
Height	53	142.27	140.67	.80	51	0.42
Weight	53	39.50	34.87	1.36	51	0.17
Biceps Skinfold	53	7.35	6.33	.92	51	0.36
Triceps Skinfold	53	10.43	8.49	1.32	51	0.19
Subscapular Skinfold	53	12.73	9.55	1.16	51	0.24
Suprailiac Skinfold	53	11.13	7.03	1.67	51	0.10
Calf Skinfold	43	11.02	9.22	1.19	41	0.24

APPENDIX R

TABLE 8

t test - Sexual Maturity Stage and Urine Sodium and Potassium Levels by age 9, 10

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Female Breast	27	2.83	2.06	1.50	25	0.14
Female Pubic Hair	27	2.33	2.06	.40	25	0.68
Male Genital	26	2.10	1.62	1.42	24	0.16
Male Pubic Hair	26	1.20	1.25	-.21	24	0.83
Sodium (meq)	50	131.65	150.02	-1.13	48	0.26
Sodium (meq/liter)	50	23.82	30.67	-1.64	48	0.10
Potassium (meq)	50	40.25	38.66	.22	48	0.82
Potassium (meq/liter)	50	4.62	6.06	-1.32	48	0.19

TABLE 9

t test - Blood Pressure, Heart Rate and Cardiac Murmur Grade by Age 11

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
SBP_2	47	114.00	111.78	.63	45	0.53
DBP_2	44	74.42	69.68	1.82	42	0.07
SBP_3	47	114.31	111.35	.77	45	0.44
DBP_3	44	74.84	72.24	1.06	42	0.29
SBP_4	47	114.10	111.57	.71	45	0.48
DBP_4	43	74.47	71.37	1.29	41	0.20
SBP_5	47	112.21	108.21	.98	45	0.33
DBP_5	41	75.36	71.45	1.25	39	0.21
SBPST	47	108.94	105.71	.82	45	0.41
DBPST	38	74.50	71.81	.79	36	0.43
Heart Rate	47	90.31	89.57	.22	45	0.82
Murmur Grade	47	.15	.57	-2.04	45	0.04*

*Significant at p = .05.

TABLE 10

t test - Sexual Maturity Stage and Urine Sodium and Potassium Levels by Age 11

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	*t*	df	*p*
Female Breast	27	3.50	3.42	.25	25	0.80
Female Pubic Hair	27	3.50	3.84	-.71	25	0.48
Male Genital	20	3.45	4.33	-2.48	18	0.02*
Male Pubic Hair	20	2.72	3.22	-1.11	18	0.28
Sodium (meq)	42	159.12	142.49	.76	40	0.44
Sodium (meq/liter)	42	26.46	25.60	.19	40	0.84
Potassium (meq)	42	36.55	34.42	.39	40	0.69
Potassium (meq/liter)	42	6.25	5.97	.21	40	0.83

*Significant at p = .05.

TABLE 11

t test - Height, Weight and Skinfold Thickness Measurements by Age 11

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Height	47	149.10	150.82	-.71	45	0.47
Weight	47	42.36	45.00	-.66	45	0.51
Biceps Skinfold	47	6.47	6.97	-.37	45	0.70
Triceps Skinfold	47	9.92	10.44	-.30	45	0.75
Subscapular Skinfold	47	9.72	10.43	-.33	45	0.73
Suprailiac Skinfold	47	8.55	9.96	-.68	45	0.49
Calf Skinfold	37	12.13	13.69	-1.17	35	0.24

APPENDIX S

TABLE 12

t test - Blood Pressure, Heart Rate and Cardiac Murmur Grade by Sex (Female)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
SBP_2	53	113.30	107.63	1.57	51	0.12
DBP_2	45	74.82	67.07	3.06	43	0.004**
SBP_3	53	114.60	106.00	2.34	51	0.02*
DBP_3	47	75.66	69.03	2.74	45	0.01**
SBP	53	113.95	106.81	2.03	51	0.04*
DBP_5	44	75.00	68.22	2.99	42	0.005**
SBP_5	53	108.80	103.57	1.38	51	0.17
DBP_5	45	75.00	67.70	2.62	43	0.01*
SBPST	53	84.95	86.39	-.45	51	0.65
Heart rate	53	84.95	86.39	-.45	51	0.65
Murmur grade	53	.30	.45	-.72	51	0.47

* Significant at p = .05.
**Significant at p = .01

TABLE 13

t test - Height, Weight and Skinfold Thickness Measurements by Sex (Female)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	*t*	df	*p*
Height	53	146.25	146.45	-.08	51	0.93
Weight	53	44.20	42.03	.50	51	0.61
Biceps Skinfold	53	8.70	7.60	.78	51	0.43
Triceps Skinfold	53	12.91	10.50	1.36	51	0.30
Subscapular Skinfold	53	15.26	12.21	1.04	51	0.30
Suprailiac Skinfold	53	12.98	9.93	1.17	51	0.24
Calf Skinfold	40	14.14	12.03	1.36	38	0.18

TABLE 14

t test - Sexual Maturity Stage and Urine Sodium and Potassium Levels by Sex (Female)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Female Breast	53	3.10	2.75	1.04	51	0.30
Female Pubic Hair	53	2.80	3.0	-.43	51	0.66
Sodium (meq)	50	133.95	152.36	-.99	48	0.32
Sodium (meq/liter)	50	19.03	26.09	-2.15	48	0.03*
Potassium (meq)	50	31.91	36.01	-.91	48	0.36
Potassium (meq/liter)	50	4.48	6.68	-1.9	48	0.05*

*Significant at p = .05

TABLE 15

$\underline{t}$ test - Blood Pressure, Heart Rate and Caridac Murmur Grade by Sex (Male)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	$\underline{t}$	df	$\underline{p}$
SBP_2	47	104.85	110.07	-1.66	45	0.10
DBP_2	46	69.53	73.76	-.86	44	0.06
SBP_3	47	104.09	109.23	-1.68	45	0.10
DBP_3	46	71.04	74.00	-1.25	44	0.20
SBPS	47	103.85	107.92	-1.17	45	0.24
DBPS	43	71.42	75.18	-1.38	41	0.17
SBPST	47	101.33	103.23	-.52	45	0.60
DBPST	43	69.60	70.95	-.43	41	0.66
Heart rate	45	84.76	79.20	1.74	43	0.08
Murmur grade	47	.47	.26	1.09	45	0.28

TABLE 16

t test - Height, Weight and Skinfold Thickness Measurements by Sex (Male)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Height	47	144.66	144.26	.15	45	0.87
Weight	47	37.61	36.69	.32	45	0.76
Biceps Skinfold	47	5.27	5.40	-.18	45	0.85
Triceps Skinfold	47	7.61	8.04	-.44	45	0.65
Subscapular Skinfold	47	7.60	7.12	.35	45	0.72
Suprailiac Skinfold	47	7.03	6.50	.32	45	0.75
Calf Skinfold	40	9.25	10.44	-.99	38	0.32

TABLE 17

t test - Sexual Maturity Stage and Urine Sodium and Potassium Levels by Sex (Male)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Male genital	46	2.80	2.60	.52	44	0.59
Male Pubic Hair	46	2.00	1.96	.11	44	0.90
Sodium (meq)	42	155.03	139.26	.84	40	0.40
Sodium (meq/liter)	42	31.64	31.11	.11	40	0.91
Potassium (meq)	42	46.02	37.56	1.03	40	0.30
Potassium (meq/liter)	42	8.34	7.97	.22	40	0.82

APPENDIX T

Table 18

Sodium and Potassium Excretion by Group, Age, and Sex ($\bar{X}$)

	Sodium (meq)	Potassium (meq)
Group 1		
Females		
9, 10 years	128.70	29.5
11 years	141.83	35.53
Male		
9, 10 years	135.57	54.59
11 years	174.5	37.46
Group 2		
Females		
9, 10 years	161.18	39.94
11 year	145.61	33.01
Males		
9, 10 years	140.96	37.62
11 years	135.85	37.42

APPENDIX U

Table 19

Blood Pressure Measurements (mm Hg) -
Combined Age, Sex and Group

Variable	n	$\bar{X}$	Sx	Range
SBP_4	100	108.53	11.47	84-152
DBP_4	90	71.56	7.66	51-90
SBPS	100	105.81	12.24	82-152
DBPS	88	71.95	9.38	52-94
SBPST	100	102.58	12.62	80-148
DBPST	84	69.86	10.47	42-94

Sx = standard deviation

Table 20

Mean Blood Pressure (mm Hg) by Group

	Group 1 (n = 41)			Group 2 (n = 59)		
Variable	X	Sx	Range	X	Sx	Range
SBP_2	108.96	13.0	84-150	108.71	10.93	84-134
DBP_2	72.05	7.95	58-88	70.11	9.02	42-90
SBP_3	109.22	13.51	84-156	107.42	10.64	84-130
DBP_3	73.18	8.26	60-94	71.33	7.79	50-88
SBP_4	109.1	12.95	86-152	108.14	10.41	84-130
DBP_4	72.39	7.46	59-90	70.77	7.84	51-89
SBPS	106.27	13.7	84-152	105.49	11.23	82-138
DPBS	72.88	9.23	58-94	70.81	9.08	52-90
SBPST	103.17	14.36	80-148	102.17	11.37	82-138
DBPST	69.76	10.53	48-94	69.59	16.27	42-64

Sx = Standard deviation

APPENDIX V

Table 21

Percentile Distribution of Systolic* Blood Pressure (mm Hg) in Females for Age and Group

	$\bar{X}$	Sx	$S\bar{x}$	PERCENTILES 75th	90th	95th
Group 1 (n = 20)						
9, 10 years	109.75	7.91	2.30	112	125.8	130
11 years	120.25	16.30	5.76	133.75	152	152
Group 2 (n = 33)						
9, 10 years	102.5	12.94	3.46	112.75	123.5	129
11 years	110	9.92	2.28	117	130	130

Sx = Standard deviation
$S\bar{x}$ = Standard error of the mean
* = SBP_4

Table 22

Percentile Distribution of Systolic* Blood Pressure (mm Hg) in Males for Age and Group

	$\bar{X}$	Sx	$S\bar{x}$	PERCENTILES 75th	90th	95th
Group 1 (n = 21)						
10 years	98.8	12.04	3.81	111	116.7	117
11 years	109.63	8.81	2.66	119	124	125
Group 2 (n = 25)						
10 years	107.12	6.67	1.62	112	119	119
11 years	114.89	9.32	3.11	123	128	128

Sx = Standard deviation
$S\bar{x}$ = Standard error of the mean
* = SBP_4

Table 23

Percentile Distribution of Diastolic* Blood Pressure (mm Hg) in Females for Age and Group

	$\bar{X}$	Sx	$S\bar{x}$	PERCENTILES 75th	90th	95th
Group 1 (n = 20)						
9, 10 years	73.11	5.3	1.76	77.5	83	83
11 years	77.13	9.01	3.19	86.5	90	90
Group 2 (n = 34)						
9, 10 years	67.33	8.94	2.58	73.25	78.1	79
11 years	68.5	5.92	1.48	73	76.6	78

Sx = Standard deviation
$S\bar{x}$ = Standard error of the mean
* = DBP_4

Table 24

Percentile Distribution of Diastolic* Blood Pressure (mm Hg) in Males for Age and Group

	$\bar{X}$	Sx	$S\bar{x}$	PERCENTILES 75th	90th	95th
Group 1 (n = 21)						
10 years	67.8	6.53	2.06	72.5	78.5	79
11 years	72.54	6.95	2.09	79	82.2	83
Group 2 (n = 25)						
10 years	73	6.81	1.70	78.5	83.2	86
11 years	75.44	8.63	2.88	82	89	89

S_x = Standard deviation
$S\bar{x}$ = Standard error of the mean
* = DBP_4

APPENDIX W

Table 25

Mean Height (cm.) of Females for Age and Group

	$\bar{X}$	Sx
<u>Group 1 (n = 20)</u>		
9, 10 years	144.7	5.83
11 years	149.38	7.37
<u>Group 2 (n = 33)</u>		
9, 10 years	140.43	6.79
11 years	150.89	10.17

Sx = Standard deviation

Table 26

Mean Height (cm.) of Males for Age and Group

	$\bar{X}$	Sx
<u>Group 1 (n = 21)</u>		
9, 10 years	140	6.57
11 years	148.9	7.91
<u>Group 2 (n = 25)</u>		
9, 10 years	140.88	9.02
11 years	150.67	5.24

Sx = Standard deviation

Table 27

Mean Height, Weight & Quetelet Index
for Sex and Age by Group

	Height (cm)	Weight (kg)	Quetelet Index (%)
Group1			
Female			
9, 10 years	144.17	42.17	20.18
11 years	149.38	47.25	20.80
Male			
9, 10 years	104.00	36.30	18.19
11 years	148.9	38.82	17.41
Group 2			
Female			
9, 10 years	140.43	35.59	17.78
11 years	150.89	46.79	20.12
Male			
9, 10 years	140.88	34.29	16.95
11 years	150.67	41.22	18.07

APPENDIX X

Table 28

Mean Skinfold Thickness (mm) Measurements
Combined Age, Group, Sex

Skinfold Thickness	n	$\bar{X}$
Biceps	100	6.77
Triceps	100	9.74
Subscapular	100	10.53
Suprailiac	100	9.04
Calf	80	11.38

Table 29

Mean Skinfold Thickness (mm) by Group and Sex

	Group 1		Group 2	
Skinfold Thickness	Male	Female	Male	Female
Biceps	8.71	5.28	7.61	5.41
Triceps	12.91	7.61	10.51	8.05
Subscapular	15.26	7.61	12.22	7.12
Suprailiac	2.98	7.04	9.94	6.5
Calf	14.15	9.25	12.04	10.44

Table 30

Mean Skinfold Thickness (mm) for Group by Age

	Group 1		Group 2	
Skinfold Thickness	9, 10 year	11 year	9, 10 year	11 year
Biceps	7.35	6.47	6.34	6.97
Triceps	10.43	9.93	8.49	10.44
Subscapular	12.73	9.73	9.55	10.44
Suprailiac	11.13	8.55	7.03	9.96
Calf	11.02	12.14	9.22	13.69

APPENDIX Y

Table 31

Sexual Maturity Level by Group and Age
Using Tanner Staging
(n=100)

	Group 1		Group 2	
	Age		Age	
	9, 10	11	9, 10	11
Breast Maturity (Females)	1.83	3.50	2.07	3.42
Pubic Hair Distribution (Females)	2.33	3.50	2.07	3.84
Pubic Hair Distribution (Males)	1.20	2.73	1.25	3.22
Genital Development (Males)	2.10	3.45	1.63	4.33

APPENDIX Z

TABLE 32

t-test - Demographic Variables (by Group)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Mother age	96	35.82	32.75	2.16	94	0.03*
Father age	86	40.94	36.22	2.45	84	0.01**
Mother Education	96	11.84	12.44	-1.50	94	0.13
Father Education	81	11.66	12.02	-.85	79	0.39
Mother Occupation	95	3.73	3.73	-.008	93	0.75
Father Occupation	61	2.96	3.72	-1.41	59	0.16
Relatives with Hypertension	100	1.31	0.77	1.63	98	0.10

* Significant at p = .05
**Significant at p = .01

TABLE 33

t-test - Demographic Variables by Subject's Age (9,10)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Mother age	52	35.42	31.90	1.71	50	0.09
Father age	45	40.26	36.07	1.60	43	0.11
Parent Education	51	12.45	12.96	-.91	49	0.36
Parent Occupation	41	3.44	3.52	-.11	39	0.90

TABLE 34

t-test - Demographic Variables by Subject's Age (11)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Mother age	44	36.27	33.76	1.29	42	0.20
Father age	41	41.70	36.37	1.81	39	0.08
Parent Education	47	12.26	12.35	-.20	36	0.83
Parent Occupation	36	3.27	4.32	-1.31	34	0.20

TABLE 35

t-test - Demographic Variables by Subject's Sex (Male)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	$\underline{t}$	df	$\underline{p}$
Mother age	46	36.10	32.46	1.94	44	0.06
Father age	41	41.55	35.30	2.35	39	0.02*
Parent Education	46	12.35	12.69	-.59	44	0.53
Parent Occupation	45	3.53	3.81	-.38	33	0.70

*Significant at p = .05.

TABLE 36

t-test - Demographic Variables by Subject's Sex (Female)

Variable	n	$\bar{X}$ (Group 1)	$\bar{X}$ (Group 2)	t	df	p
Mother age	50	35.52	33.00	1.17	48	0.25
Father age	45	40.33	37.00	1.17	43	0.24
Parent Education	52	12.36	12.66	-.66	50	0.51
Parent Occupation	52	3.25	4.03	-1.13	50	0.26

APPENDIX AA

TABLE 37

Analysis of Co-Variance - Physiological Variables
with Mother Age and Father Age
Held Constant (df = 83)

Dependent Variable	R^2	F	p
Height	.51	0.91	0.62
Weight	.49	0.82	0.73
SBP_2	.48	0.79	0.77
SBP_3	.48	0.79	0.77
SBP_4	.47	0.77	0.80
SBPS	.57	1.16	0.32
SBPST	.65	1.61	0.06
Murmur Grade	.45	0.72	0.85
Triceps Skinfold	.48	0.79	0.77
Subscapular Skinfold	.60	1.31	0.19
Suprailiac Skinfold	.49	0.83	0.72

TABLE 37 (Continued)

Analysis of Co-Variance - Physiological Variables
with Mother Age and Father Age
Held Constant

Variable	R^2	F	p	df
DBP_2	.54	0.89	0.64	75
DBP_4	.65	1.40	0.16	75
DBP_3	.59	1.17	0.31	81
DBPS	.66	1.29	0.23	73
Heart Rate	.36	0.46	0.99	81
Calf Skinfold	.69	1.20	0.33	64
Female Breast	.57	0.45	0.96	44
Female Pubic Hair	.66	0.66	0.82	44
Male Pubic Hair	.81	0.68	0.77	38
Male Genital	.83	0.79	0.69	38
Sodium (meq)	.58	0.97	0.54	76
Sodium (meq/liter	.50	0.71	0.85	76
Potassium (meq)	.67	1.43	0.14	76
Potassium (meq/liter)	.71	1.72*	0.05*	75

*Significant at .05

APPENDIX BB

Table 38

Summary: Backward Discriminant Analysis Steps and Variables (N = 68)

Variable Detected	Partial R^2	F Statistic	Prob > F	Wilks' Lambda	Prob Lambda
Sitting Systolic Blood Pressure (SBPS)	.000	0.003	0.954	0.9160	0.982
Average Supine Systolic Blood Pressure (SBP_4)	0.0001	0.008	0.928	0.9161	0.970
Urine Potassium (meq/L)	0.0003	0.023	0.879	0.9164	0.952
Body Mass Index (Quetelet)	0.0004	0.027	0.870	0.9167	0.926
Sex	0.0004	0.028	0.867	0.9171	0.891
Height	0.0005	0.037	0.8470	0.9175	0.842
Weight	0.0003	0.026	0.8728	0.9178	0.780
Standing Diastolic Blood Pressure (DBPST)	0.0025	0.202	0.6544	0.9201	0.719
Urine Sodium (meq/L)	0.0041	0.332	0.5661	0.9239	0.663
Murmur (grade)	0.0037	0.302	0.5843	0.9273	0.593
Murmur (presence)	0.0024	0.199	0.6571	0.9295	0.504
Average Supine Diastolic Blood Pressure (DBP_4)	0.0035	0.297	0.5875	0.9328	0.418
Standing Systolic Blood Pressure (SBPS)	0.0059	0.506	0.4787	0.9384	0.351
Sitting Diastolic Blood Pressure (DBPS)	0.0047	0.404	0.5268	0.9428	0.269
Age	0.0081	0.710	0.4016	0.9505	0.211
Heart Rate	0.0127	1.133	0.290	0.9627	0.184
*Pubic Hair Distribution	0.0246	2.243	0.1377	0.9870	0.279
*Breast and Genital Development	0.0130	1.184	0.2794	--	--

* = Combined sexes

APPENDIX CC

Table 39

Inter-rater Reliability for Blood Pressure Measurements

Variable	Difference X	Sx	$S\bar{x}$	*t*	*p*	df	Correlation
Systolic Blood Pressure	0.167	1.586	0.458	0.36	0.72	11	0.985
Diastolic Blood Pressure	0.667	2.309	0.667	1.00	0.34	11	0.90

Sx = Standard deviation
$S\bar{x}$ = Standard error of the mean

APPENDIX DD

Table 40

Percentile Distribution of Systolic Blood Pressure (mmHg) in Black Children*

Sex and Age	$\bar{X}$	Sx	$S\bar{x}$	PERCENTILES 75th	90th	95th	n (in thousands)
Female							
9 years	106.7	13.9	3.13	119.2	120.0	129.7	222
10 years	106.4	14.1	3.54	117.5	120.0	124.0	312
11 years	104.5	9.7	1.83	109.6	119.3	119.9	333
Male							
9 years	99.7	13.0	3.03	109.8	115.3	121.1	375
10 years	104.4	11.3	2.73	113.1	119.2	119.6	241
11 years							

Sx = Standard deviation
$S\bar{x}$ = Standard error of the mean

Adapted from Blood pressure levels of persons 6-74 years, United States 1971-1974. (Publication No. (HRA) 78-1648). Hyattsville, Md.: U.S. Department of Health, Education, and Welfare, Public Health Service, 1977.

Table 41

Percentile Distribution of Diastolic Blood Pressure (mmHg) in Black Children*

Sex and Age	$\bar{X}$	Sx	$S\bar{x}$	PERCENTILES 75th	90th	95th	n (in thousands)
Female							
9 years	65.8	9.6	1.66	69.7	79.5	85.1	222
10 years	66.5	9.7	1.58	69.8	79.5	83.9	312
11 years	65.4	10.4	2.07	69.9	79.6	87.3	333
Male							
9 years	61.8	9.9	2.46	69.5	74.7	75.8	375
10 years	65.4	8.5	1.88	69.8	74.0	79.3	241
11 years	66.2	12.3	3.80	79.2	79.8	80.0	300

Sx = Standard deviation
$S\bar{x}$ = Standard error of the mean

Adapted from Blood pressure levels of persons 6-74 years, United States 1971-1974. (Publication No. (HRA) 78-1648). Hyattsville, Md.: U.S. Department of Health, Education, and Welfare, Public Health Service, 1977.

GRADUATE SCHOOL
UNIVERSITY OF ALABAMA IN BIRMINGHAM
DISSERTATION APPROVAL FORM

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Major Subject Community-Mental Health

Title of Dissertation Assessment of Certain Physiological Parameters in Children of Hypertensive and Non-Hypertensive Parents.

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PS-1428